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A THEORY OF REFERENCE FOR PRODUCT DESIGN: THE SEMANTICS OF PRODUCT IDEATION

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To the memory of **Martha Rengel de Lacruz,**
my loving mother and an exemplary scholar .

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SYNOPSIS

The present research focuses on the way designers make sense of things while developing their design concepts. The idea was to investigate whether the use of an appropriate segmentation of the meaningful aspects comprising products could help designers to work more consciously and more effectively in their exploration of ideas for design concepts. To this aim a methodology based on the inclusion of different forms of knowledge to understand design situations (Cross, 2002) and design themes (Margolin, 2005) was developed, with semiotics as its modelling paradigm and cognitive psychology as its experimental counterpart. Such an inclusive methodology allowed: (1) the identification of key issues and notions about concept formation (in general and within design), (2) a quite comprehensive review of the contributions of semiotic and non-semiotic theories to the understanding of meaning in products, (3) the formulation of a theoretical model about the meaningful aspects of products, and (4) the development of an experimental method to test the feasibility of this model. The last three points aforementioned are indeed the contributions of the present research to knowledge.

This dissertation is organised in five chapters. The first chapter introduces the reader to the subject of this research, the relevance of researching about this subject in design and the methodological aspects involved. The second chapter presents the literature review of design concepts and the theoretical positions about the construction of meaning in products. The third chapter outlines the theoretical notions and considerations that are needed to formulate a theory of concept ideation as a preamble to chapter four, in which the theoretical model is developed. This model is mainly inspired by the work of Roman Jakobson, and it suggests the existence of six meaningful dimensions for the ideation of design concepts. The last chapter presents the results and discussion of eight experimental carried out with 20 industrial design students and three studies developed to test the practical feasibility of the theoretical model formulated as part of this research. The conclusions show that the proposed division of meaning for concept ideation into six dimensions is quite feasible.

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INTRODUCTION

During the last 35 years there has been a growing concern within design about the effects that technological developments have in the configuration of our everyday objects. We have come to a point where our utilitarian objects can have any overt configuration: covered, exposed, excessive, playful, and even ironic (Selle, 1995). Such a formal arbitrariness, together with the level of complexity derived from the creation of new functions and hybrid products (i.e. those capable of doing rather different functions), has made more difficult the acceptance of new products by their users. Therefore, today more than ever, we need to make technology to conform to the needs of people (Norman, 1999). This situation was indeed the main motivation for the realisation of the present research.

Given that the most common way to make sense of things is by referring to something we already know, this research was focused on what is known in some theories of meaning construction as **reference,**[1] that is, the way of making sense out of things by referring to other things. With this in mind, I decided to explore the possibility of creating a theoretical model to help designers carry out all the due considerations to create products that make sense to their users. Hereof, the central hypothesis of this research states that "the ideation of design concepts within product design is an activity that, from the standpoint of meaning construction, can be envisaged through an appropriate segmentation of the aspects that such an activity involves".

In order to develop this research I realised from the very beginning that it would not make any sense to tackle design in concept ideation from the unique perspective of one particular discipline. Especially if one considers that views on the subject such as those of psychology and semiotics are complementary rather than opposed. In this sense, my research is a clear attempt to include different forms of knowledge in the understanding of concept ideation in design, as suggested by some authors (cf. Cross, 2002; Margolin, 2005). This approach brought along many difficulties but also many satisfactions when one comes to realised that some of the things we

[1] This view is commonly known as the relational view of meaning.

believe to be true about concept ideation in design have (actually) scientific confirmation. There are also things we take as true with no scientific confirmation and things with scientific proof against them. The realization of this particular situation encouraged me to do inter-disciplinary research, with the fortunate support of an open-minded Director of Studies, an experienced semiotician (my second supervisor) and two psychologists. The inter-disciplinary nature of this research also made more difficult to write about it, given than new terminology had to be interiorized before putting it in intelligible terms to any designers. I hope to have been able to do it.

The readers of this work should also bear in mind that the subject of my study is not a new one. What is new about this research is my approach and the theoretical proposals derived from it. I was myself surprised by how far back in history I had to go sometimes to trace ideas of particular interest for this study; especially since some topics are only intensively researched during certain periods of time, becoming less intensely studied in the following years. Such is the case of the seminal studies on the psychology of concept formation developed during the 1970s, and the climax achieved by semiotic studies in the 1970s. As a researcher with a background in design theory, I believe the right thing to do is to contrast the original ideas with their more updated versions. Finally, it is important to clarify that, in the particular case of design theory, the realisation of the usefulness and applications of contributions from different fields of knowledge sometimes takes as long as twenty or more years. Indeed, for instance, the theory of affordances of psychologist J.J. Gibson was first studied and applied to design in the 1990s, even though its formulation was in the 1970s. I truly believe that theories should be judged by their utility and truthfulness instead of by their dates.

Chapter 1

Reference and meaning construction in the ideation of design concepts

Since design does not only help to create formal coherence among the different repertoires of artefacts of our daily life (Bonsiepe, 1978; Munari, 1991) but also contributes to define the physical properties of those artefacts with no historical antecedents (Sottsass, 1986; Lawson, 1990; Simon, 1992; Irigoyen-Castillo, 1998), few studies seem to be more important about the synthesis phase of the design process than those about meaning construction. In this sense, studies on **concept ideation** are perhaps the best mirrors of the way in which designers give sense to their material surroundings in order to formulate their design proposals. Let us not forget that it is through the provision of ideas, in the form of conjectures, that designers come to terms with the problems they have to deal with (Hillier, Musgrove and O'Sullivan, 1972; Darke, 1978; Arnheim, 1995; Tversky et.al, 2003).

But, even though concepts are so important to design, very few books seek to establish theoretical grounds for their ideation within design (e.g. Wake, 2000). Journal articles on this subject tend to focus more on the design process than on the nature of the concepts generated as part of it. This is the reason why one of the purposes of this piece of research is to offer a structured view of design concepts based on their semantic components. To this aim, the present chapter will briefly introduce the reader to the subject of study, the reasons that encourage this sort of research, and the methodological approach developed for this subject.

1.1. The subject of study

In order to offer a brief but clear outline of the subject of study, two different but complementary directions will be followed: one centred on the role of reference in meaning construction, and another focused on the place of meaning in design problems and processes. The first direction will provide the reader with a general insight to how design can be conceived in terms of reference. The second direction will introduce the reader to the ways in which meaning intervenes as a mediating and driving force in the resolving of design problems.

1.1.1. The construction of meaning and reference

Since the most basic effort to understand the world around us has to do with what things mean to us (Mucchielli, 1969), the world we live in can be seen as an ensemble of *signs* (Barthes, 1964a; Greimas, 1973; Ricoeur, 1976; Peirce in Sebeok, 1976; Chandler, 2002). That is to say, as a world of things referring to other things through some kind of trace (Vetrov, 1973).[2] In this sense, what we know as 'reality' is loaded with signs, and is experienced and understood by us through networks of signs (Pross, 1980). Some authors even consider the use of signs as the real beginning of our intelligence (Langer, 1957) as well as the end of our direct mediation with reality thanks to the birth of our symbolic[3] networks (Cassirer, 1945). This does not mean, however, that signs are exclusively linked to human beings or that things only exist as signs. Indeed, something only becomes a sign if it is interpreted as such by someone (Nagel, 1972; Morris, 1985; O'Sullivan et.al. 1994, Pérez de Medina, 2002a), and there are also sign processes in situations different to those in which humans are involved (Uexküll, 1934; Boulding, 1956; Sebeok, 1976; Lieb, 1979; Deely, 1990), since sign processes help organisms to act in and react to the environment (Breidbach in Gfesser, 2003). Therefore, there is no doubt that signs are at the basis of our behaviour (Uexküll, 1934; Langer, 1957; Maldonado, 1961a; Mucchielli, 1969), especially in our thoughts and communication (Maldonado, 1959; Danesi in Sebeok, 1996). "Without signs we would not have cognition" and "without cognition we cannot [could not] read signs" (Tuovinen, 1999: 138).

The place of signs in our behaviour entails that our understanding of the world is always mediated by some kind of meaning (Greimas, 1973). In other words, we understand the world in terms of what makes sense to us. Indeed, 'sense' is regarded as a complex form of consciousness and as a synonym of 'meaning'

[2] The American Philosopher Charles Sanders Peirce outlined the existence of 66 different classes of sign. Nevertheless, nowadays only six types are regularly identified and used (Sebeok, 1996): *signals*, *symptoms*, *icons*, *indexes*, *symbols*, and *names* (proper names).

[3] The adjective 'symbolic' is used here to designate man-made signs (i.e. conventional signs).

(Berger and Luckmann, 1997). In this respect, the meaningless does not exist for us. If something is meaningless to us it is because it is temporarily out of our perceptual reach (Mucchielli, 1969) or something we refuse to perceive to avoid bringing conflict into our ways of understanding reality (Boulding, 1956). Therefore, there is no way to escape from meaning. It is multi-formed and omnipresent (Greimas, 1973).[4] In fact, the absence of meaning in things is seen by us as an anomaly (Dewey, 2005).[5]

To understand how meaning is generated three aspects should be kept in mind. Firstly, that meaning does not take place on its own but as a result of what is known as **signification** or **semiosis**: the process by which something stands for something else. That is to say, the process by which a sign is associated to a certain thing, notion or event during the production of meaning (Barthes, 1969; Guiraud, 1976; Fiske, 1990; O'Sullivan et.al., 1994; Merrell, 1998). Secondly, when something stands for something else, as happens with any sign, meaning depends upon the capacity or knowledge that interpreters have to relate signs to things or ideas. And, thirdly, as meaning is a way of consciousness and consciousness is always about something (Berger and Lukchman, 1997), interpretation always aims toward a direction or thing (Gadamer, 1961). Indeed, through meanings we fill mental spaces previously opened to various possible interpretations with particular things or ideas, also known as **referents**. These latter are not necessarily about physical manifestations of our outer world (e.g. objects and events) but also about intangible elements (e.g. ideas and feelings) of our inner world (Acero, Bustos and Quesada, 2001). The presence of an associative mental process that allows us to see signs as such, together with the dependency of signs on the interpreter's knowledge to be understood, and the inevitable directionality of signs toward some kind of referent, encompass the general idea behind what is known as **reference** in different theories about meaning. That is to say, the mechanism by which signs are vested with meaning when we link them to something in order to understand them (Acero, Bustos and Quesada, 2001).

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[4] Roland Barthes (1964b) has even asserted that if an object or thing seems to have no-meaning for us, this latter may indeed be its meaning.

[5] John Dewey (2005) takes this idea even further by equating our lack of understanding of things to our realisation of no meaning in things.

Thus, within product design the notion of reference can assume two main directions. One direction has to do with the ideas and beliefs consumers or end-users have about products during their purchase, usage or any other type of situation. The other direction has to do with the designer's capacity to elicit mental associations, induce actions, express functions and somehow materialise the aspirations placed by the end-users on a product through his/her selection and by the combination of forms, materials, colours and finishes as part of a design proposal. The present research is focused on this latter position.

1.1.2. Meaning construction and the nature of design

One of the most common ideas associated to design is that of problem-solving. Generally speaking, a 'problem' is a set of circumstances that make something difficult to achieve (RAE, 1992). However, in terms of design, problems have more to do with the questioning of certain reality and therefore, with the search for solutions different to the existing ones. The starting point for such a search can be a state of *deprivation*, a *want* or simply a *demand*. In the particular case of product design, it is clear that not all products are the result of a state of deprivation. Indeed, a great deal of them really emerge from people's discontent with existing solutions (in which case design deals with *wants*) or situations where the solution required is imposed by social standards or created as a departure from them (as happens with fashion). In this sense, design solutions should be linked to the act of finding meaningful interpretations for the requirements at stake (Tversky et.al. 2003). This is the reason why the definition of people's needs will always be an act of interpretation in design (Arnheim, 1978; Fry, 1992).

Design methodologists have classified design problems into three groups (Rowe, 1987): well-defined, ill-defined, and wicked problems. **Well-defined problems** are those that can be formulated in an exhaustive way and solved in an appropriate manner by the designer because their aims and means are evident or have been already prescribed for similar problems. **Ill-defined problems**, on the other hand, are those whose aims and means are unclear or unknown, focusing most of the designer's work on defining or redefining the problem at stake. Finally, we have the so-called **wicked problems**. These are complex problems with various stockholders and therefore difficult to solve in a definite manner. Their unique nature means they could have many solutions or none, since they are resistant to rules.

Following this classification, authors such as Christopher Alexander (in Cross, 1986), Horst Rittel (1986) and Herbert Simon (1973) have come to the conclusion that most design problems are ill-defined. In this sense, Bryan Lawson (1990) and Nigel Cross (1999) have agreed to assign the following peculiar characteristics to design problems:

a) *They cannot be totally defined.* This is based on the fact that both their objectives and restrictions are generally little known and they keep changing while more information is available.

b) *They cannot be solved without referring to existing solutions.* In this sense, the way the problem is conceived affects how it is solved and vice versa. The more one tries to isolate a problem, the greater number of existing solutions one has to consider. Each solution assessed brings about new aspects of the problem at stake (Lawson, 1990). This is the reason why Bruce Archer (1965: 62) tells us that "a single design problem is a complex of a thousand or more sub-problems". Indeed, in the solving of any problem each question leads to an infinite continuity of problems that finally take us to the realisation that everything so considered is problematic by nature (Ortega y Gasset, 1984). In the particular case of design, the way of solving the problem is at the same time the problem with design problems (Schön, 1998).

c) *They do not have a definite solution.* Design problems depend on the designer's subjective interpretation of the information he/she has taken into account in order to produce a solution. Each problem may have a limitless amount of possible solutions and should be judged in terms of how appropriate or inappropriate it is, instead of based on how right or wrong it is.

Keeping these three points in mind, design critics and theoreticians have arrived at some ideas about how to deal with design problems. In this respect some authors have suggested looking at them with some flexibility, that is, more as a matter of developing interfaces[6] in constant change than as the creation of static and self-contained objects (Krippendorff, 1990). Therefore, designers should try to comprehend the way people think about their artefacts, as well as the changes in

[6] The term *Interface* is normally used in product design to refer to the 'solution space' where the interaction among a user, a task and a utensil is articulated (Bonsiepe, 1992a).

their ways of thinking about them, as a necessary step to design any product (Norman, 1988; Krippendorff, 1990). It does not necessarily imply that an appropriate design solution is that which blindly obeys people's desires. It only suggests that the designer's intentions should respond to a process of **negotiated creativity** (Jones, 1991),[7] where his/her interpretation of reality ought to meet the interpretation of the public (Krippendoff, 1989). Indeed, it was not by chance that Bruce Archer (1965) defined design as an 'art of reconciliation'. This is the reason why Jaime Irigoyen-Castillo (1998: 198) has said that "to describe, explain, justify, demonstrate and convince are all terms which give sense to design". In this respect, what designers do is to objectify a way of understanding things in order to approximate the cognitive processes present in the users of their products (Krippendorff, 1989; Irigoyen–Castillo, 1998).

In order to achieve this sort of sense in design, Ann Tyler (1992) reminds designers how important is the role played by the public in the decoding of their creations. She suggests that, besides taking into account the cultural dimension of the product, designers should give the end-users the opportunity to interpret and use such products based on their own values and standards. Similarly, Richard Buchanan (1989) has brought to designers' attention the fact that design is more than just the manipulation of materials and processes to solve practical problems (i.e. technological reasoning). In his view, design also involves the idea of making design products aesthetically desirable in some respect (i.e. emotion), as well as convincing people about the convenience of having such products playing a role in their lives (i.e. character). Thus, design problems are really complex situations in terms of meaning construction. This is why in order to achieve what Tyler has suggested, designers may need to find harmonic ways to deal with the three elements outlined by Buchanan: technological reasoning, emotion and character.

Other authors are concerned with the fact that design problems cannot be solved without referring to existing solutions, highlighting the need of keeping some of the old products' functional and formal features in the new ones to generate acceptance by the public (Loewy, 1951; Dorfles, 1968; Athavankar, 1997). Since people tend to

[7] *Negotiated creativity* is, according to Peter Lloyd Jones (1991: 84), the process in which "each new tentative behaviour by one person is subsequently endorsed or validated only if it is met by another activity from another participant".

understand new things based on what they already know (McLuhan, 1966; Glegg, 1981), it is also difficult to see the designers' creations as born *ex nihilo* (Rapoport, 1969, Krippendorff, 1989). Indeed, there are reasons to believe that an overwhelming majority of designers do not invent new forms but articulate and adapt the existing ones (Raman, 1973; Krippendorff, 1989; Wake, 2000; Michl, 2002). Even more if we realise that design problems are part of wholes structured in different levels, where the decisions made at one level (e.g. product design) may affect what happens in other levels (e.g. architecture or urban design) and vice versa (Lawson, 1990; Quarante, 1992). Therefore, designers should approach design problems as integral parts of pre-existing or future totalities (Roozenburg and Eekels, 1995), in the understanding that, by doing so, they may also have to deal with aspects of problems that belong to fields of action different to their own. This is the reason why Umberto Eco (1994b) has described designers as the last version of the 'universal men' of the Renaissance.

This impression becomes even stronger when we realise that working with problems framed as part of bigger situations or totalities inevitably leads designers to consider the codes and bodies of knowledge shared by their clients and users of their creations. After all, "...a designer cannot live on an isolated throne, but must experience and understand the problems and situations related to the use of the product" (Bonetto, 1991: 32). No matter how creative a designer is, he/she will somehow need to appeal to the existing reality by "...building on and adding to the creative contributions of earlier designers" (Michl, 2002). This is, in fact, what Rudolf Arnheim (1972) suggests by saying that our *imaginative thinking* is born from the need of reviving the 'old', and what John Walker (1989) has semiotically translated as the designer's rework of existing signs in order to construct new ones. Thus, in terms of meaning construction, the *referents* to be used in a design concept will always depend on what the designer knows or is capable to understand about the problems he/she has to tackle.

Besides the study of design problems, another way to appraise design as a matter of meaning construction is through the nature of its process. To this aim, Peter Collins (1970) has studied the use of analogies in design theory from 1750s onwards. As a result of this, Collins arrived at the conclusion that designers conceive the form of their creations intuitively at first, rationalising them only afterwards. This same view has been also supported by Gordon Glegg (1981) but with particular reference to the way in which systematic methods of thinking relate to imaginative (intuitive) ones within design. In other words, both authors characterise design as a process that emerges from clear, intimate and instant moments of ideation, later refined by the use of reasoning. This is a way to look at the design process that finds confirmation in studies such as that of Jane Darke (1978). She found through an interview-based study that the first ideas designers use as design concepts come from the subjective valuation of those aspects of the problem on which they have placed their attention. These findings suggest that designers need to formulate conjectures in order to design (Hillier, Musgrove and O'Sullivan, 1972), as well as the idea that an important part of designing rests on the designer's judgement, that is, his/her capacity for critical evaluation.

This latter, however, should not be understood as a simple translation of what the designer sees or understands based on aspects such as his/her client's demands or contextual constraints. To criticize is about discerning and pondering the good and the bad of something (Attoe, 1982). Therefore, it has nothing to do with chance. The observations and discoveries of criticism always respond to 'guided transformations' of reality and the establishment of 'distances' between what the nature of the situation at stake is or could be about (Barthes, 1987). In this sense, the designerly ways of proceeding to tackle problems are different from other ways of problem-solving. Indeed, design solutions are deduced from desireable results (consequences) instead of from actual causes, as happens in other problem solving activities (Eekels, 1982). That is to say, from the abstract to the concrete instead of from the concrete to the abstract (Glegg, 1981). This is the reason why, in order to keep the design process going, some conjectures (some sort of solutions) seem to be needed in advance. Thus, despite the design process may start with the settlement of a goal, the establishment of certain restrictions (constraints or requirements) and the formulation of some criteria to recognise an acceptable solution (Cross, 1999), the driving force of the process will always rest on the designer's capacity to generate conjectures or ideas for possible solutions.

In this respect, there is no doubt that design is a process of variety reduction, i.e. about reducing the number of possible solutions for a design problem. What is not yet totally clear is whether analysis follows conjectures (Hillier, Musgrove and

O'Sullivan, 1972; Darke, 1978) or synthesis follows analysis (Alexander, 1964; Rittel, 1964; Jones, 1982; Quarante, 1992). What we only know for certain is that: (1) Analysis and synthesis are related, (2) that some actions within the design process aim toward analysis and others toward synthesis (Alexander, 1964; Rittel, 1986; Cross, 1999; Quarante, 1992), (3) that different cognitive styles such as those known as divergent, convergent, impulsive, reflective, serialist,[8] and holist[9] take place as part of the design process (Jones, 1982; Cross, 1983; Tovey, 1984), (4) that design problems are solved through the consideration of possible solutions along the process of designing (Hillier, Musgrove and O'Sullivan, 1972; Lawson, 1990; Cross, 1999), and finally (5) that intuition as well as reasoning have a role to play in such a process (Collins, 1970; Darke, 1978; Glegg, 1981; Papanek, 1984; Jones, 1982; Roozenburg and Eekels, 1995). The curious side of this process is that, even though it starts from a goal or intention, the solution to the problem at stake is only known once the process has ended (Cross, 1999). Thus, there are reasons to believe that the act of designing is a process of meaning construction whose circularity is defined in similar terms to those used by Hillier, Musgrove and O'Sullivan (1972), and Schön (1998). That is to say, as a process where each conjecture (meaningful association) about a possible solution opens up new ways of looking at the problem, through the realisation of new data that keeps modifying what, in terms of the final solution, will be achieved. This is, indeed, the **semiosis of concept ideation.**

1.2. The need for a theory of reference for design concepts

If design is such a complex activity as to be described in similar terms to the job of the 'universal men' of the Renaissance (Eco, 1994b), the first logical thing designers should do is to attempt 'reading' the levels from which such a complexity is made up. In this sense, the present section outlines the most important aspects supporting the need of formulating a theory of meaning construction for concept design different to the existing ones (see chapter 2). To this aim the three axes of design suggested by Richard Buchanan (1989), i.e. *technological reasoning*,

[8] The *serialist* style refers to a way of processing information following string-like cognitive structures where items are related by simple data links (Cross, 1983).

[9] The *holist* style, on the other hand, alludes to ways of processing information as wholes, picking up bits of information in no logical order and even from unrelated sources in the expectation that it will eventually fall into place (Cross, 1983).

emotion, and *character*, have been taken as a structure to explore the changes experienced by design in relation to technology, aesthetics, and design methodology, provided the fact that these three 'axes' also encapsulate the three main thematic areas playing a decisive part in concept design nowadays.

1.2.1. Toward a dematerialisation of products

Like any design activity, product design has also followed a historical development. A clear sign of this are the names it has received throughout time. From Decorative and Applied Arts during the 19th century to Industrial Art between the two World Wars, and from this latter to Industrial/Product Design from post-war onwards (Heskett, 1992). Similarly but not in parallel association with these denominations, the outcomes of product design have also followed a sequential development. It can be summarised as three distinctive ways of conceiving design products, that is, as **self-contained objects**, as **interfaces**, and as **services**. The emergence of each of them, however, has not obliterated or made obsolete the presence of the previous ways of understanding products. Indeed, these three views are simultaneously in place nowadays. The decision about which of these three types of product needs to be created depends on: the nature of the market (their beliefs and trends), the design intentions, the manufacturing capability of industry and even, of what is fashionable at the moment.

Of these three views, the oldest is that of the product as a self-contained object. Its origins go back to what some authors have agreed to call the First and Second Industrial Revolutions (Finkelstein, 1992; Ramos, 2005).[10] That is to say, a historical period located between the revolution that took place as a result of the application of the steam machine to industrial processes during the second half of 18th century, and the revolution that emerged due to the use of electricity as an industrial source of energy around the end of the 19th century and beginnings of the 20th century.

As a way to define products, the notion of the *self-contained object* is visualised through artefacts whose utility is understood as if it were frozen in time. In other

[10] It is generally accepted that the *First Industrial Revolution* goes from the 1750's till 1870, the *Second Industrial Revolution* from 1870 till 1900, and the *Third Industrial Revolution* from the Second World War onwards (Ramos, 2005).

words, through objects whose formal nature is so specifically defined as to allow no room for any significant change in the way they perform their task. Therefore, they only represent one of the many ways ever conceived to satisfy certain needs, with little or no inner capacity to be changed or adapted to satisfy other aspects of the same need. Indeed, very few real improvements are progressively incorporated to them through the different models created for the same product. Thus, it can be said that the idea of self-contained objects is about improving products already seen as 'acceptable' in order to achieve greater satisfaction. This is why these products are normally assessed in terms of how well they perform what their designers thought to be their task and form, instead of evaluating them in terms of what their task and form ought to be. In this sense, products are considered as self-contained objects in the eyes of their designers, regardless of how users understand the nature of these objects' tasks and forms. The design world was so much into the self-contained view of products that its implications were only realised after an entirely different view appeared in the theoretical scenario of product design during the 1950s and 1960s.

During those two decades other ways of looking at the outcomes of design began to emerge. Among them we ought to mention those linked to: the *systems approach* developed at the American military and aerospace industries, the use of *Information theory* in different fields of knowledge, and the semantic questioning of design that took place at the Florence School of architectural theory. Product design, in particular, began to be understood in more comprehensive terms than those related to the self-contained object, and design products stopped being visualised through mottos such as 'Fitness to purpose', 'Truth to materials', 'Less is more' and 'Form follows function' (Myerson, 1998). As a consequence of this, products started to be defined beyond the materiality they were usually associated with and their development began to be based on what they ought to be by definition instead of by tradition (i.e. they began to be designed from zero instead of doing it by modifying existing objects). This new sort of conceptual flexibility was, according to some design theorists, perfectly encompassed by the term *interface.*

When a product is seen through the notion of *interface*, its materiality is understood as a transitory way to approach the conjunction that should exist between user and object. In this respect, authors such as Klaus Krippendorff (1990) have supported the idea that products should not be understood as static and self-contained objects but as interfaces in constant development. This is a view of products that takes place as part of what is known as the Third Industrial Revolution[11], i.e. the changes introduced in manufacture as a result of the technologies at hand around the 1940s (Finkelstein, 1992). Of these changes, the most representative is perhaps the use of computers.[12] Indeed, it is from the context of information technology that the term 'interface' was brought to design (Barbacetto, 1987a). In its original sense, the word *interface* alludes to the place where two entities come into contact while they interchange information (Moles, 1973). In practical terms, this definition is applied to those devices connecting the different hardware components of a computer, as well as those aspects of software which people interact with (Bonsiepe, 1998a).

The influence of this third technological revolution comes to life in design first through a reformulation of its methods. Such a reformulation takes as a point of reference the scientific decision techniques created during the Second World War and developed further during the 1940s and 1950s (Cross, 1980 and 1981). From these techniques, new basic ideas emerged in design such as the conception of problems as 'systems' and the so-called *systematic design methods*. Indeed, it is not by chance that John Chris Jones (1969) reminds us that the idea behind the systematic design methods is to see the designer as a human computer that processes information following a planned sequence of steps (analytic, synthetic, and evaluative ones). The understanding of problems as systems has its origin in the method used by governmental agencies such as NASA and the Department of Defense of the United States, to carry out programs such as the Apollo 11 Mission and the development of nuclear submarines (Schön, 1969). This being known as the 'systems approach', it is a method that works on the development of execution criteria, quantitative measurements to evaluate those criteria, and an organisation of the totality of the problem (or system) into subsystems (Schön, 1969). The goals of the products so developed are planned at the level of subsystems (parts of the

[11] It is worth noticing that for authors such as Norbert Wiener – one of the fathers of Cybernetics- this would not be the Third but the Second Industrial Revolution (Wiener, 1969). This is a point of view also shared by S. Handel (1967) in his work about the *electronic revolution*.

[12] According to Joseph Finkelstein (1992), the Third Industrial Revolution is characterised by technological advances linked to five particular areas: microprocessors; computer aided manufacturing, design and inventory; optic fiber and telecommunications; biogenetics and bioagriculture; laser and holography.

problem at stake) to solve requirements of the system as a whole. The general idea behind the use of this sort of approach for the case of design was "...to consider the whole of which the proposed product is a part [e.g. its context and user], instead of considering the product as a self-contained object" (Archer in Cross, 1986: 415).

In design theory and methods, the influence of this approach begins to manifest itself in the proposals of Christopher Alexander, Horst Rittel, Bruce Archer and Herbert Simon. For Alexander (1964), the design process finds its roots in the creation of objects capable of expressing a new physical order, where the form is the solution and the context is what defines the problem. He even uses the notion of 'system' to describe the *interaction* that must exist between desirable and totalising properties in objects – or 'holistic system'- and the ways in which the constituent parts of those objects combine to achieve such properties - or 'generator system' (Alexander, 1969). In a similar direction, Horst Rittel (1964) adapts computer science terminology to design as a means to allude to the way architecture, product design, other types of communicational design and planning reach their purposes. In his view, the task of design should be accomplished considering three interrelated parts: 'hardware' or objects and physical devices, 'software' or modes in which people behave in front of devices, and 'testware' or means to control and measure the achievement of tasks in the hardware while it is used.

In the same vein, Bruce Archer (1965) describes design as the art of reconciling people with their tools, their tasks and their environment into a basic system at the point of use (see figures 1 and 2). This is an idea that Herbert Simon (1992) approaches four years later through his understanding of artefacts as interfaces,[13] where the artefact is seen as the meeting point between certain substance - with its own organisation or inner environment - and the surroundings in which such substance operates or outer environment. Thus, to talk about products as interfaces implies an awareness of the way in which products respond to the user's demands when they are used for a particular task in a particular context. This, indeed, may be the origin of Gui Bonsiepe's (1992a) use of the term *interface* to allude to the 'space' where the interaction between people, artefacts and certain tasks is

[13] The date cited for Simon's work corresponds to a late English edition of his book "The sciences of the artificial". Such a book was originally published in 1969.

articulated. This notion of interface may have also inspired Kiyoshi Sakashita's **Humanware**: A term coined by him in Japan during the 1970s, after a stay of three years at the research and marketing section of Sharp Electronics in New Jersey (USA). By *Humanware*, he alludes to the act of gearing "...product design towards people... [establishing] the best possible relationship between humans as users and the hardware/software" (Sakashita quoted in Mitchell, 1999: 83).

These views about interfaces, however, seem to discard the possibility of having an artefact standing for or as an interface (since the artefact is only part of a 'space' of action). Nevertheless, for authors such as Simon (1992) and Kazmierczack (2003), an artefact could be seen as an interface when its material configuration is intentionally thought to create an appropriate encounter between people and the actions they need to perform using it, i.e. when those actions are triggered by people's contact with the artefact's design. Indeed, authors such as Donald Norman (1992) use the term 'human interface' to refer to those parts of the object or technological system that people interact with (i.e. buttons, levers, indicators, light signs, etc.).

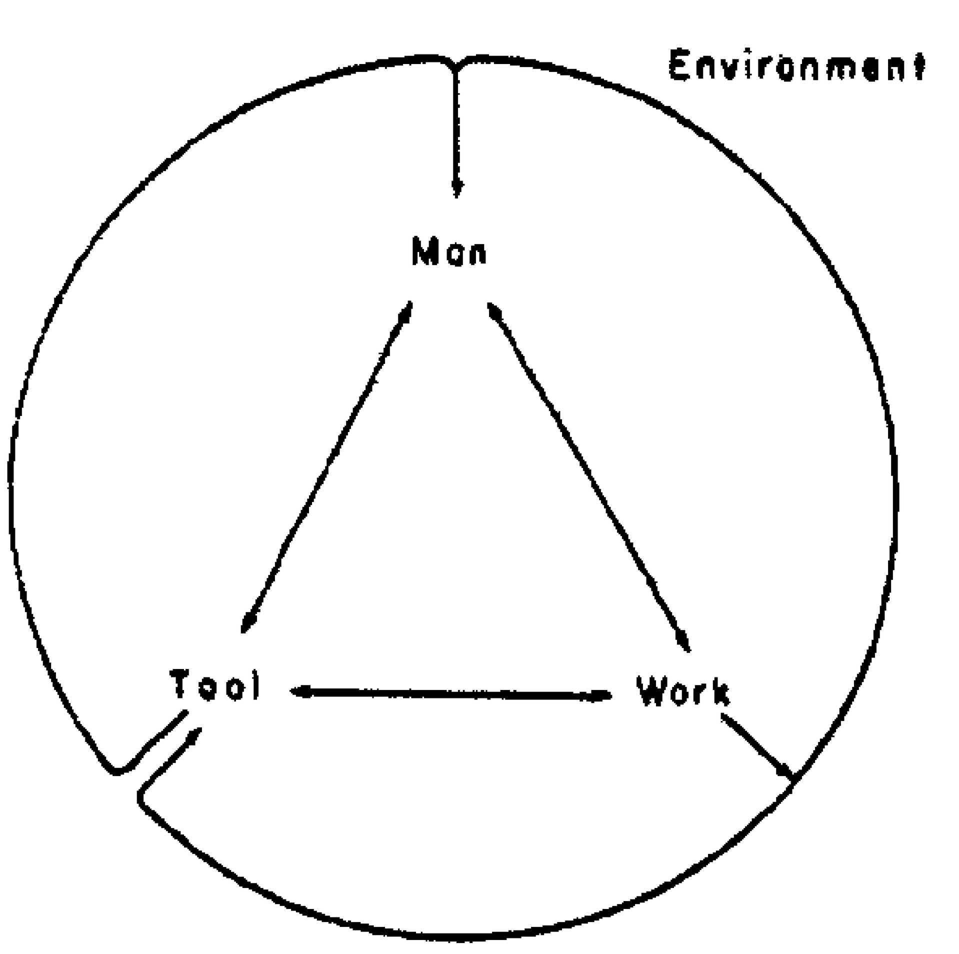

Figure 1 – Basic relationship at the point of use, according to Archer (1965).

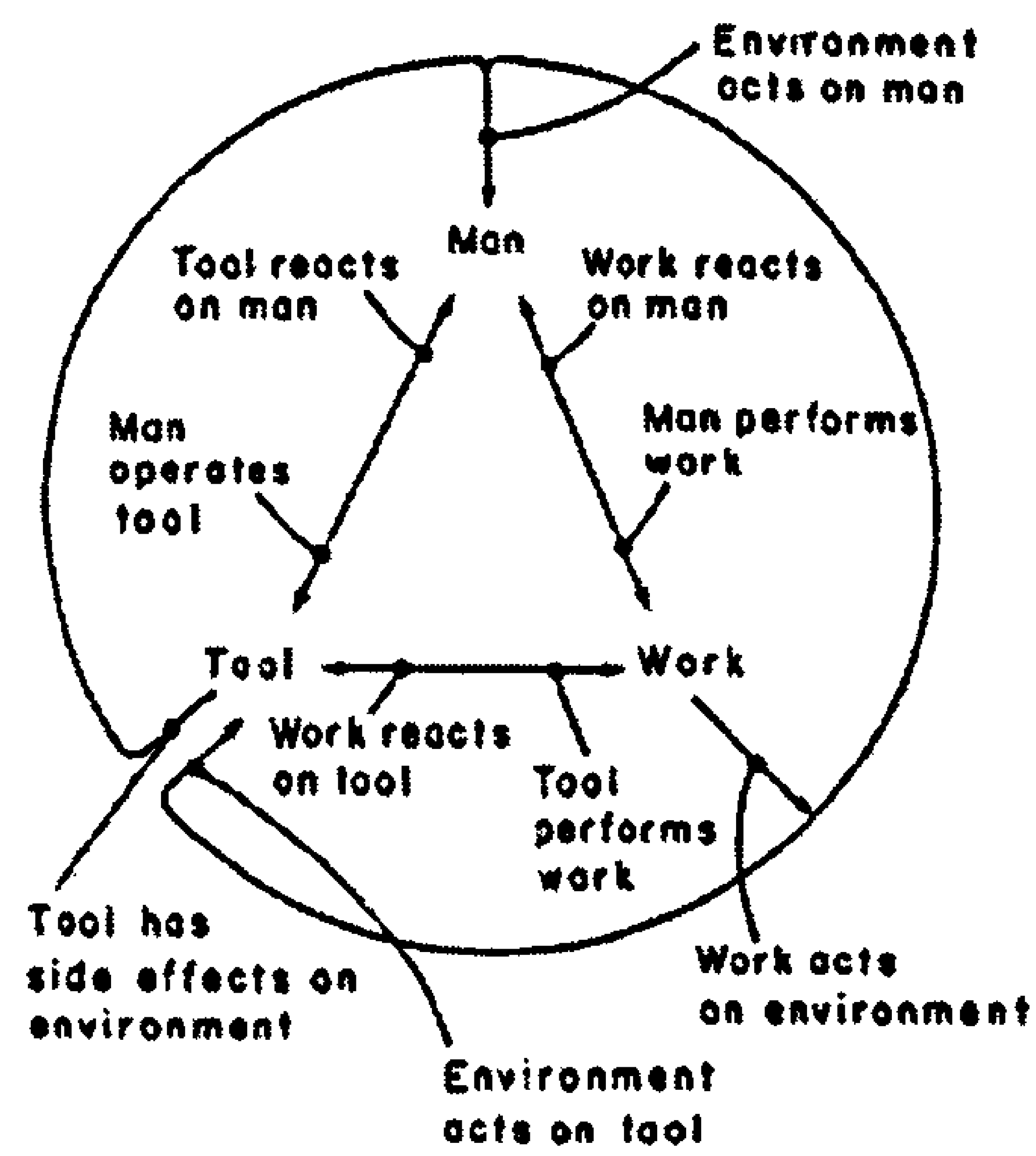

Figure 2 . Activities contained in a man-tool-work environment system, according to Archer (1965).

The view of products as interfaces together with the reconfiguration of markets and globalization have changed the productive system from one essentially massive into a more flexible one, assigning to product design a new status within the process of product development. Indeed, design is now seen more as a definer of strategies to create rather than to add value in products (Heskett, 1998). From the designer's standpoint, the view of the product as an *interface* has enhanced his/her role as the professional that acts upon existent practices in conjunction with the users (Buchanan, 1989; Krippendorff, 1990; Tyler, 1992; Heskett, 1998). It has also made the designer aware of the need for combining the product's formal and functional legibility with self-motivating factors about its use (Norman, 1988; Bürdek, 1994). Differently from this view, the notion of the *product as a service* has taken even further the achievement of an appropriate interaction between user and product. Such a notion has assumes two directions. One toward the improvement of our environment through the promotion of a significant reduction of artefacts, i.e. the production of less pollution and less unnecessary wastage from artefacts out of use. On the other hand, toward a progressive elimination of the acquisition of goods as the primary modality to satisfy people needs through the creation of products that can be leased by the user according to his/her needs and contingencies.

The notion of the *product as a service* has its roots in the idea of a post-industrial society, as it was envisaged in 1967 by the American sociologist Daniel Bell. According to him, there were situations at the end of the 1960s anticipating the coming of significant changes in the social dynamics of countries such as the United States (Bell, 1967 and 1973). For Bell, such changes imply the development of a new type of society where knowledge substitutes economic and political power, and where manufacturing economies would turn into service economies due to the information revolution and the technological achievements in areas such as automation (see figure 3). Even though these ideas were seen with sceptical eyes by many sectors at that time, they have begun to assume shades of reality thanks to some reformulations a posteriori of this idea. Indeed, by the mid-1970s the idea of a post-industrial society experienced a significant reappraisal (Cross, 1981). This evaluation changed the "hyper expansionist" (HE) characterisation of this new society into that of a "sane, humane and ecological" (SHE) society (Robertson, 1978 in Cross, 1981). Understood in these latter terms, the post-industrial society was no longer a utopia. Neither does one have to be surprised by the fact that nowadays this adjective is used to designate the type of economy that prevails in some regions of the United States, Germany, Japan, Sweden and Canada (Reyes, Boils and Pérez, 1988).

According to Ezio Manzini (1994a and 1994b), in an eco-efficient society - such as the post-industrial one - three types of consumption scenarios can be envisaged. One is where products are designed to survive technically and culturally throughout the years (i.e. products with practically no obsolescence). A second scenario is where the product is seen as a service whose design keeps up with issues of ecological and social pertinence. And a third scenario is that characterised by a drastic reduction of artefacts, maintaining the quality expectation of the previous ones. This latter scenario, according to Manzini, would take place as a result of some catastrophic event, bringing along the obliteration of the free choice of products in the market. Of these three consumption scenarios, we have already witnessed products responding to the ideas outlined as part of the first two. Indeed, the idea of creating long lasting products has found its way through an intermediary modality between the notion of interface and that of service, since the mid-1990s.

AXIAL PRINCIPLE:	THE CENTRALITY OF AND CODIFICATION OF THEORETICAL KNOWLEDGE
Primary institutions:	University, Academy institutes, Research corporations
Economic ground:	Science-based industries
Primary resource:	Human capital
Political problem:	Science policy Education policy
Structural problem:	Balance of private and public sectors
Stratification:	Base: Skill Access: Education
Theoretical issue:	Cohesiveness of 'new class'
Sociological reactions:	The resistance to bureaucratization The adversary culture

Fig. 3 – The structure and problems of a post-industrial society according to Bell (1973).

In this respect, some design researchers have been working on re-thinking the models of the user's age in order to extend the useful lifespan of products. To this aim, Roger Coleman (1994), for instance, suggested that the conception of adult age, for instance, should begin to be regarded as including people over the 60 years of age. If products were designed with this idea in mind elderly people would not feel left aside by artefacts that do not satisfy their needs. Another direction in relation to the creation of long lasting products was acknowledged by Victor Papanek (1994 and 1995) from the perspective of recycling. According to him, this new direction comprises two important trends: one centred on the idea of a *design for disassembly* (DFD) and the other focused on the *rediscovery of the product reparability.* The former refers to the design of products that are easy to disassemble, so that their parts can be organized and sorted for recycling. As such it implies a thoughtful conception of the product's parts and a careful choice of materials. Indeed, parts must be made of single materials instead of compound ones in order to make less expensive and easier their separation and classification for recycling (Papanek, 1994). In practical terms, the *design for Disassembly* has begun to be used in Europe. Within the most peculiar examples of this new way of designing are an easy to disassemble dishwasher machine created by the Swedish Company Electrolux (marketed through its Italian subsidiary Zanussi) and a sport vehicle of two seats designed by BMW (Germany) with a body made of recyclable thermoplastic that could be separated from its metallic chassis in less than 20 minutes (Papanek, 1995).

The design for rediscovering the product's reparability, on the other side, aims to the development of the user's functional and ecological awareness of his/her products. From the functional point of view, the design for reparability allows a partial or total participation of the users in the assembly of their products. This as a way to develop the user comprehension about how the product works and can be repaired. From the ecological standpoint, this design modality aims to turn users into active participants of the recycling processes. As a matter of fact, it gives them a role in the disassembly of products that are no longer in use, as well as in the transportation of these products' parts to the recycling centres - once they are classified according to their different materials. In order to fulfil this purpose, products are designed in "kit form" either to be assembled or disassembled by their own users or with the help of other people (Papanek, 1994 and 1995).

The notion of products that can be leased by the user according to his/her needs and contingencies has also been considered. Alec Robertson (1994) envisaged this as part of the technological achievements that has led to a **four-dimensional design,** where services are just one of its activities (see figure 4). As its name suggests, four-dimensional design adds to design the time dimension. It does not mean that time has never been part of design before. Indeed, design has traditionally worked with physical, psychological and political time, but not with *real time* (interactive time) as happens within four-dimensional design.[14] The difference is then between conceiving time as a static entity (as linked to a particular event, style or Zeitgeist) and understanding it in dynamic terms. Thus, four-dimensional design is focused on the interactive dynamic forms that come to life between people and artefacts (Robertson, 1994). Hereby, four-dimensional design has the need of determining in advance the role users play as an active part of its products.

The incorporation of real time to design has also brought along new areas of development. Such is the case of 'product opera', that is, the integration of time-based arts such as dance within 4D product design (e.g. the creation of artefacts for recording and monitoring these activities). However, it has been within *service design* where the best examples of four-dimensional design can be seen. Indeed, few applications of 4D design are more extensive than that of virtual reality in recreational activities (i.e. virtual-reality-computer-games) and computer systems for retailing purposes (e.g. systems for customer care and products' catalogues). The utility of 4D design has also quickly spread into the educational sector (internet, digital encyclopaedias and video-conferences) and corporate identity (helping to define the company's personality and ways of interaction with customers).

2-D Design	3-D Design	4-D Design
Graphic design	Furniture design	Animatronics
Illustration	Ceramics & glass	Interaction design
Printed Textiles	Interior design	Multimedia design
Film	Industrial design	Product opera
Video	Fashion design	Software design
2D Animation	3D Illustration	Service design
	Architecture	Corporate identity

Fig. 4 – Classification of design activities in the present technological scenario. [Source: Robertson, 1994].

[14] Donald Norman (1992) has summarised the differences among these four types of times in the following terms: *real time* has to do with the duration of a physical event, *psychological time* has to do with the duration of subjective experiences, *physical time* is an arbitrary quantity based on some recurring physical event, and *political time* is defined by the convenience of the parts/people involved.

Whatever the case, all seem to indicate that the information-based products are the ones setting the standards for this new design dimension. Indeed, some authors such as Ralf Trachte (1999) have already talked about the possible emergence of different types of product differentiation where, instead of separating models of the same product through few details (Selle, 1975), products are separated by getting the best out of the same technological platform. In other words, a *differentiation* centred in the different uses that can be assigned to the same technological components (e.g. digital menus and LCDs). This, however, has not been the only view in this matter. For Jochen Gros (1990 and 1997), for instance, information-based products might differentiate in two ways. From the standpoint of standardization, these products might be semi-finished and their parts combined to produce differentiation. From the standpoint of individualization, on the other hand, the formal neutrality of most microelectronic products might place differentiation on their picture language (screen design) and surface ornamentation.[15]

The expectation placed on information-based products has also started to promote important changes in design practice. Among these, the most significant seems to be the creation of more comprehensive approaches to software design. The important thing here is not whether designers are dealing with a 2-D or 3-D product, but if the design work has to do with the information in the software – in which case the focus is on content and user's reactions (as with entertainment software) – or with the function of software – i.e. what enables the user to "...process, enter, or generate something which was not fixed in advance" (Lango, 1999: 67). In this context, *Interaction Design* has emerged as a discipline whose aim is to develop the function of software at a structural level considering visual, acoustic, kinaesthetic and virtual reality interfaces. As such it comes to tackle in microelectronic products what, in the control panels of previous products, was tackled by software ergonomists and product designers, including the aesthetic or stylistic side previously developed by *Screen Design* (Lango, 1999). In this respect, some authors have remarked the need of leaving behind the formal neutrality typical of the experimentation with new technologies to transform them through design into true human extensions (Smith, 1994; Norman, 1999).

[15] Ornamentation is here understood as something that helps give sense to the product instead of something simply added to its surface.

In the light of the three views on products previously reviewed (i.e. as self-contained, as interfaces and as services), however, the challenges posed to design have been envisaged as having to do with the development of four basic types of products (Manzini,1998): (1) *Information products* or those almost immaterial products that are created to satisfy instructional, recreational and cultural needs; (2) *result products* or those created to reduce the need of other products; (3) *community products* or collective products "...by virtue of the fact that they are owned and managed (direct or indirectly) by a group of users" (Manzini, 1998: 54); and (4) *duration-products* or products conceived for individual consumption, with a long lifespan, easy to repair and recycle.

The encounter we are witnessing today between the technological advances and the challenges above outlined, gives us reasons to think that in the near future the materiality of many of the components of our actual products will be substituted by more technologically advanced and even virtual versions of them. Interfaces may even disappear to allow us more direct contact with some ways of satisfying needs previously mediated by objects (Kerchove, 1999), since the way in which we conceive the satisfaction of our needs always rests on the consumer's or the designer's interpretation of them (Arnheim, 1978; Fry, 1992). Thus, nothing can be more important than working with the meaningful side of products, especially if we consider that hereafter "...the bulk of our efforts will be spent more for manipulating information than for manipulating objects" (Moles, 1995).

We are entering an age where this trend to immateriality has begun to take over the design practice (Flusser, 2002). Such is the case of *Teledesign*, that is, the use of expert systems (i.e. computer programmes which performs many functions normally done by human experts), in the form of virtual templates, to allow consumers choose some design features in the products they buy via internet (Crabbe, 2001)[16]. Thus, the designer is no longer a sculptor of messages but a planner of systems of messages (Barbacetto, 1987a), in a scenario where technology is no longer approached as referring to 'neutral boxes' whose destiny depends on who use them (Barbacetto, 1987b). Let us keep in mind that the three common

[16] Today, some clothing companies such as Assyst and Lectra are using Teledesign.

consumer reactions to technology are resistance, acceptance, and modification (Williams, 1984), and hope that design could reduce resistance by modifying technology so as to generate a sincere public acceptance. To this aim product design need to be theoretically and practically envisaged in more comprehensive terms. If information is seen as the new unit of design work and meaningful communication[17] the goal design should achieve, the search for theories about reference in product design becomes a need. That is to say, there needs to be a search for theories capable of explaining designers the way in which meaning is holistically created and communicated through products considering aspects related to both the designer and the user.

1.2.2. The aesthetics of technology

There are two fundamental images or views of what technology is about: one intellectual and one artefactual (González, López and Lujan, 1996). The former is rooted in the 19th century vision of science as a cause-based set of theories whose arguments attempt to explain the world in objective, rational and neutral terms. The second image of technology, on the other hand, emerges from everyday life and looks at technology as a conglomerate of objects created for a diversity of tasks. Thus, while the first approach sees technology as applied science or academic knowledge, the second understands technology in terms of what it does for us in everyday situations. Since design is an activity that helps to give physical form to our tasks, our interests here will be focused on the *artifactual view of technology*.

From this perspective, a significant part of what mankind is nowadays comes from the artefacts we have created throughout history, and progress is understood as more than just the result of man's inborn intelligence. Progress is seen as a consequence of the success experienced by each new artefact used to accomplish a task (Washburn in Mazlish, 1978) as well as a result of the different levels of consciousness awakened – especially in terms of know how - by each new artefact (McLuhan, 1987; Leroi-Gourhan, 1993). Thus, the progress of humankind can be conceived as a cumulative process of cultural evolution where innovation and

[17] Generally speaking, all communicative activities ought to be meaningful by nature (otherwise they could hardly be envisaged as communication). Nevertheless, the reality in this matter shows that communication not always takes place in the activities we think to be communicative.

imitation - possibly supplemented by instruction - worked together to make such a progress possible (Tomasello, 1999). Herefrom, design can be seen as one of the activities *par excellence* to turn our world perceptible in some sense (Flusser, 2002). Indeed, "design is a way of giving meaning to technology" (Sottsass, 1986), of helping technology to have the form we seek in things: The shape that makes the nature of things comprehensible to us (Arnheim, 1961). As part of this dynamic design supplies the 'soul' for the matter of each object (Mendini, 1996) within a process where technology provides 'what' can be done and design 'how' to materialise it as part of artefacts. In this sense, the instrumental approach to technology is more than just a matter of artefacts. It shares with design the possibility of understanding the world in which we live through the world that we have made (i.e. through our artefacts). Let us not forget that design does not create just objects but 'projects' for people's lives (Mendini, 1996; Aicher, 1994a).

On the other hand, to write about the aesthetics of technology should not be seen as a forced attempt to join two separate things (Lacruz-Rengel, 2002b). Especially since the essence of design aesthetics is rooted in the mediation that takes place between aesthetic and non-aesthetic factors (Bonsiepe, 1980), and since "the products of aesthetic practice tend more and more towards integration into technical-scientific culture" (Nadin, 1981: 2). Thus, aesthetics is no more the study of beauty, as it was defined in the past.[18] Today, it is the territory of the *aisthesis* - i.e. that of the perception of the world - as it was originally understood by the Greeks (Calabrese, 1999). In this sense, aesthetics can be better defined as the set of preferences and aversions that intervene in our immediate relations with reality (Acha, 1990). Under this scope, the aesthetics of design has to do with the way in which we relate ourselves to the world of man-made utilitarian creations. Therefore and distinctively from the aesthetics of art, aesthetic experiences in design can take place at any time and place as well as without the need of highly elaborated experiences. This way of understanding the aesthetics of design has been widely accepted since the last quarter of the 20th century (Cf. Löbach, 1981; Haug, 1989; Rotte, 1993; Macdonald, 1993 and 1998).

[18] A simple comparison between the definitions of 'Aesthetics' present in the 1970 edition of the *Encyclopaedia Britannica* and that of the 1993 *New Encyclopaedia Britannica*, clearly shows a broadening in the field of aesthetic studies.

This 'new' approach to aesthetics has also brought about other important changes to aesthetics in general. Firstly, the traditional emphasis of aesthetics has moved from the object - vested with special qualities - to the subject – either the producer or the beholder of those objects (Bense, 1972; Löbach, 1981). Secondly, categories such as beautiful, ugly, tragic, funny, sublime, trivial, typical, and novel have been incorporated as part of aesthetic studies (Bense, 1972; Berlyne, 1974; Acha, 1999). Thirdly, aesthetics has begun to be linked to cognitive states (Bense, 1972; Goodman, 1976; Csikszentmihalyi and Rochberg-Halton, 1981; Reid, 1982). Indeed, in our aesthetic descriptions the information about how a thing looks is mediated by the information of what that thing is about (Moles, 1975; Somerville, 1988; Haug, 1989). And finally, a diversity of different approaches to study aesthetic phenomena has been developed (cf. Bense, 1972; Löbach, 1981). Among them, the most significant for design are (Löbach, 1981): *informational aesthetics* (focused on our use of objects), *empirical aesthetics* (the study of our preferences and aversions), *generative aesthetics* (centered in the creation of objects from the aesthetic standpoint), and *axiological aesthetics* (concerned with the role played by our values in aesthetic states).

Consequently, the aesthetics of many of the functional objects we surround ourselves with turns out also to be the aesthetics of our technology. Such an aesthetics is experienced as if the functional satisfaction of the object were imaginatively fused with its physical body: "the functional fulfillment as-reveal-in-the-form-of-the-body" (Reid, 1954: 148). In other words, it is aesthetics that transforms the functional object into a sort of metaphor of the task it helps to accomplish (Lacruz-Rengel, 2002b).[19] This entails the consideration of the physical features of the utilitarian object in similar terms to those of the words in a poem (cf. Garvin, 1968), i.e. as features aesthetically elaborated to elicit certain mental associations beyond the mere expression of words (objects' function in our case). Therefore, the production and interpretation of such objects rests on people's accumulated experience (Arnheim, 1972; Gombrich, 1975),[20] selective interest (Haug, 1989; Kotler and Armstrong, 1990) and emotional attitude

[19] This idea comes from a wider discussion considering the nature of aesthetic pleasure as an immediate and meaningful experience whose aesthetic object is not necessarily apart from the object's utility (cf. Lacruz-Rengel, 2002b).

[20] In this respect, Gombrich (1975) reminds us that what we see as part of an aesthetic situation is mediated by our past experiences and our future expectations.

(Csikszentmihalyi, 1995) – either from the design or the user side. As a matter of fact, the functional object is not only acquired to fulfil a practical task, but also to symbolise the aspirations and character of its owner (Fornari, 1989; Packard, 1992). Let us not forget that "symbolization arises from the need to give perceptible form to the imperceptible" (Giedion, 1960). These sort of considerations are equally applicable to the artefacts and their technology, since we get to know and use both thanks to their perceptible features (Findeli, 1994).

The aesthetic side of technology becomes even more interesting, however, once we realise that it does not only involve physical features on their own. As a matter of fact, in order to have any impact, technology must take into account the human surrounding of each activity it aims to support and the different levels of human knowledge involved (Mackenzie & Wajcman in Mackay, 1997). Hereof that even the best and most useful technology cannot be imposed on people who are not prepared to deal with it since such an imposition could only lead to *technological bewilderment* (Kerchove, 1999). On the other hand, technology has also brought along some serious problems to be tackled by design, even though it has created: new and interesting materials (e.g. smart materials), more flexible productive techniques (e.g. robotics) and improvements in the way functions are carried out (e.g. digital technology). Nevertheless, the speed of change experienced by this technological race is also breaking with incredible regularity the image of the *technological continuum* we are used to (Chaput, 1988).

These problems are mostly attributed to the emergence of electronic components and systems to substitute the old mechanical parts in many products. In this direction, Uri Friedländer (1989) has asserted that the obliteration of many firms specialised in mechanical components from the industrial scenario brought along: an increase in the number of manufacturers competing for the same market, a reduction in the prices of many products, and, most importantly, a preoccupation with the quality of the product's components, its selling appearance and packaging, instead of focussing on designs that make sense to the public. Thus, design has also contributed to make our life more complex. And even in the case of versatile products such as personal computers (PCs) there are reasons to believe that, instead of simplifying things, new levels of complexity are being introduced. In this respect two simple facts seems to have been disregarded (Norman,1999). Firstly, that simpler devices are not only superior but also easier to use than those devices capable of doing too many different things. And secondly, that it is quite difficult to design products which are intended to be used by hundred of millions of people all over the world in terms of the diversity of users and backgrounds involved (age, education, culture, etc.).

Given that people's functional understanding of artefacts relies to a certain extent on aesthetics, there is a great number of design scholars and critics who have expressed their major concerns in relation to the visual disappearence of the objects' functional and typological features (cf. Scheuer, 1989; Krippendorff and Butter, 1993; Selle, 1995; Kerchove, 1999; Gross, 1997; Groot, 1997; Norman, 1999), and about the new sort of sensibilities that might be needed to interact with them (cf. Dorfles, 1979; Branzi, 1988; Dormer, 1990; Virilio, 1991; Baudrillard, 1994; Findeli, 1994; Moles, 1995; Trachte, 1999; Dune, 1999). One important issue in this respect has been the effect of the miniaturization of components in these objects. Indeed, it is not only seen as the impelling force behind the disappearance of these objects' formal determinants and the enhancement of many of their less important features (Krippendorff and Butter, 1993; Groot, 1997), but also as one of the main forces sponsoring the use of arbitrary visual affinities with objects of disparate nature (Dorfles in Barbacetto, 1987b; Khron and McCoy, 1989; Selle, 1995).

Another important issue has been the shift from hardware-based design solutions to software-based ones. In this direction, most of the concern has been focused on the role design will play in the definition of the appearance and functional performance of the box-like multifunctional objects that have been forecasted. Some authors have even come to the conclusion that design will have to define the qualities of this new type of interaction (Smith, 1994; Kerchove, 1994) and, to do so, it will also have to develop new levels of professional specialisation (Robertson, 1994; Lango, 1999). Nevertheless, there are many other opinions on the subject. From those who think that the potential of this new type of hardware should be maximized by strengthening the relationship between people, hardware and software (Sakashita, 1996) to those who speak of giving a new status to the 2D surface ornamentation (King and Miranda in Barbacetto, 1987c; Gros, 1997). From those who preach the need for a return to a new type of simplicity centred on design more selfexplanatory – i.e."less but better" design (Rams, 1998) - to those whose concern is in the new kinds of differentiation that will have to be developed, based on tool-like qualities and metaphors such as paths, branches and menus (Trachte, 1999).

For other authors, we should be looking at issues such as the effects of the so-called **anthropomorphosis of the functional object**. According to them, our concern should be focused on the human-like status that electronic technology and automation are giving to our functional objects. This is happening up to the point of treating some products (e.g. computers) almost literally like another organism that can also pick up infections – i.e. computer viruses (Dormer, 1990). In other words, as if these objects were beings with a life of their own and therefore unable to keep mirroring their users and to satisfy their needs propertly (Baudrillard, 1994). It is the 'revenge of the crystal' outlined by Jean Baudrillard: "a form of challenge, seduction, or play which brings more intense things into being" (Baudrillard in Dune, 1999: 60-61). As a matter of fact, it is now very common to see people 'being used' by machines - in terms of the knowledge required to get some feedback from these artefacts - when they actually try to use machines (Sottsass, 1986). This lack of clarity about the role of functional objects has given some critics reasons to think about the risks derived from the instauration of an *unmotivated technology* (Dorfles, 1979), i.e. a technology offering no clear clues about the artefacts' function and purpose.

In this same line of thought, there are also authors concerned with the effects of virtual reality and telematic means of communication such as the internet on our understanding of reality. In relation to this, Abraham Moles (1995) has asserted that this is an **age of telepresence** whose main characteristic is the establishment of equivalences between 'actual presence' and 'vicarious presence' to redirect our realm of consciousness away from the materiality of objects. Hereby, for him our efforts will be increasingly focused on manipulating more information than objects. In this respect, there are authors who believe that the idea behind these technologies is the elimination of any interfaces to enable direct contact with certain types of satisfaction (Kerchove, 1999), whereas there are others who think that the intention behind it is about saving the public the need of decoding things on a rational level by making information available and easy to absorb (Branzi, 1988). Whatever the case, it is clear that our senses have now acquired a different status – perhaps as more reliable instruments of perception than before (Branzi, 1988) – since we are now invited to "see more, listen more and feel more" (Stockhausen in Kerchove, 1999: 113). Such a 'revolution of the senses', however, has imposed on us an **aesthetics of search** as a substitute of our traditional search for an aesthetics (Virilio, 1991).

Some of the views here presented may not be totally true. Many of them may only come to life under special circumstances (e.g. at the introduction of a new technology in a marketplace or according to the accessibility people have to this type of products in each society). In any case, not everyone uses all the new technologies nor all users assimilate new technologies at the same pace. Insomuch that statistics such as that suggesting that every new technology needs about 30 years to be fully incorporated in a society (Saffo, 1992) will also change. By now, there are sufficient reasons to think of design as a way to 'domesticate'[21] technology (Panzar, 1997) and as an active part of that process of acquisition of knowledge and skills that is needed to guarantee certain levels of technological literacy in the users (Liddament, 1994). Let us not forget that, when confronting a new technology, our natural impulse is to try to fit it into what we already know (McLuhan, 1966).[22] In this sense, several attempts have been already devised to address these matters (cf. Baudrillard, 1969; Levinson, 1977; Luh, 1994; Dumas, 1994; Smith, 1994; Kerchove, 1994; Lacruz-Rengel, 1997; Athavankar, 1997). Unfortunately, they can hardly be said to be comprehensive enough to help designers address the problems posed by the increase of semantically neutral products in our societies.

1.2.3. Design methods and the ideation of design concepts

Even though authors historically linked to the *Design Methods Movement* such as Christopher Alexander (1971 in Margolin, 2005), Geoffrey Broadbent (1969) and Jones Christopher Jones (1973) have openly expressed their lack of trust of the extreme rationalisation achieved by design methods, the need for methods is still indisputable. In this respect, Amos Rapoport (1969) once insisted that the problem

[21] This idea entails, according to Panzar (1997), the design of products as part of evolving networks of goods to help people relate them to their predecessors.

[22] This learned response to new technological situations is what Marshall McLuhan (1966) has named 'negative feedback'.

was that methods were overestimated in relation to the designer's intentions and the type of information needed. Other authors such as Gert Selle (1975) have seen the kernel of the problem in the lack of a regular sociological control of these methods, i.e. of their social pertinence at the time of their implementation. Bruce Archer (1979) once even asserted that the problem never was in the methods themselves but in the methodologists' exclusive concern with procedure. Hereby, there are reasons to believe that the problem has never been in the methods themselves but in the way they are used. This is why Archer (1979) convincingly remarked that the study of methods is and always will be alive as part of design research.

Beyond this, there are three negative allegations that should be carefully assessed in relation to the design methods themselves (Raman, 1973). Firstly, that they have only succeeded in promoting an analytic fervor. Secondly, that most methods assumed that the design process followed by one and other designers, were more less the same. Thirdly, that design methods have failed to provide an intelligible account of synthesis. In this respect, there are three basic aspects to bear in mind. Firstly, not all methods are good for analysing, synthesizing or assessing design matters. Each method has a specific location or use within a design process (Jones, 1982; Cross, 1999). Secondly, the use of one method instead of another implies indeed a critical position toward what the designer expects to achieve (Iglesias, 1986). To the extent that it has been said that the more steps a method has, the more strict its techniques are, and less original its products (Iglesias, 1986). And finally, one should keep in mind that few things are more important about methods than knowing the extent to which they are valid to solve a particular problem. To this aim, Broadbent (1969) reminds us that the selection of methods should be determined by the nature of the problem, and Jones (1982) that such a selection should be based on the capacity methods have to guide and feed us with useful information during the act of designing.

One way to approach the critical position that accompanies the selection of each method is dividing the act of designing into 'inner' and 'outer' states (cf. Rittel, 1964; Jones, 1982; Martin, 1982; Eekels, 1982; Simon, 1992).[23] The **inner states** have been either characterised as the substance/organization of the object to be

[23] The term 'states' is here used in substitution of the terms 'systems' – generally used by Simon (1992) - , 'games' - used by Martin (1982) – and 'realms' – used by Eekels (1982).

designed (Simon, 1992) or as part of the realm of the mind - comprising *truth statements* (representations of states, aptitudes of the designer, etc.) and *value statements* (basically attitudes and judgements) (Eekels, 1982). The **outer states**, on the other hand, are seen as part of the realm of the material states of the world: the content items which make up a physical environment or context (Eekels, 1982; Martin, 1982). Thus, it is assumed that if inner states are properly designed, they will properly fit into the outer environments (Simon, 1992). In this sense, the synthesis phase of design, for instance, is the realm of inner states par excellence, whereas the analysis phase is a blend of outer and inner states.

Finally, in relation to the validity of methods, authors such as W. Mike Martin (1982), Nigel Cross (1983) and Peter Rowe (1987) have defended the idea that there is more than one way to define a design process based on the fact that designers take their decisions following different styles. To this aim, Cross (1983) and Tovey (1984) have assessed the interaction and contribution of cognitive styles traditionally conceived as opposed (i.e. convergent/divergent, impulsive/reflective, field-dependant/ independent,[24] and serialist/holist) for the act of designing. They have arrived at the conclusion that people may tend to one or another style but to not one exclusively, because the opposition of these styles should be really seen as complementary in the design process.

With these considerations in mind, we will now focus on defining the particular nature of methods for the synthesis phase of the design process. In this respect, one should keep in mind that it is in this phase where designers develop their image of products, and where a large part of their decisions rest on personal values (Rittel, 1964). Therefore, what design methods ought to provide at first are different ways of looking at things (Jones, 1982; Krippendorff, 1990), since designers' values are largely controlled by their world view and their image of the public (Rittel, 1964; Rapoport, 1969; Gelernter, 1973; Eekels, 1982; Irigoyen-Castillo, 1998). A review of various authors clearly shows that design synthesis is generally tackled using the so-called *black-box methods* (Broadbent, 1969; Bonsiepe, 1978; Quarante, 1992; Baxter, 1995; Roozenburg and Eekels, 1995; Cross, 1999; Jordan, 2000). That is to

[24] The *field-dependant* and *field-independent* cognitive styles focus on the degree to which different people are influenced by the context of things when they see something or encounter a problem that need to be solved (Cross, 1983).

say, methods where the creative leap takes place in a way that cannot be totally explained in rational terms, due to the intervention of aspects related to the personality and particular experience of each designer (Jones, 1969).

There are also authors like André Ricard (1982) and Héctor Iglesias (1986) who think that there is no such a thing as design methods for the synthesis phase of designing. According to them, there are only logical and rational procedures for the analysis and assessment phases of the design process. Nevertheless, it is a position hardly shared by the design community. As a matter of facts, attempts have been made to formulate methods for the synthesis phase. Proof of them are methods such as Brainstorming, Synectics, the elimination of mental blockages and Totem-Building,[25] among the black-box methods, and the Morphological Chart, Morphograms and SCAMPER,[26] among the glass-box[27] ones.

Standing on methods like these, new methods[28] have been developed for concept design. In this direction, two different trends can be identified: one primarily working around manufacturing, and another primarily working around the satisfaction of the public/users (Margolin, 2005). The former is focused on developing and justifying a conceptual model of the design product that can be shared by all the team (departments or people) that works on its formulation. The latter, on the other hand, is centred on helping designers to integrate knowledge from different fields to improve the outcome of their work in terms of the users' satisfaction. A good example of the manufacturing-laden approach is Ulrich and Eppinger's (1995) five-steps method for concept generation, and a representative example of the second approach (the integration of knowledge to satisfy the public) is Patrick Jordan's method for the creation of pleasurable products.

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[25] It is a method for metaphorical ideation of products where the features of existing products (selected by potential users), images of the product's context and written opinions are assessed and translated into families of dominant qualities to generate design concepts (Dumas, 1994).

[26] SCAMPER is an acronym that stands for: Substitute, Combine, Adapt, Magnify or minify, Put to other uses, Eliminate or elaborate, and Rearrange or reverse (Baxter, 1995).

[27] *Glass-box methods* are defined as those "...inside which can be discerned a completely explicable rational process" (Jones, 1969).

[28] It is worth clarifying that some authors call 'methodology' what is generally named as 'method'. For the sake of clarity, the term *method* is used in this research to allude to the set of steps formulated to achieve certain design goal, and the term *methodology* understood as the study of methods.

The practical differences between these two approaches can be easily realised through a very brief description of the steps comprised by the two methods used here as examples. In this sense, Ulrich and Eppinger's method comprises the following steps: (1) Clarifying the problem (understanding and decomposing of the problem to critical sub problems), (2) search externally (consultation with lead users and experts and review of literature, patents and benchmark related products to outline the reality of existing products), (3) search internally (generation and assessment of ideas for the new product within the team working on that product), (4) explore systematically (classification and combination of the ideas generated by the team to integrate solutions, define alternatives, and come out with solutions), and (5) reflect on the solutions and the process.

Differently from this, Patrick Jordan's method can be outlined through a series of four steps aiming to a holistic understanding of the potential user. To this aim Jordan's method begins encouraging designers to characterise the potential user in terms of his/her physical (body characteristics, physical dependencies, etc.), social (social personality traits, lifestyle, etc.), psychological (cognitive proficiency and emotional characteristics), and ideological (beliefs, morals, taste and aspirations) nature, using a variety of techniques such as Reaction Checklists,[29] questionnaires, interviews and Laddering[30]. Based on this characterisation, a specification list of the product desirable benefits and properties is outlined and expressed in experiential (e.g. should reflect the user's femininity) and formal (e.g. dark colours and smooth finishes) terms. Then, concept ideation takes place as a way to define how those experiential and formal properties will combine. Finally, the design proposals so obtained are assessed directly with potential consumers.

The two trends abovementioned tackle in different ways the construction of meaning in concept design. The validity of these approaches depends on the standpoint from which they are assessed, either the manufacturing or the consumer

[29] *Reaction checklists* are, in its more basic form, lists of reactions used to ask potential users to mark their reactions toward a product or a product concept (Jordan, 2000).

[30] *Laddering* is a technique used to understant links between "...formal product properties, experiential product properties, product benefits and the characterisitics of a person experiencing a product" (Jordan, 2000: 165). As part of this technique the investigator asks a participant to mention a feature that he/she feels particularly positive or negative of a product, asking the reason (why) of this impression then and after each subsequent answer is provided until the participant gives a really reasoned response.

side. Nevertheless, it is worth noticing that the trend here exemplified with Jordan's method has attracted more attention than the manufacturing-laden one. To the extent that the trend on user-satisfaction has gained already a special place within the product design community. Indeed, books, international conferences, and a lot of research have now been especially dedicated to it (cf. Norman, 1988; Crozier, 1994; Jordan, 2000; McDonagh and Lebbon 2000; Juez, 2002; Green and Jordan, 2002; Norman, 2004). In terms of methods, attempts have included: the use of descriptive words and mood boards as inspiring sources (McDonagh-Philp and Lebbon, 2000; Bruseberg, McDonagh and Wormald, 2004), the consideration of sensory and cultural values in terms of physical properties (Macdonald, 2002), and the translation of emotional categories into visuals, using techniques such as the association of products with "emocards" (cards depicting emotional responses based on cartoon phases), laddering and collages (Desmet, Overbeeke and Tax, 2001).

Many of these new methods have inherited some of the techniques and concerns previously seen in methods developed as part of Product Semantics. It becomes especially obvious when one looks at the nature and steps of methods such as Reinhart Butter's (1990) *Semantic Detour* and Hans-Jürgen Lannoch's (1990) *Semantic Transfer*. Among the essential features common to those methods and the present ones, we ought to mention: (1) their intrinsic purpose of altering cognition and the subconscious conditions behind the creative process through the use of techniques of free mental associations, (2) the use of verbalization for the realisation of desirable and undesirable attributes as well as a basis to evoke desirable physical properties in absence of a particular product or during the public's interaction with it, and (3) the assessment, selection and integration of those manifestations with the best potential for the design concept. But despite of the experience so accumulated in matters of concept design, methods for the synthesis phase of the design process are still very much focused on partial aspects of what a product is (i.e. emotional responses, cultural values, manufacturing feasibility, etc.). This might be due to the lack of a theory properly substantiated about the act of designing (Bonsiepe, 1985c; Archer in Margolin, 2005).

Nevertheless, the experience and knowledge so developed have taught designers a few valuable lessons. Firstly, that creative efficiency increases with the knowledge designers have of their own psychological processes (Gordon, 1961). Secondly, in creative matters the emotional (subjective) components of the situations or problems at stake are some times more important that the rational (objective) ones. Thirdly, the flow of ideas in terms of free mental associations (regardless of their practicality or feasibility) is highly recommendable as a way to explore unusual ideas and impel creativity (Baxter, 1995). Beyond these, it is also important to bear in mind that some of the usual procedures followed by designers may hinder the creative process. Among them we ought to mention after Bryan Lawson (1990): (1) to pre-categorise the problem and its possible solution before studying them, (2) to articulate the parts of the problem and its solution without a holistic view of what is intended, (3) to forget that the means of representation used (drawings and models) have implicit limitations, and finally (4) to keep working around ideas that have proved to be hard to materialise instead of exploring other alternatives.

1.3. An overview of the research methodology

Since the way in which a research subject is approached depends on the theories and premises used by each researcher (Olivé, 1991), this section will introduce: firstly, the general views on design research that prevailed during the development of this study; secondly, the methodological foundations of semiotics used to appraise the theories of meaning here considered and generate the theoretical model for concept ideation proposed as part of this work; finally, the empirical techniques used in design to study this sort of matters are briefly presented as a general framework for the experiments carried out in the last phase of this research.

1.3.1. The nature of design and design research

Any research methodology presupposes certain conception of the field where it is used. In this respect, some authors have attempted to locate the identity of design as being closer to technology (Cross, Naughton and Walker, 1981; Acha, 1990); closer to science (Maldonado, 1960; Rittel, 1964; Gregory, 1981; Simon, 1992); or as a blend of science, art and technology (Bonsiepe, 1980; Maser, 1987b; Buchanan, 1989; Byrne, 1990; Quirós, 1998; Jiménez, 2000; Findeli, 2001). Those who understand design as an activity pre-eminently technological argue that it is the only way to develop a theory about design with forms of knowledge capable of recognising its historical roots. For those in favour of looking at design through science, operational thinking is the convenient way to assimilate the types of relations emerging between theory and practice and engendered by the new scientific developments. And for those who visualise design through a blend of science, art and technology, design is a soft discipline capable of articulating not just the aesthetic or functional aspects of objects, but also their social, ethic and even political implications.

The existence of these positions shows that design research has evolved following only a few paradigms of inquiry. These paradigms encapsulate the elements which are the common possession of the practitioners and researchers of design.[31] In this respect, the logic of design thinking (and therefore that of design research) can be said to have emerged from two major paradigms: *applied art* and *applied science*, with the involvement of technology as a mediating force (Findeli, 2001). The pre-eminence of one of these paradigms over the other derives from the role assigned by designers either art or science. Nevertheless, the nature of design has never been exclusively bounded to art or science, since art is generally visualised as 'applied' to design and the scientific side of design is always coloured by the technology of the time. In this respect, the experience developed in design schools such as the Bauhaus and the Hochschule für Gestaltung of Ulm clearly supports this view (Maldonado, 1960; Bonsiepe, 1978 and 1980; Aicher, 1987; Maldonado, 1987).

The historical emphasis on art or science in design has been generally explained in relation to the designers' attitude toward industrializalization or toward their social responsibility. In relation to industrialization, such an emphasis has been defined either as a reaction against the values of industrial civilization or as an attitude of acceptance of the possibilities offered by new technologies (Quarante, 1992). From the perspective of social responsibility, on the other hand, views move along the understanding of designers as auhtorities and their understanding as mediators of user's practices (Bonsiepe, 1972; Krippendorff, 1990). The former view stems from the Beaux Arts tradition (Bonsiepe, 1972), whereas the latter derives mostly from

[31] According to Kuhn (1977) *paradigms* include symbolic generalisations, models and exemplars.

the critiques of functionalism (Krippendorff, 1990).[32] Nevertheless, if we take into account that design is "...a multi-dimensional activity characterized precisely by its ability to sinthesize heterogenous criteria from a number of different orders (technical, economic, humanistic, etc.)", the formulation of conceptual categories such as that of *design-as-art* or *design-as-science* add little to our understanding of it (Dilnot, 1982: 144).

In this sense, it might be more useful to look at the changes experienced by design as a field of work. Indeed, design has achieved levels of specialization and diversification that clearly outline a scenario of continuous development (Maser, 1987a; Robertson, 1994; Lango, 1999). It is a scenario where, more than ever, human existence needs to be approached as Olt Aicher (1978) suggested at the end of the 1970s. That is to say, as being about "...grasping complexities, assessing classifications, mastering interconnections [and] recognising designations" which turn the search of truth into a matter of establishing the right links of meaning (Aicher, 1978: 49). Within this context it is logical to think that values such as objectivity, rationality and universalism - traditionally assigned to the scientific method – are still quite attractive to some designers as a future hope (cf. Maser, 1987b), even though, nothing seems to be clearer nowadays than the idea that design is not a science. The activity of science is "...directed by *knowing that*, towards error-free explanation", whereas design is "...directed by *knowing how*, towards seeking performances and products of skill and quality" (Cross, Naughton & Walker, 1981: 200). The scientist can build his/her own sub-reality neutralizing those factors deemed by him/her as being inappropriate, the designer cannot do it (Rittel, 1964).

There is, however, one particular aspect in common between science and design: both seek innovation (Rittel, 1964). But even here, the nature of their products, procedures and elements is quite distinctive. The aim of scientific innovation is the production of knowledge, its language the formulation of assertions, its standard practice the production of evidence and its criterion for success is truth (Bonsiepe, 1995a). The nature of design innovation, on the other hand, works around the

32 *Functionalism* is normally understood through the idea that utilitarian objects should be simple, honest, well-adapted to their purpose, bared of ornament, standardized, and expressive of their structure and materials, among other features (Marcus, 1995). However, for Marcus the understanding of functionalism through its revivals has led to stereotypes and misconceptions.

articulation of the interface between artefact and user, its language is that of judgements on functional and aesthetic aspects of things, its standard practice the creation of variety and coherence in our environment and people's lifestyle, and its criterion for success the satisfaction of a market (Bonsiepe, 1995a). All this, despite the opinion of those critics who have seen the planning behaviour of designers as rarely committed to innovation (Maldonado, 1972).

Since design requires the consideration of all sorts of causes and effects related to its products, its concepts cannot be so rigidly established as happens with science (Rittel, 1964). The same happens with the definition of the epistemological roots of design. Let us not forget that differently from other ways of knowing, design involves knowledge of desires, intentions, methods, technology, and science, among other things (Norman, 1992). Therefore, its chief elements are inextricably linked to technological means, solution types, information expressed in terms of the users, and information extraneous but relevant to the problems it seeks to solve – such as standards, constraints, quantification rules, etc. (Hillier, Musgrove and O'Sullivan, 1972). With elements like these in mind, the lines of inquiry in design can hardly be framed as part of a single way of knowing.

This comprehensive view of design has caught the attention of theorists since the 1970s, when some of them began to question the affinities and differences of design with scientific and scholarly processes such as those of the humanities. Some theorists took this matter even further by stating that the rational basis of design "...must always be understood under interdisciplinary aspects" (Maser,1987b: 97), linking design to fields such as technology, art, science and politics (Buchanan, 1989). Later authors on the subject have acknowledged that the research methods of design are a blend of the scientific and humanistic traditions, including technology as applied science. Kevin Byrne (1990), for instance, has asserted that the methodological dimension of design moves between two poles: a *speculative* one - that relies heavily on analysis, logic, evaluation and criticism - and an *experimental* one - based upon observation, measurements, hypothesis and test. It has also been said that design research should be placed between science and humanities, since the former deals with the objective side of design and the latter with its subjective aspects (Quirós, 1998).

Other authors have been even more specific with respect to such a correlation. Klaus Krippendorff (1990), for instance, has asserted that according to whether the emphasis is on use, language, genesis or ecology of artefacts, design should be respectively approached through psychological theory, socio-linguistic theory, techno-economic theory or a theory of interaction among species of artefacts. Others, like Luz Jiménez (2000), have taken the classification of sciences into empirical-analytical, hermeneutical-historical, and socio-critical suggested by Jürgen Habermas, as the starting point to characterise the holistic and synergetic nature of design thinking. For her the use of knowledge from different fields depends on whether the design object is considered as:

1. A *physical entity* with certain mechanical and organoleptic properties, in which case its study rests on the natural and physical sciences.
2. As part of an *interacting system* yielding social signification, in which case its study is carried out through social sciences.
3. As a *lever of social transformation* (modifying attitudes, values and habits), in which case it should be studied leaning on the critical sciences.

Thus, instead of alluding to a *design science* we may be really referring to the *science of design* (Cross, 2001). That is, "...a federation of sub-disciplines having design as the subject of their cognitive interests" (Gasparski and Strzalecki in Cross, 2001: 6). In this respect, Nigel Cross insists that such a 'science of design' should work around the reflective practice of design, where different forms of knowledge should be taken as a basis to develop *designerly ways of knowing*. Since the disciplinary frontiers of design are still blurred, some authors have also suggested to think design in terms of specialised areas of research such as: design epistemology, design praxiology, design phenomenology, and design taxonomy (Archer, 1981; Salinas, 2003); whereas others prefer to look at design in terms of general themes such as: design practice, design products, design discourse, and design metadiscourse or study about the design studies (Margolin, 2005). The idea behind these general themes, in particular, seems quite clear: if design is located at the intersection of so many fields of knowledge the safest approach is to look for subjects of interest instead of particular disciplinary practices. This is especially pertinent since design has moved into "...the realms of philosophy, of explanations of the world and understanding of the times" (Aicher, 1994b). This thematic approach nurtured with contributions from different disciplines is indeed characteristic of the present study.

1.3.2. Semiotic methodology and design

Beyond its definition as a 'science' (Saussure, 1980; Nadin, 1981) or as a 'doctrine' (Peirce in Eco, 1995), **semiotics** is the study of signs and the way in which the meaning they convey is transmitted and understood. Thus, its subjects of study are systems and processes of signification (Fabbri, 2000): processes of meaning production and reception. In more technical terms, semiotics can be also defined as the theoretical discourse about semiosic[33] phenomena (Eco, 1986), i.e. a system of study by means of which research can be made about signs and the actions mediated by them. This is perhaps the best definition of semiotics since for some authors it is either a consolidated discipline (Fabbri, 2000) or a science about the production of meaning (Nadin, 1981; Verón, 2002; Danesi, 2004); whereas for others semiotics is neither a discipline nor a science but just a mode of analysis (Chandler, 2005).

The understanding of semiotics as a study or discourse rather than as a discipline finds its reason in the fact that there is no such a thing as a unified method to do semiotics (Chandler, 2005). Indeed, methods may vary with each semiotician and the theoretical premises in which they stand on. What semiotics actually provides is a general structure in which different methods seek their own niche (Bopry, 2002). Thus, semioticians study signs in all its forms and manifestations – linguistic and non-linguistic, human and non-human, normal and pathological (Morris, 1974; Sebeok, 1976 and 1996; Deely, 1990). Therefore, their methods and views are rooted in fields such as linguistics, philosophy and psychology. And, even though, many semioticians use terms borrowed from linguistics, the way in which they use them clearly shows that they are more interested in the abstract notions behind them than in their mere linguistic entailments (Sonensson, 2004).[34]

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33 A clear distinction should be made between the adjectives 'semiosic' and 'semiotic'. The former alludes to situations in which sign processes (semiosis) take place, whereas the latter refers to the study of how those sign processes come to life.

34 For a further discusion of these issues see section 2.2.2. of next chapter.

The considerations previously outlined, however, do not intend to suggest that there is an absolute lack of common features among semiotic studies. Indeed, it can be said that there are six generic features behind any semiotic study. The first of these has to do with an understanding of signs as bifacial entities (Barthes, 1969; Sebeok, 1996). The second feature rests on the fact that all semiotic studies are not only preoccupied with the identification of the procedures underlying the reception (understanding) and production of meaning, but also with the identification of the meaningful units and categories involved (Greimas and Cortés, 1982). Thirdly, the units so considered are subjected to a detailed observation of their *similarities* and *differences* in order to unveil *meaningful relations* (Greimas, 1973; Lotman, 1982). Fourthly, as the goal is to unveil relations, the primary aim of semiotic studies is the production of models[35] capable of explaining sign situations (Kristeva, 1981), where the presence of particular examples is only a means to that end (Walker, 1989). Fifthly, semiotic studies are always placed within certain contexts and circumstances (Eco, 1986). Finally, semiotic studies are generally located in the crossroads between *signification* - i.e. the production of meaning - and *communication* - i.e. the use and diffusion of meaning (Eco, 1995).

In relation to the first feature above mentioned, it can be said that practically all the models about the inner structure of signs - from the Stoic philosophers to contemporary thinkers - conceive signs as comprised of something perceptual/sensitive or *aistheton* and something rational/conceptual or **noeton** (Sebeok, 1996). The presence of these two elements in the sign stops interpreters/beholders from taking only the sensitive part of the sign as if it were the sign itself. This also entails that every element of *expression* [i.e. perceptual] in a sign process leads to an element of *content* [i.e. conceptual] (Eco, 1994a). Thus, when designers outline the expression of a product (its shape, texture, colour, etc.) they are also acting upon its content (Taboada and Napoli, 1977). On the other hand, the expression and content of the signs involved are not of any kind. Its expressive means are linked to contents in such a 'form' to elicit only certain meanings in the mind of both the designer and the beholder/user of the artefact. Indeed, sign processes only take place in the *form* of the sign's expression and that

[35] The term 'model' is here understood as the formal representation whose structure is analogous to that of the phenomena under study.

of the sign's content (Greimas and Courtés, 1982), since in order to convey meanings signs need to assume some specific form.

This latter realisation led semioticians to consider the *expression* and *content* of signs as divided into *substance* and *form*,[36] so that each expression and content have a substance and a form of their own. As part of this division, the *form* is defined as something opposed to the *substance*, where the form is responsible for the identity and permanence of the substance, even though the substance is not necessarily of a material nature. Thus, the *substance of the sign's expression* is always material (e.g. a sound, an image, a physical feature of an object), whereas the *substance of the sign's content* is mostly immaterial,[37] encompassing the universe of all that can be thought or interpreted about signs (e.g. emotive, ideological or cognitive aspects of the sign's content). On the other hand, the *form of the sign's expression* refers to the juxtaposition or arrangement of material aspects (colours, shapes, sounds, etc.) of the substance of the sign's expression (Barthes, 1964b), whereas the *form of the sign's content* alludes to the way in which the substance of the sign's content is organised (e.g. what part of such a content is present or absent, highlighted or underestimated). Therefore, it is wrong to suggest that the 'central issue' of designing is only the *form* of the sign's expression (cf. Hjelm, 2002), since the sign's content has a *form* which is also defined through design.

In relation to the semiotic preoccupation with identifying units and categories of analysis, a clear example of categories widely is in Charles Morris' (1985) division of the study of sign processes (semiosis). In his view, semiosis can be assessed from three standpoints (see figure 5): a *semantic* one or study of the relations between signs and the things they refer to (e.g. cutlery as an extension of human hands), a *syntactic* one or study of the relation between signs (e.g. the relation between a stool and a chair as artefacts created for the act of sitting), and a *pragmatic* one or study of signs as used by their interpreters (e.g. the meaning of the white colour in a wedding means purity whereas in a war scene it means peace). Another quite illustrative example of general categories for semiotic analysis is that dividing

[36] It was the Danish linguist Louis Hjelmslev (1899 – 1965) who actually propounded this new theoretical division. Later on, Roland Barthes (1969) adapted this theoretical division to be used in the world of objects.

[37] It can also be mediated certain kinds of materiality - e.g. by words – (Barthes, 1969).

meaning into *denotative* (objective and value-free), *connotative* (associative, attitudinal and evaluative), and *myth* (arbitrary and intentionally distorted) (Barthes, 1972). In terms of the units of analysis there are plenty of examples. From those of general application like the *semes* (i.e. any surrogate of something) to those confined to particular areas of study such as *lexemes* for lexical expressions, *graphemes* for written linguistic signs, *gestemes* for gestures in body language, *kinemes* for patterns of body movement, *melemes* for units of melody in music, and so on.

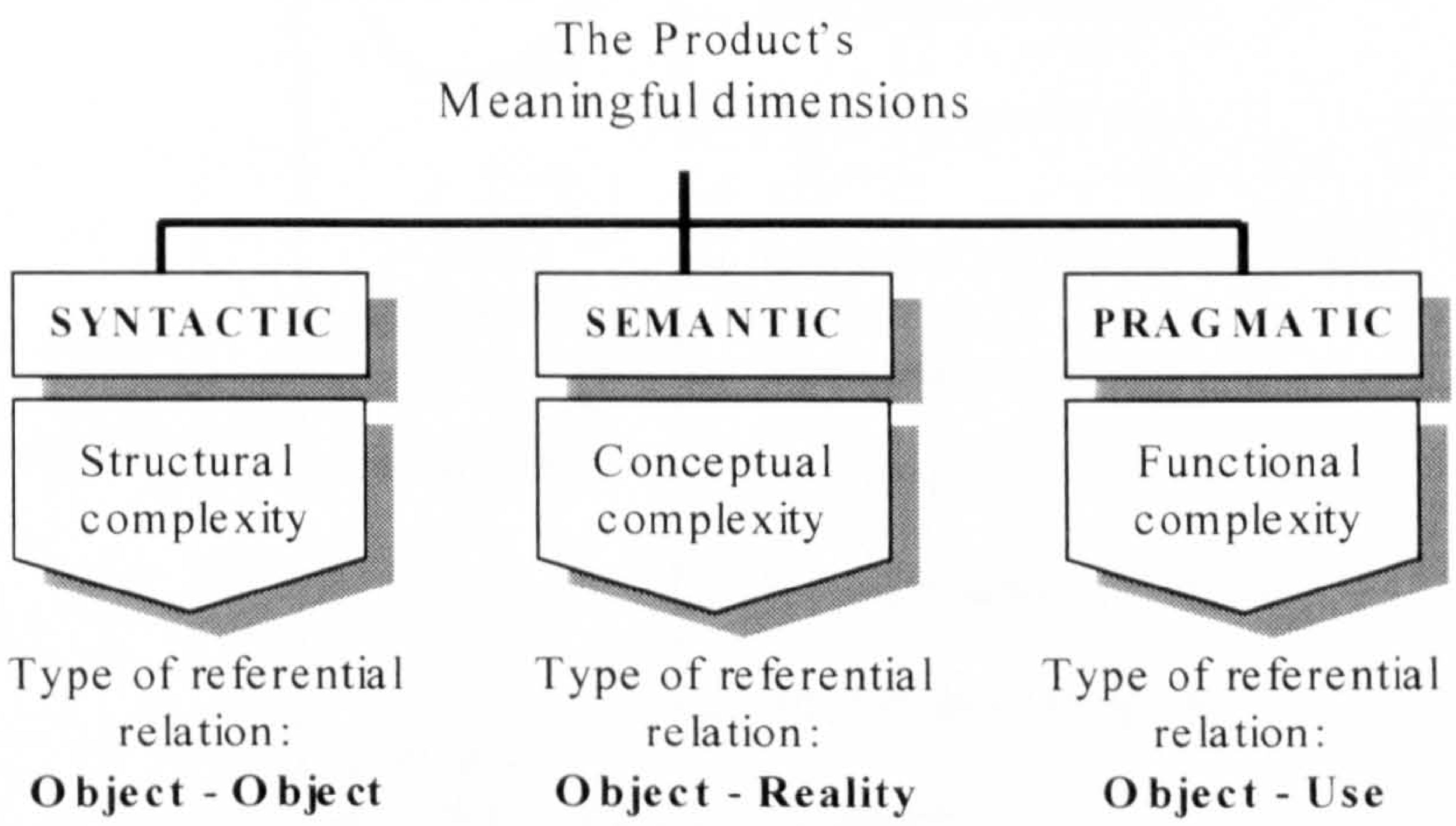

Fig. 5 – Categories for semiotic analysis according to Morris (1985).

The application of these categories and units of analysis to design has not escaped from criticisms. Klaus Krippendorff (1992), for instance, has suggested that the categories proposed by Morris outline an understanding of signs beyond human reality because, in his view, they disregard individual differences in favour of a universal understanding and use of signs. However, Krippendorff seems to forget that mass-produced objects such as those of product design could never be adapted to all the preferences and points of views of their potential users. Therefore, categories such as these should be pondered in terms of their contribution to reduce diversity based on what is common to the different users of a product (see figure 6). In relation to the units of analysis, authors such as Robin Kinross (1986) and John Walker (1989) have suggested that they are difficult to apply for the case of design. They seem to ignore that many adaptations have been already carried out to make them applicable to design. This is reflected in the formulation of terms such as *objectemes* (for the functional aspects of objects), *stylemes* (for culturally-rooted aesthetic configurations), *gestaltemes* (for our inborn capacity to perceive certain configurations) and *perceptemes* (for physical characteristics such as form and colour) in substitution of terms such as 'monemes', 'lexemes' and 'morphemes' - which refer to linguistic units (cf. Rossi-Landi, 1975; Bense and Walther, 1975; Pineda, Sánchez and Amarilles, 1998).

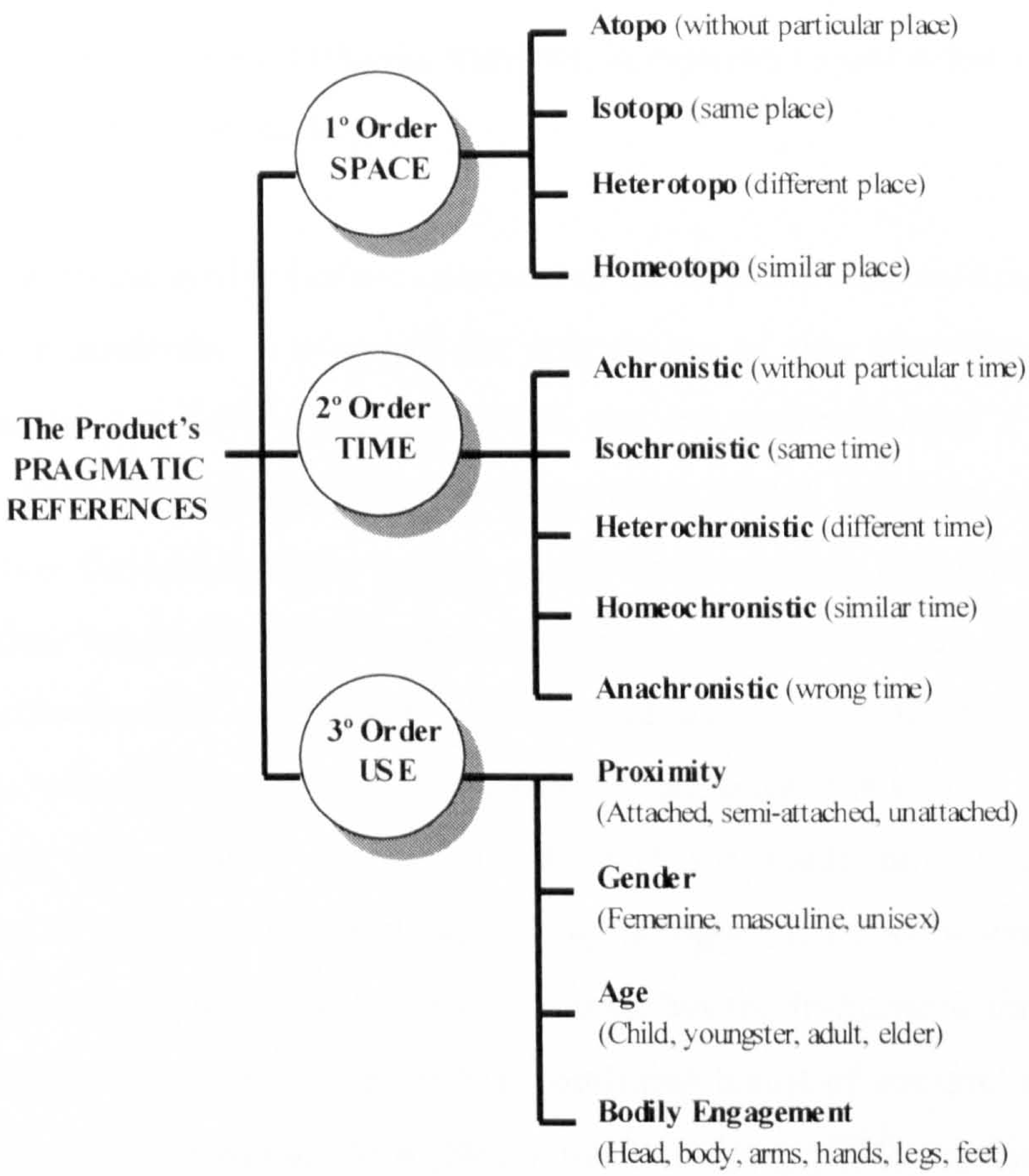

Fig. 6 – Pragmatic categories for the study of products suggested by the author.

In relation to the third relevant feature of semiotic studies (the determination of differences and similarities between the units involved), semioticians have explained that "...signs are constituted by differences" (Barthes 1964a: 159), since in order to establish a meaningful relation between units at least something in common (to allow comparisons) and something different (to stop us from comparing same things) is needed (Greimas, 1973). Indeed, this is an inevitable procedure in semiotics given that differences are part of the materilialization of signs (since different signs can be used to express the same meaning) and similarities are a natural part of the abstract systems semioticians create to illustrate what is constant among different signs (Lotman, 1982). Such a view is rooted in the linguistic approach of Ferdinand de Saussure,[38] but it has also found psychological support in George Kelly's (1955) theory of personal constructs, and Osgood, Suci and Tannenbau's (1957a) notion of Semantic Differentials.[39] Indeed, for Kelly, people formulate their interpretations of things according to dichotomous patterns based on equivalences and differences. Whereas for Osgood et.al., the nature of our concepts relies on how different they are in relation to our other concepts located within the same semantic space.

In relation to the fourth feature common to all semiotic studies, it is clear that since the aim of semiotics is to unveil the articulation of sign situations, models are its fundamental products. Thus, semiotics can be understood as a formal science (Nadin, 1981) of *nomothetic* nature (Sonensson, 2004), that is, a science that seeks to discover the general laws behind events and processes (Mautner, 1997). Hereby the models semioticians elaborate are not of any kind. They are basically cognitive and psycho-social,[40] as suggested by the founding fathers of semiotics. Indeed, for Charles Sanders Peirce a sign is something that, once it is known, help us to know something else (Peirce in Eco, 1989), and for Ferdinand de Saussure (1980) semiotics is definitely linked to social psychology. This is why semiotic models do not really attempt to reveal the world as it is, but the framework through which it is known (Sebeok, 1996; Merrell, 1998), outlining a sort of comprehension instead of an empirical or factual domain (Sercovich in Peirce, 1974). In this sense, *semiotic objects* (i.e. those theoretically determined by semiotics) are mere products of the meaningful relations propounded by the semiotic approach (Merrell, 1998).

In relation to the fifth relevant feature of semiotic studies, we should acknowledge that sign situations do not take place at anytime and nowhere. Within semiotics,

[38] Semioticians such as Greimas have acknowledged that part of their technique of analysis stems from the work of Ferdinand de Saussure (cf. Greimas, 1973).

[39] The similarities observed between Kelly's and Osgood's tests have misled some researchers to think that the latter was inspired by the former. Nevertheless, Osgood developed his approach based on the semantic relation between synesthesic images and language metaphors, whereas Kelly developed his approach to measure people's personality and be used in psychotherapy (cf. Osgood et.al., 1957a: 20 - 24 & 215 - 216).

[40] *Cognitive models* represent elements, processes and outcomes linked to sensations, perceptions and thinking; whereas *psycho-social models* represent emotional, habitual and gregariou aspects of behaviour (cf. Hasdoğan, 1996).

"...meaning can never be analysed in an isolated fashion" (Barthes 1964a: 158). This implies that no semiotician could take any final interpretative decision without a context and certain circumstances in mind. It is, indeed, a way to deal with polysemy (the variety of possible meanings that can be assigned to signs). The realisation of a context provides the abstract possibility of connecting signs to a meaningful whole (semiotic system); whereas the realisation of circumstances represent the abstract possibility of linking signs to the events in which they were produced (Eco, 1993). Thus, context and circumstances provide the minimal conditions for semiotic interpretation (Eco, 1986), and secure that only one meaning is taken into account out of the many possible. Otherwise, no pertinent interpretation could be achieved, provided the fact that sign systems are reversible (i.e. contents and expressions sometimes exchange roles within semiosis) leaving open the possibility of having an unlimited semiosis in interpretative terms (i.e. non-stop interpretations) (Eco, 1986).

Our fifth feature of semiotic studies has been also approached through theoretical distinctions such as that between *sense of the basis* or potential meanings of a sign, and *sense of the context* or actual meaning of a sign in a particular situation (Guiraud, 1976),[41] but more frequently through the notion of **Semiosphere**. This latter alludes to the particular semiotic space (context and circumstances) in which each semiosis/sign process takes place. Each semiosphere is characterised for having a kind of homogeneity and individuality in relation to the semiotic spaces external to it, and for having an abstract frontier defined by filters and translators whose functionality changes with the 'historical' moment (Lotman, 1984). As such, this notion was initially created for the semiotics of culture, that is, as a subdivision of the *Noosphere* or space of human ideas (cf. Chardin, 1967 and Morin, 2003). Nevertheless, it is now also applied to study other living organisms.

Finally, we have the sixth feature common to all semiotic studies: the location of semiotics at the crossroad of signification and communication. In this respect, some things should be clarified. Firstly, there is signification when a material or perceptible thing represents something to someone according to certain 'rules' or known interpretation (e.g. one based on experience). Secondly, there is

[41] The *sense of the basis* and *sense of the context* are also known by semioticians under other labels such as those of *sense* and *sense effect*, *sense* and *signification*, respectively (Guiraud, 1976).

communication only when the perceptible thing above mentioned is used by someone (a sender) to elicit a particular interpretative response (effect) in its receiver (Eco, 1995). Let us not forget that "every message is the encounter of a level of expression... and of a level of content" (Barthes, 1963: 173), and as such messages can only take form thanks to someone. Therefore, not all sign processes are about communication. There can be signification without communication, but no real communication without signification. In this sense, a separation between a *semiotics of signification* and a *semiotics of communication* is not desirable at all (Eco, 1995), even less within design (cf. Byrne, 1990). Design should communicate, and in order to do it should also signify. This is why theoreticians like Tomás Maldonado (1961a) suggests types of communication for design which clearly involve signification (see Maldonado in "The Peircean Object", section 2.2.4.of next chapter).

1.3.3. Empirical testing and design

As the outcomes of semiotics are mainly units, categories and relations encapsulated as part of theoretical models, some semiotic claims may require the intervention of empirical methods from other fields to be tested. In the particular case of design concepts, no other methods are more pertinent than those from psychology. Indeed, concepts are mental entities and the aim of psychology is the study of mental life (Wallon, 1985; Miller, 1970). Since design is an activity fundamentally directed to the satisfaction of its users, its products should not only signify but also communicate. Therefore, psychic aspects of design such as those of concept ideation can be tackled either as part of cognitive psychology (especially when they are studied in terms of signification) or as part of the psychology of communication (which also involves cognitive aspects).

Whatever the branch of psychology we prefer, the most popular methods for this sort of studies in design have been either the observational or the experimental one. In the *observational method* the situations under study are witnessed and registered in video and audio recorders for a period of time (Girbau, 2002). These recordings are then transcribed (including the verbal and non-verbal), classified (according to certain system) and later quantified in terms of frequency. The data so gathered is then processed using a conventional statistical analysis (such as sequential analysis or the comparison between arithmetic means) in order to outline a pattern. In the *experimental method*, on the other hand, the situations are modified in order to study them under special circumstances (Rivera, 1978). To this aim experiments are devised to take place under ideal conditions, that is, controlling some of the elements playing a part in the situation under study. Thus, information is gathered and classified according to certain format and subjected to statistical analysis.

Observational studies in design, however, tend to bear some similarities with the experimental ones. The most relevant of these is the development of the observations in locations different to those in which the subjects under study normally design (i.e. any place different to their actual studios or offices). That is to say, controlled rooms (e.g. isolated from noises and distractions) equipped with video and audio recording means. Another important aspect is the assignment of tasks to the subjects under study instead of observing them working with any of their actual projects. These are tasks that, besides being artificially imposed, should also be accomplished within a limited extent of time by which the subjects' normal pace of work is actually disregarded. However, we can still designate as *observational* this kind of studies, provided that it is the observation of the design process - strictly as it develops – the main focus of attention.

With the above modifications, observational studies seem to be quite popular among the researchers interested in the design process. Most of these studies have been developed around a technique known as *Protocol Analysis*. Such a technique involves the formulation of experiences where a design task is assigned to a subject (either professional or novice) to be solved during a period of time, drawing sketches and thinking out loud every consideration, step and decision taken as part of this task. The whole process is audio and video recorded. Once finished, the data so gathered is transcribed and analysed, establishing the type, sequence and frequency of use of different sorts of information and the operations applied at each state of the sequence leading to a new state. Then, the consistencies and patterns of behaviour that were present during the design process are determined.

The results of such protocols have been traditionally represented through graphs comprised by nodes and lines which are called *Problem Behaviour Graphs* (PBG). In these latter, the states of information so observed are represented by nodes joined through lines and the operations used as part of these states subdivided into a sequence that runs from left to right and then down. Since the 1990s, however, another graph technique known as *Linkography* has also began to be used in relation to protocol analysis but for more than just presenting the sequence of events during the act of designing. According to Goldschmidt and Weil (1998), Linkography differs from other graph techniques in that it does not parse the verbalizations of protocols based on time units (e.g. 3-minute units) but grouping them as part of subject matter units, which are in turn parsed into chronologically ordered *design moves* (i.e. steps or operations which transform the design situation in relation to previous moves). Each *design move* is assessed in relation to the previous moves based on their similarity or closeness of subject matter, and related to those moves located after them in other units. The aim of this technique is to generate a link-pattern to see in what units or design episode is located the higher productivity of the designer, considering the links-per-moves ratio (Goldschmidt and Weil, 1998).

According to Eastman (1970), protocol analysis is useful to look for three kinds of information: (1) physical elements manipulated (design elements), (2) design constraints (limitations and attributes), and (3) the manipulations made on a design to deal with those limitations and fulfil those attributes. Thus, besides helping to outline processes, protocol analysis has also contributed to understand sketching behaviour (Scrivener, Ball and Tseng, 2000) and differences in terms of design expertise for concept ideation (Foz, 1973; Kavakli and Gero, 2001; Suwa and Tversky, 2001). However, this sort of analysis has a main drawback. It is a technique extremely elaborated, which has led to many studies with no more than one subject involved (cf. Eastman, 1970; Akin, 1979; Chan, 1990; Suwa, Purcell and Gero, 1998; Do et.al., 2000) and in some cases no more than six (cf. Foz, 1973; Tovey, Porter and Newman, 2003; Popovic, 2004).

This situation has turned design researchers toward the use of modified versions of *Protocol Analysis*, including some observations on team behaviour (Cross and

Cross, 1995) and quite a few unstructured studies (Ingram, 1980). Some of these studies even turn away from what observation is about, since their recordings are carried out after the design task has been accomplished instead of during its execution. Among these retrospective techniques of protocol analysis we ought to mention the use of questionnaires (Visser, 1995), interviews (Darke, 1978), analysis with predefined categories (Suwa, Purcell and Gero, 1998; Dorst and Cross, 2001), and even self-introspection (Kraus and Myer, 1970; Galle and Kovács, 1992; Oxman, 1997; Suwa and Tversky, 1997). Many of them also involve the analysis of sketchbooks, mostly in qualitative terms.

However, there are also forms of protocol analysis in which sketchbooks have been the main focus of attention. Especially those carried out during the 1980s and 1990s about the role of sketching within collaborative design (Garner, 2005). In this respect, even a new research technique has been created for studying the contributions of individuals in design-team tasks: *Analysis of Graphic Acts.* A Graphic Act is the sketching and writing contribution that a member of a design team can make to a design task, which is separated by pauses or interruptions of less than one second of duration (Garner, 2005). During this type of observations, interconnected computers are used to register the particular contributions of each member of the team and participants are video recorded.

In relation to the experimental method, design studies have been developed for the characterisation of how designers think during the solution of specific tasks (Lawson, 1979), to define their individual style of problem solving (Eisentraut and Günther, 1997), to outline differences in terms of design expertise – i.e. Freshman vs. senior design students – (Atman et.al., 1999), to explore the designers' activity as part of interdisciplinary teams (Austin et.al., 2001), to assess the designers' use of drawings/sketches during designing (Verstijnen et. al., 1998; Rodgers, Green and McGown, 2000), the designers' use of verbal expressions to characterise products (Lenau and Boelskifte, 2005), and their capacity to criticise and grade design proposals (Ulusoy, 1999). Experiments to quantify originality have also been developed (Malhotra, Thomas and Carroll, 1978; Shah, Vargas-Hernandez and Smith, 2003). The data recollected in these experiments is quantitative (number of drawings, number of words, number of solutions, etc.) and therefore, also subjected to statistical analysis. On the other hand, despite experimental studies are considered to be 'artificial' in relation to the observational ones, they have the advantage of involving more participants (in most studies around 20 subjects), which creates more reliable results. This latter fact, together with its flexibility to deal with particular variables, favours the use of the experimental method for the verification of the semiotic model developed in the present study.[42]

[42] It is important to acknowledge that the studies here mentioned only describe situations where designers intervene as participants. There are also experiments with consumers/users as part of design studies. Nevertheless, their characteristics and results are of no interest for the present research.

Chapter 2

A literature review of antecedents about Design Concepts and Reference

The previous chapter clearly stated that the subject of this research is the way in which meaning is constructed as a part of design concepts. In order to review the literature about meaning construction and design concepts, this chapter is divided into two parts. The first part offers the reader what has been published about design concepts and what can be deducted from it. The second part, on the other hand, is entirely destined to present, explain and even appraise the contribution made to design by the best known theories about meaning construction in utilitarian objects and design products. To this latter aim theories are organised in such a way to progressively introduce their particular terminology and theoretical complexities.

2.1. An inquiry into design concepts

One unfortunate reality about design concepts is the lack of an extensive bibliography especially dedicated to this subject. Indeed, design concepts are commonly presented as part of small sections, and in the best cases as whole chapters, in books with a wider scope. In journal articles the situation is not better since they focus more on the design process as a whole than on design concepts. Therefore, in the following pages an effort has been made to synthesize what has been asserted about design concepts in order to achieve a working definition of them for the present research.

2.1.1. Six milestones on the way to the definition of design concepts

There is an open disagreement among design theoreticians and historians about whether the first utilitarian artefacts of humankind can be considered as design creations. For authors such as Geoffrey Broadbent, Peter Dormer, Herbert Simon, Victor Papanek and designers such as Ettore Sottsass, humans began to design from the moment they created their first objects, even though such a process did not involve previous drawings or models to pre-visualise things before their construction. As such these authors seem to follow the idea that designing is about thinking before acting through any sort of plan, as suggested by methodologists like Rittel (1972).

In order to substantiate this view Broadbent (1988) acknowledges the Neolithic period as a pragmatic phase of design, Dormer (1993) relates design to all ascendant civilizations, and Sottsass (1973) envisages the utilitarian artefacts of primitive societies as derived from design since their construction responds to an adequate sequence of pre-established steps. Simon (1992), on the other hand, conceives any action aiming to transform an existing situation into something else as the case of design, and professionals from such diverse fields as architecture, economics, laws and medicine as designers. Differently from this, Papanek (1984) circumscribes design to the transformation of the environment and, by extension, of mankind, through the creation of objects.

In clear opposition to the above view there are authors like John Walker (1989), for whom the historical roots of the term *'disegno'* show that design actually appeared with the physical modelling of plans through means such as drawings. Others like Paul-Alan Johnson (1999) argue that the understanding of design as an intervention upon existing things should lead us to place it in a time subsequent to that of archetypal objects. Most of the authors in favour of locating the historical origins of design after handcraft, indeed, link design to the circumstances imposed by the Industrial Revolution (Ricard, 1982), particularly the technical division of aesthetic labour derived from it (Acha, 1990), and the need of overcoming the prevailing fixation on historical styles (Aicher, 1994b).

This second point of view seems also to be one of the reasons why researchers on concept design normally let aside any theoretical contribution previous to the 1830s, that is, before the decade in which the Industrial Revolution began to take over the manufacturing of everyday objects (Read, 1957a; Ferebee, 1970). Nevertheless, what we understand today as design concepts and design thinking could not be possible without the contribution made by philosophy to the understanding of the human mind (Arnheim, 1969; Daley, 1982; Bürdek, 1994; Gelernter, 1995; Aicher, 1994b). In this sense and keeping in mind some theoretical distances, only six philosophical milestones will be here succinctly revised. They have been commonly referred to in studies about creativity in art and design (cf. Arnheim, 1969; Wong, 1974; Moore, 1976; Tatarkiewicz, 1977; Daley, 1982; Papanek, 1984; Scruton, 1985; Bürdek, 1994; Aicher, 1994b; Gelernter, 1995; Senosiain, 1996).

The first of these historical milestones appears with the ideas of Democritus: a pre-Socratic philosopher of Ancient Greece, born around the year 460 BC. Of his work very few written testimonies remain. Among them there is a passage where he asserts that we are 'pupils' of the animals in the most important matters "...from the spider we learn about weaving and darning, from the swallow about construction... [from] the swan and the nightingale about singing by mimicry" (in Bernabé, 1988: 309). Such a passage is among the oldest registered attempts in Western culture to suggest the observation of nature as a primary source of inspiration for the ideation of man-made objects. Therefore, it brings about a way to see what a design concept can be made of.

A second important milestone can be found in the ideas of Plato (427–347 BC) and his pupil Aristotle (384–322 BC). The former introduces in the creation of artefacts (man-made objects) the notion of what nowadays is known as archetypes[43] whereas the latter outlines what is normally named as the essence in our utilitarian objects. The contributions of both thinkers have cast light on the way we understand basic functions of concepts such as categorisation. In the case of Plato, it can be said that his contribution tackles indirectly the theme of complex categorisations by referring us to some sort of supra-categories (that is, his archetypes).[44] In relation to Aristotle, his contribution to concepts is much more direct, involving simple and complex categorisations at the same time. As a matter of fact, Aristotle's ideas are nowadays studied in psychology as an approach to categorisation based on the recognition of defining features (Roth and Bruce, 1995).

[43] Plato never used the term *archetype* in his writings. Such a word is a paraphrase used by later scholars to explain the concept of 'form' developed by him (Lacruz-Rengel, 2001b).

[44] Indeed, the word *archetype* (form the Greek Arkhétupon = the first mold or type) conveys a way to categorised objects based on their historical antecendents.

Plato is the first Western thinker to provide a critical and systematic account of our imagination (Kearney, 1988). For him every object (natural or artificial) is 'created'[45] following abstract models (archetypes) that exists in a kind of parallel world to ours and whose objectivity relies in the fact that these models are independent from human thinking (Ross, 1951). Thus, according to Plato **archetypes** guide the work of artisans and artists without being totally apprehended in the materiality of man-made things (cf. Plato's *Parmenides,* 133ª and *The Republic,* X596b), provided that archetypes encapsulate all the alternative 'designs' that can be formulated for an object without transgressing that object's identity (Lacruz-Rengel, 2001b). The work of artists and artisans is then limited to 'imitate' in the closest possible way the content of the archetype of the object they want to 're-create' (Tatarkiewicz, 1977). However, a better interpretation of Plato's ideas about the creation of artefacts can be formulated following Jung (1990), since he understands any work based on archetypes as a conscious realisation of the parts of a reality that is there beforehand. From this perspective, Plato's ideas help us to understand that concept ideation derives from a progressive realisation of what artefacts are about.

Differently from Plato, Aristotle focuses his ideas about object creation on the objects themselves, in the immanent instead of the transcendent, that is, those physical parts or aspects of their actual configuration that help us to define them. Consequently, in his *Metaphysics* (1947), Aristotle writes that things do not differ from their own essence and that the essence of each thing rest in its form. To this assertion he adds that **essence**[46] and material manifestation are different things, even though the creation of any object responds to the union of both (*Metaphysics*, book VII, chapter 8). This is the reason why, for him, the difference between two models of chair, for instance, is located in their matter not in their essence since in their essence rests the principle underlying the different models of chairs. In this respect, the obvious relation between design concepts and Aristotle's ideas is the respect

[45] In ancient Greece the only ones considered to be creative were the poets (Tatarkiewicz, 1977). For the people of that time, artists and artisans only 'imitate' archetypes (in Plato's view) or express 'essences' (following Aristotle's ideas). However, the verb to create has been used to help the reader follow my argument.

[46] For Aristotle the essence of an object is its form, no its sensible or material manifestation.

that prevails in any design towards the object's essence. Indeed, designers always work around a basic idea of what the object's parts are or need to be.

Another historical milestone worth to mention in our way to the definition of design concepts can be found in the writings of a Roman architect from the year 25 BC: Marco Lucius Vitruvius. He wrote the only treatise on architecture that has survived from that historical period: *The Ten Books on Architecture*. Beginning the first chapter of his first book, Vitruvius puts forward the need of uniting theory and practice in any art. To this aim, he establishes the existence of two fundamental ideas for the architectural profession: the thing signified (*significatur*, in Latin) and that which gives this latter a manifestation (*significat*). The nature of these two aspects is explained by him asserting that the former (*significatur*) is the subject matter the architect will refer to; whereas the latter (*significat*) is a demonstration developed according to scientific principles (Vitruvio, 1991).[47] Thus, we find in Vitruvius an open declaration in favour of using theory to guide and even define any material creation in architecture (Krampen, 1979a). This is a statement that can be equated to the idea that all design objects come from a pre-visualization of what they are about (design concept) that guides the physical manifestation assigned to them by a designer.

Another important milestone in our definition of design concepts can be found in the writings of Leonardo Da Vinci. In 1508 he produced a series of notes about what we know today as creativity, including aspect such as the place of nature as a source for inspiration[48] and the need of uniting theory and practice.[49] Through these notes he explores an interesting combination of that on which Democritus and Vitruvius were insisting centuries before. However, Leonardo's most important contribution to concept design can be seen in his definition of **comune senso** (better known in Latin as *Sensus Communis*). According to him, it is a sort of sixth sense in

[47] This idea is expressed in Latin as follows: *"Significatur proposita res de qua dicitur. Hanc autem significant, demonstratio rationibus doctrinarium explicita"* (quoted in Krampen, 1979a: 194).

[48] Besides referring to the observation of nature as a source of knowledge for men, Leonardo studies and writes about birds in order to build a flying machine (García de Zúñiga, 1997).

[49] In this respect, Leonardo writes: "Practice should always be built uppon a good theory" (García de Zúñiga, 1997: 40).

charge of judging the information coming from the five Aristotelian senses: sight, hearing, smell and taste (García de Zúñiga, 1997).

The idea of *comune senso* was originally formulated by the ancient thinkers, who pointed out that its location was in people's head (Leonardo in García de Zúñiga, 1997). And even though, Leonardo never directly suggested that it plays a role in creativity, his understanding of *commune senso* as a judging capacity of everything that we perceive, filter and store in our memory[50] shows how important it may have been for him, especially to explain creative processes linked to the production of knowledge, objects and art. Thus, despite the fact that there is no direct indication of design concepts resulting from the *comune senso*, the mere acknowledgment of such a capacity is in itself a clear sign of the role Leonardo assigned to personal judgements (subjectivity) in the creative arts. As a matter of fact, he is not alone in this view since even authors from the 20th century agree that designers' judgements and decisions are largely controlled by their personal experience and their understanding of the world (cf. Gelernt, 1973; Darke, 1978; Eekels, 1982 and Irigoyen-Castillo, 1998). This is a view of the role of subjectivity in design that becomes even more interesting in the light of the conjunction between theory and practice supported by Leonardo and the audacity present in his nature-based designs.

A fifth milestone on the way to design concepts can be located in the writings of one of the most conspicuous and influential philosophers of modern times: Emmanuel Kant (1724 – 1804). In his *Critique of Pure Reason* (1952), he developed a theory of knowledge that resembles in some aspects what some contemporary authors have asserted about the way designers think. In this respect, Kant (1952) suggests that knowledge is comprised of intuitions and concepts, where intuitions are of two kinds, either empirical or pure. The former comes from our contact with the physical world (that is from our sensations); whereas the latter exist before hand and on the fringe of our contact with the material world. Bearing this in mind, Kant asserts that during our process of knowledge construction we organise

[50] About this point, Leonardo writes: " Comune senso judges things transmitted to it from the other senses... The outer objects send their images to the five senses, these are transferred from here to sensibility and perception, and then to the comune senso... [where] after they are assessed, they pass to memory..." (García de Zúñiga 1997: 22 - 23).

our *empirical intuitions* in space and time, which are considered by him as *pure intuitions.* The empirical intuitions so organised are then assessed by our thinking and used to generate concepts.

The elements of this philosophical description, in spite of not complying with the scientific rigour of psychology nowadays, help us to realise the relevance of intuition in the formulation of concepts. This was an idea worked with a special emphasis in the early days of the Bauhaus School of Design (Rykwert, 1968; Sless, 1981; Miller, 1994), experiencing a renewed interest during the 1960s through the research on 'black-box' design methods (cf. Gordon, 1961) and theoretical formulations from authors such as Peter Collins (1970) and Jane Darke (1978) - for whom intuition is at the basis of design. It has also been the subject of theorisations about the nature of art by authors such as Benedetto Croce (1973), Herbert Read (1957b) and Susanne Langer (1966).

The last antecedent in our way to design concepts is in the ideas of the German philosopher Georg W. F. Hegel (1770–1831). His writings are said to encapsulate the most systematic and complete aesthetic theory of modern times (Shapiro, 1995). Indeed, his *Lectures on Aesthetics* are considered, by authors such as Ernst Gombrich, as "...the first attempt ever made to survey and systematize the entire history of art" (quoted in Carrier, 1995: 14). Hegel structures his doctrine about the types of art standing on the existence of what he calls the *Idea.* Contrary to the metaphysical definition of an idea, Hegel defines his Idea as the concept from which works of art originate and at the same time as the physical manifestation of them.[51] In other words, the Hegelian Idea is the addition of the concept plus the material reality that derives from it (Inwood in Hegel, 1993), to the extent that "...the Idea, and its plastic mould as concrete reality, are to be made completely adequate to one another" (Hegel, 1993: 80). With this in mind, Hegel describes the genesis of forms in art as depending upon the way in which the Idea is apprehended as an artistic content. Thus, for him, the Idea relates to its outward shaping in three possible ways: as a *Symbolic Form,* understood as an experimental type of form whose expressiveness is in the search to be but which has not yet reached an

51 In this respect Hegel asserts: "...the Idea as the *beautiful in art* is at once the Idea when especially determined as in its essence individual reality, and also an individual shape of reality essentially destined to embody and reveal the Idea." (Hegel, 1993: 80).

adequate embodiment for the Idea; as a *Classical Form* or that coming into existence when a free and adequate expression of the Idea takes place; and as a *Romantic Form,* which reflects the destruction of the adequate union achieved between Idea and material reality as part of the Classical Form, bringing along a sort of antagonism between the two of them.

If we analyse Hegel's theoretical position in the light of the subject of this research, we can hardly say that the Hegelian Idea is equivalent to what we know as design concepts given that it includes the material reality through which it is expressed, denying the possibility of this being understood as a concept in its own right, that is, as a mere mental representation. Nevertheless, design concepts and Hegel's Ideas have something in common: both highlight the need of working around the relation of correspondence that exists between the material realities that are supposed to be derived from them.

2.1.2. The design concept in the specialised literature

Even though some theorists do not see any reason to inquire about design concepts before the 1830s, there are some important facts about them which belong to the previous centuries. Indeed, a close reading of Leonardo Da Vinci's writings and Giorgio Vasari's biographies of painters, sculptors and architects shows that the notion of design concepts - as we know it nowadays – emerged during the Renaissance. There are three facts supporting this thesis. Firstly, the Renaissance is a historical period characterised by the 'self-conscious awareness of consciousness itself' or focus on the human way of understanding reality beyond pre-ordained dogmas of knowledge (Gelernter, 1995). Indeed, Leonardo (1997) exhorts the men of science of his time (historians, mathematicians and poets) to see things with their own eyes before writing about them. Similarly, within the arts, few things were more important than the development of the artist's own ways to encapsulate reality (cf. Vasari, 1978; Gombrich, 1998). Secondly, during the Renaissance there was a drastic change in the ways of understanding the sources of creativity. As a matter of fact, artists and architects took their design ideas either from personal insights or from personal perceptions of nature instead of from pre-established doctrines and acceptable codes of practice as happened in the Middle Ages (Tatarkiewicz, 1977;

Gelernter, 1995). And thirdly, before Renaissance the drawings and models developed as part of the act of 'designing' (or what we call *design* nowadays) were conceived more as means to show how a design will be built or look at last than as a means to reflect and nurture the creative process from which design proposals emerge (Gelernter, 1995; La Puerta, 1997; Gombrich, 1998). Insomuch that the use of drawing can be said to have changed during Renaissance from being a mere language to become a way of thinking (LaPuerta, 1997). This is the reason why Leonardo (1997) sees painting as 'mute poetry' - given that poetry was understood in Ancient Greece as the creative activity par excellence (Tatarkiewicz,1977)[52] - and Vasari (1978) begins the biographies of most of the great artists of the Renaissance alluding to their ability to draw.

In this sense, the Italian terms *schizzo* (origin of 'sketch') and *disegno* (origin of 'design') are among the oldest known expressions in the Western world to refer to design concepts. Both were coined during the Renaissance. *Schizzo* was used to refer to the first strokes that help define a design (La Puerta, 1997). The word *disegno*, on the other hand, was used to talk about the drawings expressing the idea from which an artwork originates (Hauffe, 1998). The correspondence with the idea of thinking implicit in the term *disegno* might be the reason why it became more popular than *schizzo*. Indeed, the term *disegno* also became the source of theoretical distinctions like that suggested in 1607 by Federico Zuccari between *disegno interno* or first design idea prior to its graphic manifestation (i.e. a *design concept* in its pure sense), and *disegno esterno* or graphic presentation of a design idea according to practical, technical and professional requirements (LaPuerta, 1997). Such a linkage to the act of thinking may also be the reason why *disegno* was the term chosen and translated in England to designate what we have called *design* since the 16th century onwards (Hauffe, 1998). However, it was not the only term used to allude to *design concepts* in the centuries following the Renaissance.

In the second half of the 19th century, the French terms *Croquer* and *Le Parti* also became very popular to designate design concepts. The former was used by theorists of architecture such a Julien Guadet (1834-1908) to allude to the freehand drawings derived from the detail assessment of something during the act of

[52] Indeed, Leonardo (1997) sees painting as mute poetry and poetry as blind painting.

designing (LaPuerta, 1997). The latter, on the other hand, is said to come from the École des Beaux Arts of Paris where *Le Parti* was the name given to the first sketches developed to define the configuration of design proposals (Ramírez, 1987). According to Paul Grillo (1960), the meaning of the word 'Parti' is *decision.* However, there are those who assert that its real meaning is 'selection' because it implies that a design proposal has been chosen from several alternatives developed beforehand (Bermúdez, 1993).

In the particular field of industrial arts (product design), there is written evidence suggesting that design ideas literally assumed the form of concepts during the early days of the industrialisation of our everyday objects. Indeed, by the 1850s it was common to think that, besides alluding to precedent styles of ornamentation, *design concepts* were in charge of making objects 'tell their own story' (*Journal of Design and Manufactures*, 1852) and communicate their purpose on a visual or symbolic level (Ferebee, 1970; Marcus, 1995). In this sense, the use of metaphors such as that of 'the Muse of Harmony and singing birds' on the decoration of a piano, for instance, as well as the use of motifs from nature as symbols, were the means to express concepts. There are also written statements from renowned designers of that time which also reflect this way of understanding concepts but in more practical terms than the above mentioned. Such is the case of Christopher Dresser (1973)[53] for whom decorative forms have a general expression capable of acting upon people's senses to induce effects such as: evoking repose in a bedroom or reflecting the sitting position of someone through the proportions of the different parts of a chair.

The beginning of the 20^{th} century brought along different insights to the definition of design concepts. In the writings of American pioneer product designers, such as Raymond Loewy (1951), Henry Dreyfuss (1955) and Harold Van Doren (1954), design concepts became closer to 'concepts' in advertising (i.e. advertising ideas).[54] This new way of understanding design concepts may have its roots in three main factors: The appeal that evocative (narrative) designs have for the American

[53] This is an edition of Dresser's book which was originally published in 1873.

[54] Norman Bel Geddes' *Horizons* (1934) and Walter Dorwin Teague's *Design Today* (1946) have not been included as part of this account because they do not provide explicit assertions about the way designers conceive their ideas during the design process.

consumer (Dormer, 1990), the diversity of choice that has historically characterised the American system of production (Heskett, 1980), and the influence exerted by the work of designers with experience in the commercial arts such as Norman Bel Geddes, Walter Dorwin Teague and Raymond Loewy. These three aspects moulded the product design scenario of USA during the first half of the 20th century as mostly preoccupied with the sales appeal of products. As a matter of fact, one should not be surprised by the role assigned to the sales appeal (particularly the product's appearance) in Henry Dreyfuss' (1955) *Five-Point Formula*, in Raymond Loewy's (1951) *MAYA stage* and advertising remarks about designing, and in Harold Van Doren's (1954: 38) views of design as dealing, among other things, with products "...metamorphosed in order to make former models obsolete". Such an approach to design concepts achieved its climax in the two decades following the Second World War; this being also the time when the *concept approach to advertising* took its definitive form (Hurlburt, 1981).

But besides the realisation of *design concepts* as more than just 'poetic' tools, this new approach also brought along some contentious views on concept ideation. Most of them stemming from the belief that design ends were always more important than the means and procedures needed to achieve them, locating those aspects different from the 'look' of the product in a second plane. In this sense, three curious aspects can be highlighted based on the writings of the American pioneer product designers. Firstly, they do not define the nature of what they name **rough design sketches** (or pre-concepts) and **preliminary sketches** (or design concepts). To the extent that it is hard to tell how different one type is from the other. Secondly, in their writings there is a lack of actual statements fixing the beginning and end of the 'visualisation phase' (their equivalent to the 'synthesis phase' nowadays).[55] And finally, the visualisation phase is mostly seen by them as a trial and error process, where sketches separately developed (i.e. sketches created by different people and from different ideas) are stuck together as if they were coming from the same basic idea or designer.[56] In this sense, the achievement of a final

[55] Indeed, when Dreyfuss (1955) describes 'How the designer works', he asserts that countless rough sketches are produced, arranged and re-arranged on the way to the actual technical drawings (orthographic views).

[56] Raymond Loewy (1951: 313) particularly refers the use of sketches of various design ideas in order to define a 'germinal direction' where "...those that show the greatest promise are studied

design was really down to the ability of the chief designers (Loewy, Dreyfuss, etc.) to master or guide the amalgamation of the diverse ideas produced by their subordinates.

For the professor of psychology E. F. O'Doherty (1963), nonetheless, the real problem about the understanding of any creative aspect of design up to the 1960s has its roots in the assumption of the term *design* in a two-tiered way. That is to say, as an artefact as well as a plan or conceptual creation.[57] Indeed, the idea behind design concepts really began to assume a clear separation from end-products with the *Design Methods Movement*. This is testified by the significant number of authors writing about design concepts from the 1960s onwards, many of them clearly inspired by the awaken concern on design methods. Such a concern brought about all sort of contributions, including those of authors who wrote about design concepts without providing any working definition of them (cf. Alger and Hays, 1964; Löbach, 1981; Quarante, 1992 and Cross, 1999). On the other hand, any survey of the literature on *design concepts* reveals that there is more than one term used to refer to them and that terms vary according to the background and ideological tendencies of their authors. This lack of uniformity has led us to consider the following 35 definitions as part of our review of the specialised literature on the subject. These definitions can be chronologically ordered and briefly summarised as follows:

- Morris Asimow (1962), a methodologist from engineering, uses the term **Design Concept** to allude to the abstraction in which ideas and forms are related to the particular circumstances of a problem using words, graphics and mathematical symbols to describe it.

- Christopher Alexander (1964), architect and mathematician, uses the expression **Constructive Diagram** to define the pattern which is abstracted from a real situation and serves as a bridge between the requirements of a problem and its formal configuration. In this respect, for Alexander, these *Diagrams* are the

in detail" and use in combination or arrangements with others for the development of automobile body styling.

[57] O'Doherty's statement was presented in the 1962 *Conference on Design Methods* that took place in London.

synthesis of two other types: *Formal Diagrams* (which describe only formal characteristics) and *Requirement Diagrams* (those summarizing the set of functional properties and constraints intervening in a project).

- Horst Rittel (1964) refers to **Design Models** as those abstractions of iconic (graphic) nature in which the data of a problem is combined with the designer's knowledge and experience to produce a design solution.

- Bruce Archer (1965), engineer and formerly professor of Design Research at the Royal College of Art (London), uses the expression **Design Idea** to talk about the prescription or model formulated in order to solve a design problem and therefore, define the materiality of a solution before it comes to life.

- José Menéndez (1968), architect and methodologist, uses the term **Concept Generator** to allude to the graphic expression of the understanding a designer has of a problem that defines the way in which his/her solution will be structured.

- William Dennis Cain (1969), an engineer concerned with the education of product designers, defines **Design Concept** as the "statement of the essential and main design features, having due regard to the feasibility of producing the [a] final article" (p.104). According to him, any designed article must contain a single dominant central concept and several secondary concepts which complement the former by helping to develop its individual features. In this sense, the design concept should present an integrated solution of the design problem.

- Gui Bonsiepe (1978 and 1985a), German product designer and theorist, calls **Project Concept** or **Design Scheme** the total formulation of a product that, stemming from analogies, morphologic considerations and methods such as Brainstorming, is expressed through schemes, pre-models and qualitative non-discursive codes (properties of the design product).

- Jane Darke (1978), an architect and researcher on local authorities housing schemes, names **Initial Conjecture** the first conceptualised image of a design solution originated from a broad initial objective or small set of objectives highly valued and self-imposed on the problem by the designer (called by her *Primary*

Generator). This *Initial Conjecture* is later tested against various requirements and modified if necessary.[58]

- Eskild Tjalve (1979), professor at the Technical University of Denmark and author of a design handbook, uses the term **Form Concept** to designate the proposals for the variation of a product's form (geometry), main dimensions and even choice of materials, expressed through free-hand sketches and according to the *basic structure* (scheme of connections between the sub-functions it accomplishes) and *quantified structure* (specification of parameters and relative arrangement for the product's elements or components) assigned to the product at stake.[59]

- Edward White (1979a), an architectural methodologist, uses the term **Architectural Concept** to designate the designer's response to a situation that, being outlined as part of a design programme (design brief), works as a means to translate a problem into a design solution.

- John F. Pile (1979), an architect, calls **Concept** the idea or group of ideas developed during the process of designing to represent the form of a physical object before its realization (construction).

- Gordon Glegg (1981), a consulting engineer and formerly lecturer at Cambridge University, sees the development of a design as comprised by three ideational stages: a **Basic Idea,** the **First Embodiment** of that basic idea and its **Contemporary Embodiment**. According to him, these three metaphorically correspond to 'a castle [plan] in the air', 'a castle in the ground', and 'a castle in the market place'; where the first two are sometimes easy to muddle in practice. Thus, the *Basic idea* is a generalised and abstract plan, its *Contemporary Embodiment* is the way in which that particular idea is put into a context of use

[58] In some parts of Darke's presentation of what the term 'primary generator' stands for the reader may get the impression that it is the same as a *design concept*. However, she clarifies that the 'primary generator' does not refer to the first conceptualised image of a design solution but "...to the ideas that generate it" (Darke, 1978: 330). That is to say, it is part of a previous stage to that where the design concept is actually outlined.

[59] According to Tjalve (1979), *Form Concepts* are really developed in two sequential steps: a first one where the number and arrangement suggested as part of the *quantified structure* are reconsidered, and a second one where the designer's work concentrates on form geometry, the main dimensions and the choice of materials.

and consumption, and its *First Embodiment* is a mediating idea which works as the common ground between the particular and the general way in which a design product is conceived (i.e. an idea between the *Basic Idea* and its *Contemporary Embodiment*).

- André Ricard (1982), a renowned Spanish product designer, calls **Generatrix Idea** (idea generatriz, in Spanish) the 'axis' – integrated by basic concepts – around which the morphological configuration of a design proposal is developed.

- Michael Joseph French (1985), professor of Engineering Design at the University of Lancaster (UK), uses the term **Scheme** to designate the solution outlined for a design problem "...carried to a point where the means performing each major function [of a product] has been fixed, as have the spatial and structural relationships for the principal components" (p. 1).

- Gerardo Rodríguez (1987), Mexican product designer, defines **Design Concept** as the collection of characteristics defining the idea behind a product in a diagram like or graphic format. Such a concept is, according to him, based on aesthetic criteria (formal aspects), structural criteria (interrelation among components and parts of the product), and functional criteria (technical principles).

- Óscar Olea and Carlos González (1988), two Mexican methodologists, name **Partido** (seemingly a Spanish word for the French 'Parti') the sort of conceptual synthesis resulting from the manipulation and arrangement of images in the designer's memory that works as the basis for the elaboration of alternative formal solutions to satisfy the different aspects involved in a design problem.

- Donald Norman (1988), a pioneer psychologist in the use of cognitive psychology to study design objects, calls **Designer's Model** the idea that the designer bears in his/her mind about the way an object (or 'system' in his jargon) should perform its function and how such a function is physically reflected in the configuration of that object (or system's image).

- Nelson Ramírez (1987), another academic of Architecture at Universidad de Los Andes (Venezuela), names **Architectural Concept** the essentially graphic expression of the solution of an architectural design problem, which communicates through a personal, spontaneous and instant language the qualities of a building in a holistic and syntactic manner using different degrees of abstraction.

- Eli Saúl Uzcátegui (1988), an academic of Architecture at Universidad de Los Andes (Venezuela), uses the expression **Concept Generator** to allude to the basic idea or model that defines the way a problem will be tackled to achieve a design solution in which an adequate correspondence among form, function and technique takes place.

- Horst Oehlke (1990), professor at the Höchschule für Formgestaltung at Halle (Germany), uses the term **Produktbild** (product concept) to refer to that part of the meaning and expression of products that alludes to the idea, images, experience and values that are introduced as part of them. In Oehlke's view the *Produktbild* is the counterpart of the *Produkterscheinung* (product appearance), which refers to the gestalt and all the perceptible properties and elements of the product.

- Willem Gilles (1991), an academic at the School of Industrial Design at Carleton University (Canada), uses the term **Ideation Sketch** to allude to the freehand "...rough visualisation of ideas and trials for design solutions" (p.119).[60]

- Stuart Pugh (1991), Head of the Design Division of Engineering at the University of Strathclyde (Scotland), calls **Concept** the representation of the totality or sum of all the subsystems and component parts that comprise a projected artefact. As such it is a graphic, diagrammatic or modelled representation mediated by the designer's general knowledge, his/her technological knowledge and the information gathered by him/her about the context of the designed artefact.

- Guido Bermúdez (1993), an academic of Architecture, calls **Concept Generator** the functional basis from which the fundamental idea of a design is built up.

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60 Gilles (1991) does not make any distinctions between rough *ideation sketches* and preliminary ones.

- Mike Baxter (1995), professor of Product Design, defines **Design Concept** as the principle that describes the way in which a product functions and looks, providing examples of its manifestation in graphic form.

- Rudolf Arnheim (1995), a psychologist with a variety of publications in art and design, calls **Goal Image** the mental representation expressed through sketches that shows how a product will be structured, based on the designer own ideas or ideas imposed by a design programme.

- Karl Ulrich and Steven Eppinger (1995), engineers and academics at the MIT, define **Design Concept** as the description of the form, function and characteristics of a product.

- Norbert Roozenburg and J. Eekels (1995), academics from the Faculty of Industrial Design Engineering of Delft University of Technology, call **Design Concept** the abstract idea that works as a solution principle, broadly encapsulating the properties that a product will contain (i.e. its parts and components as well as the shape and materials of each of them) bearing in mind considerations of appearance, operation (use), manufacturability, cost and technical functionality.

- Francis D. K. Ching (1997), author of a dictionary and a book on general principles of architectural design, defines **Design Concepts** as schematic representations of the designer's mental formulations on the form, structure and features of a building or construction.

- Jaime Irigoyen-Castillo (1998), an academic from the Universidad Autónoma Metropolitana of Xochimilco (Mexico), uses the term **Ordering Principle** or **Ordering Concept** to allude to the graphic or discursive manifestation of the way a designer organises and integrates data, images, ideas, perceptions and feelings in order to solve a design problem.

- Helene Karmasin (1998), Lecturer at the Academy of Applied Arts of Vienna, divides design concepts into *individualistic* (those extremely usable but also exceptionally tempting and glamorous), and *egalitarian* (those reacting against differentiation and the increase of non-functional levels).

- Warren Wake (2000), from the Boston Architectural Centre, calls **Design Paradigms** the physical metaphors of forms, mechanisms and assembly techniques that are used as visual and functional analogies to solve design problems.

- Mauricio Sánchez (2001), a Colombian academic of product design, defines **Design Concept** as the generative principle of a product's morphology that synthesises the idea or group of ideas used by a designer to integrate the utilitarian, technological and commercial aspects of it.

- Félix Sanz and José Lafargue (2002), a Spanish academic of Industrial Engineering and a Bachelor of Fine Arts respectively, use the term **Diagram of Interpretation** to allude to the graphic visualisation produced by the designer to express his/her understanding of the product requirements during the development of design alternatives.

- Elizabeth Olver (2003), a Professor of Jewellery Design at Central Saint Martin College of Design, defines **Design Concept** as the idea behind a design which is manifested in graphic form to communicate the intentions of the designer (what he/she wants to say to the public through his/her work). Insomuch that, in her view, a design concept hard to understand by the public may fail to have any appeal.

- Claus Hansen and Mogens Andreasen (2003), academics from the Department of Mechanical Engineering of the Technical University of Denmark, call **Design Concepts** the "answers" suggested to solve design problems which articulate, a as part of a single proposal, need/market-based ideas and design/realisation-based ones. The former ideas refer to the formulation of a new dimension in the product's marketing, a new way of satisfying needs and a use value; whereas the latter alludes to the form, structure or mode of action, needed to fulfil the required functionality.

2.1.3. A working definition of design concepts

A detailed assessment of these ideas leads us to two fundamental conclusions about the definition of design concepts:

a. From all the terms used to designate the subject of our inquiry, *design concept* seems to be the most neutral considering the diversity of theoretical tendencies and disciplinary backgrounds of the authors referred to as well as a term sufficiently descriptive of the things these concepts stand for.

b. Most of the definitions reviewed tend to assert at least two of the three following aspects of *design concepts*: what they are, what they are used for and how they manifest.

In relation to 'what a design concept is', all definitions coincide in assuming it as the result of the designer's capacity for abstraction, using expressions whose implications are semantically close such as: representation, description, pattern, translation, main idea, model and metaphor. In terms of 'the function design concepts should fulfil', the use of verbs such as: relate, combine, formulate, structure, arrange, integrate and organise lead us not just to the act of **composing** characteristic of any design, but also to the act of **configuring**. Both terms encapsulate a theoretical difference that should be clarified at this point. The composition of a design proposal refers to the total organisation of its components, i.e. its structuring character, from the Latin *componere* which means to "put together" (Ayto, 1991). This expresses the visual relations present in a design object (Scott, 1974). The idea of configuration in design, on the other hand, has to do with more than its final appearance as a composition: it also involves its content (Pastor and Echegaray, 1997; Wong, 1998). Therefore, the configuration of a product unites the idea of 'composing' (harmoniously arrangement of its parts) with the effect such a composition may, or is due to cause in its beholder or user (Löbach, 1981).

Indeed, the German equivalent to product design nowadays is **Produktgestaltung** (product configuration), and its so-called *Gestaltelemente* (elements of configuration) are classified according to the impact they have in the beholder's perception. Gestaltelemente are either *macro-elements* or those more consciously perceived - such as colour, form and material - or *micro-elements,*[61] i.e. those that even though are hardly seen as part of the object's general appearance are also perceived - such as the joints between components (Löbach, 1981). In this sense, to talk about *design concepts* in terms of configuration is another way to allude to their holistic character as well as a way to acknowledge the role played by the designer's intentions as part of them. Therefore, design concepts should also be understood as communicative tools between the designer and his/her clients, the designer and the public (who, in the case of product design, is generally different from the client), and the designer and himself/herself (as part of his/her own thinking process).

In this latter respect, the way design concepts manifest is also a very important aspect of how we understand them. Indeed, the use of terms such as diagram, look, iconic, scheme, model and image in the definitions previously reviewed is a clear indication of a pre-eminence of the visual over the other sensory modalities during the conceptualisation phase. It does not necessarily imply that, besides drawings and diagrams, no other means such as words and mathematical symbols can be used to express design concepts. It only highlights the idea that some means may be more relevant than others to express certain design concepts.[62] Indeed, the use of sketches as part of concept ideation normally arises from the need to manipulate ideas as if they were actual objects as well as from the need to foresee how the outcome of such manipulations will look (Fish and Scrivener, 1990). On the other hand, it is clear that, given the abstract nature of design concepts, they may also require the incorporation of words to express what images cannot express (Fish and Scrivener, 1990), even though design education tends to privilege the communication of design ideas through images (Tsow and Beamer, 1987). In this sense, design concepts which cannot be expressed either in words or graphically are virtually impossible to shape into actual products (White, 1979b; Bonsiepe, 1985a; Krippendorff, 1989).

In this same direction, we may also bear in mind that assertions such as that of 'one image says more than a thousand words' should be cautiously considered, since an

[61] Gui Bonsiepe (1992b) has referred the design of these 'micro-elements' as a job at the level of the *aesthetic micro-structures of product design.*

[62] For authors like Glegg (1981) the means of representation may vary according to whether the design ideation is more imaginative (intuitive), evolutionary or systematic.

image capable of expressing many things at once may also end up expressing nothing in particular. This is the reason why most designers place words together with their sketches to add more precision to the communication of their ideas. As a matter of fact, design practice teaches us that the presentation of design concepts using means with limited or ambiguous communicative attributes (e.g. only drawings or only words) is a privilege mainly reserved to consecrated designers – i.e. those who already count on their clients' trust. Therefore, the most recommended practice is the use of drawings (the more three-dimensional the better) combined with words (Pugh, 1991).

Having stated the nature of these three aspects, we can define a **design concept** as:

> *A holistic and mostly graphic description of: (1) the physical configuration that will prevail in a design product, (2) the mental associations from which it has emerged and (3) the innovative intentions of its designer* (understanding innovation as the act of creating something different or new).[63]

Therefore, any design concept should:

(i) DESCRIBE the product as a whole (its materials, forms and other properties).

(ii) EXPRESS in an explicit way the associations and design intentions from which the product was born.

(iii) SUGGEST a 'general pattern of order' for the product. That is to say, provide explicit clues about the location, proportion and combination of materials, forms, colours, finishes, etc. in order to guarantee a clear expression of the mental associations and design intentions encapsulated as part of that concept.[64] In this respect, any variation to a concept's pattern of order may lead to a totally different concept.

Besides this, it is important to acknowledge that successful design concepts generally answer, in an explicit manner, questions about the product such as: what

[63] A substantiation of this definition of 'innovation' is presented in chapter 4.

[64] The expression of the designer's mental associations and intentions should be obvious because, differently from the aesthetics of art, the aesthetics of design has to do with the daily sensibility of men as part of their search for use-value in design objects (Acha, 1990).

does it seek to solve? who will be its end user? and, what is the difference between the proposed product and the others? since successful products tend to be, in some respect:

a. USEFUL, by presenting promises of use-value clearly identifiable.
b. PERTINENT, by responding to the culture of which it is part, i.e. its context of use and user.
c. ORIGINAL, by keeping a harmonic balance between novelty and familiarity, complexity and simplicity.
d. PERSUASIVE, through its capacity to convince people about its usefulness and its suitability to satisfy users' expectations.
e. COMPETITIVE, by allowing its user to perceive the features and benefits it offers in relation to those of other products in the market.

2.2. An inquiry into Reference and its theoretical use in design

Having achieved a working definition of design concepts for the present research, the other job we need to accomplish is that of outlining how meaning is built in relation to utilitarian objects and products. Since meaning is here understood as the abstract[65] outcome of using something (a sign) to stand for something else (a referent), our approach will involve ideas from fields as diverse as philosophy, linguistics, semiotics and design theory in its own right. Thus, this literary review will begin with the philosophical origins of the notion of reference. Then, our review will progressively move towards design through theories of semiotic, aesthetic, and socio-cultural nature.

2.2.1. The theoretical roots of reference

The first philosophical reflections about reference take us back to Greek philosophers such as Plato and Aristotle. But it was really with the Stoic philosophers (300 BC – 300 AD) that the distinctions between *signification* (i.e. the process by which meaning is produced) and *reference* (i.e. the act of referring to something as part of meaning) used nowadays were stated (Eco, 1994a). As a

[65] *Meaning* is abstract because we cannot attain it directly through our senses, only through its manifestations (Christensen, 1968).

matter of fact, they proposed the consideration of three aspects as part of signification (Eco, 1994a): the **semainon** (a physical sign), the **semainómenon** (what is said about the sign and therefore something which is not physical) and the **pragma** (that to which the sign refers: an event, action or something physical). This is a distinction that has been put forward several times with different names throughout the history of the philosophy of language and linguistics, becoming later an object of study also in psychology. However, the way in which *reference* is studied nowadays is inspired by ideas originated between the end of the 19th century and the beginning of the 20th century, particularly the works of Gottlob Frege (1892), and that of Charles Ogden and Ivor Richards (1923).

Frege was a Professor of Mathematics at the University of Jena and the intention behind his writings was "...to enable the theorems of mathematics to be expressed in such a way as to do justice to their content" (Currie, 1982: 95). His ideas, however, are taken to be the foundation for modern semantic investigations (Currie, 1982). In 1892 he published an essay entitled *Über Sinn und Bedeutung*[66]. Here, he proposes that signs (names, set of words, or any other written signs) should be seen as designating something – that he called *Bedeutung* (translated into English as 'Reference') – in a certain manner – which he called *Sinn* (translated as 'Sense'), and where reference is "...neither a concept nor a relation but a particular object" (Frege, 1892: 51). Thus, for example, when one uses expressions such as 'Morning star' or 'Evening star' to name the planet Venus, the expressions themselves are *signs*, their *reference* is what these two expressions name (i.e. planet Venus) and their *sense* the ways in which each of those expressions or signs indicate such 'reference', that is, equating planets to stars and acknowledging the fact that they were seen either in the morning or in the evening. This is the reason why Frege suggests that whereas each 'expression' (or sign) has a distinctive 'way' of being presented (or sense), the 'object' (or reference) they indicate can be expressed through the use of different 'expressions' (or signs).

Thus, Frege's theory seems quite clear: A sign stands for an object or 'reference' according to the way or 'sense' in which it is presented (Currie, 1982; Eco, 1994a). Such clarity, however, is due to the fact that words, symbols and numbers would

66 This essay has been translated into English as "On sense and reference".

never be the same than the things they represent. But when it comes to objects two basic problems appear for its application. Firstly, it leads to two possible interpretations: that of reference as a sensible object (a *token* or example of something), and that of reference as a *type* or class of object (Eco, 1994a and 1995). Secondly and as a consequence of its first interpretation, Frege's reference has always a truth-value.

When Frege's reference is defined as a particular physical object, it is practically impossible to spot any difference between his reference and the physical expression of that reference (sense) provided that both are physical (e.g. an object with worn materials, worn colours and worn finishes standing for a worn object). On the other hand, when Frege's reference is understood as a class or type of object there is always the risk of taking a design concept for Frege's object, since design concepts also encapsulate types of objects as part of their definition. Therefore, in order to use this second approach one would have to be very cautious because, even for Frege, references and concepts are two different things (Frege, c.1892-1895). Finally, in relation to Frege's understanding of reference as having a truth-value, the obvious problem for designing is that it leaves out the use of features from non-existent things (such as cartoon characters or futuristic situations), limiting the designer's capacity to create new products. Thus, even though Frege's approach is a historical milestone in the understanding reference, it is definitely not suitable for product design.

Another theory that helped to popularise the use of the term *reference* in studies about meaning is that of Charles Ogden and Ivor Richards (1923). Differently from Frege's ideas, their notion of *reference* was developed as a result of their study of the relationship among thoughts, words and things. In their view, words stands for things as part of a triadic cycle where each *symbol* (word)[67] we employ while speaking causes a thought or **reference** in the listener, which in turn relates it to a **referent** (a thing) in a direct (when we are alluding to something present) or indirect manner (when we are talking about something which is absent). Hereby,

67 The use of the term 'symbol' instead of 'sign' in Ogden's and Richards' view is due to their focus on conventional signs (words). Nevertheless, in their book *The Meaning of Meaning* (1923) they draw a clear distinction between signs and symbols, looking at the latter as special kinds of the former that people use to communicate with each other as well as to think.

what Frege calls 'reference' is for Ogden and Richards the 'referent' provided that they define 'reference' as the thought elicited in the mind of the listener by a symbol (word) – see figure 7. This allows *reference* to vary according to the context and circumstances in which it is conceived. So that when we say, for instance, 'the King of England' and 'the owner of Buckingham Palace', two different references are used for the same referent. This is the reason why in Ogden and Richards' view, a symbol can only be substituted by another symbol when it complies with two conditions: It should have the same referent and the same reference.

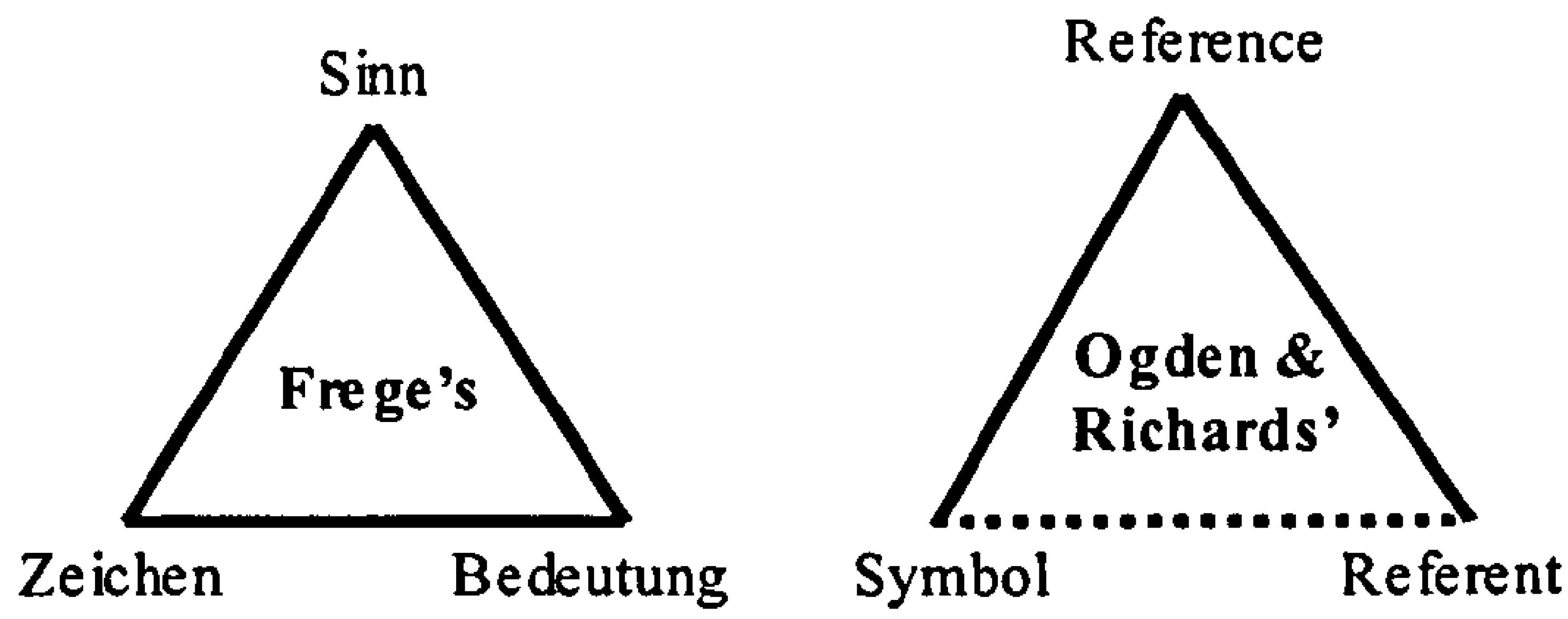

Fig. 7 - Comparison between Frege's and Ogden and Richards' semantic triangles.

Unfortunately, the theoretical triangle propounded by Ogden and Richards is of no use to appraise the meaning of objects. Indeed, in an attempt to study the reference of a door, Umberto Eco (1980, 1994b) found that the only possible options to apply such triangle inevitably leads us to a substitution of the referent (the door) by its symbol (the door as it is represented) or to a substitution of the referent by its reference (e.g. the thought of 'the possibility of access to somewhere'), causing in both cases the ontological death of the triangle (i.e. the death of its triadic nature). This led Eco to the conclusion that design signs cannot refer to physical things, as suggested by Ogden's and Richards' theory, but to functions (i.e. cultural meanings).[68] Such a conclusion brings along the idea that resemblance is not necessary for reference, since objects do not stand for other objects but for ways of conceiving their functions (Eco, 1994b). This also implies that the notion of reference has less to do with how the real world is and more with the ideas or concepts we have about it (Norman and Rumelhart, 1975a; Jackendoff, 1983). Therefore, reference should be understood as encompassing all cases of standing for, as suggested by Nelson Goodman (1976).

[68] From this perspective, the three elements of Ogden's and Richards' triangle could be applicable to design only if the *referent* is understood as a 'function', the *reference* as the way in which the referent is understood, and the *symbol* as a representation of that referent.

2.2.2. Semiotic traditions for the study of reference in utilitarian objects and products

Within the arena of product design the more systematic and long standing way of studying reference has been provided by semiotics. In this field, different authors have formulated a number of terms and theoretical schemes to study problems of signification. Nevertheless only three theoretical approaches have achieved the rank of recurrent models for most studies of meaning in product design. These are the theoretical positions developed by Ferdinand de Saussure, Charles Sanders Peirce and Charles William Morris.[69] These have become the ways par excellence to teach future designers how meaning can be analysed and built as part of products. Each of these represents a different approach and tradition within semiotics. There is thus a *linguistic-structuralist* approach mostly based on the ideas of Ferdinand de Saussure, a *pragmatist* approach stemming from the writings of Charles Sanders Peirce and a *behaviourist* approach developed around the ideas of Charles W. Morris. Therefore, it is wrong to assume that all the semiotic studies in design are based on a linguistic or structuralist tradition, as some authors seem to do (Krippendorff, 1992; McCoy in Mitchell, 1996).

Under the structuralist approach, reality is studied assuming that the observable social phenomena are generated by unobservable social structures (Abercrombie, Hill and Turner, 1994). These structures are seen in terms of relationships rather than particular things, where "...the nature of any element in a given situation has no significance by itself..." but only in relation to the other elements involved in that situation (Hawkes, 1977).[70] Thus, the ultimate goal of Structuralism is to unmask and describe the 'permanent' structures of human acts and perceptions (Hawkes, 1977), especially those of unconscious nature (Walker, 1989). Such structures are conceived as having three main common features (Piaget, 1971):

1.- *A sense of internal coherence*, where the totalities so constituted are made up of elements subordinated to certain 'laws of composition', and the properties of the whole are different to those of its elements.

[69] Of these three, the Saussurean and the Morrisian approaches have also been acknowledged as having a long standing application in the field of architecture (Bonta, 1973).

[70] Within Structuralism there is a variety instead of a single definition of 'structure'. Indeed, for Lévi-Strauss, structures are models devised by the analyst as a means to understand reality (Walker, 1989), whereas for others structures are like skeletons which allows the researcher to distinguish what is essential from what is accessory in a situation (Pouillon, 1975).

2.- *A dynamic nature*, derived from the transformations experienced by these structuring totalities.
3.- *A self-regulating dynamics*, since the transformation of each structure takes place within its own constitutive elements and according to laws of its own.

Within semiotics, however, the idea of structure does not always match with that in Structuralism, alluding to either a set of interacting components or the relationship between signs and reality (Johansen and Larsen, 2002). Indeed, the notion of structure has been used long before anyone was tagged as a structuralist. Structuralism really began with the idea that different sets of things can be understood and ordered by virtue of their differences and not despite them (Pouillon, 1975). This is the reason why one of the favourite structuralist methods of analysis is the reduction of the reality under study to a series of binary oppositions such as nature/culture and new/old (Walker, 1989). This also explains why Structuralism gained so much force in fields such as linguistics and ethnology since "... the linguist orders oppositions instead of grouping similarities" and "...the ethnologist is more interested in the differences between societies than in their common features" (Pouillon, 1975: 7). Therefore, one should not be surprised when structuralist thinkers such as Lévi-Strauss and Roland Barthes openly declared being inspired by the work of linguist Ferdinand de Saussure to study man-made systems different to language (cf. Barthes, 1969).

But when we speak of a linguistic-structuralist tradition - instead of just a structuralist one – what we actually acknowledge is the existence of attempts linking language and design previous to the consolidation of Structuralism. Indeed, the linguistic analogy has a long history in design theory (cf. Collins, 1970; Krampen, 1979a and 1979b). Nevertheless, it was only with Structuralism that some of its basic notions acquired the systematic nature they have now in design. Such is the case, for instance, of notions like *grammar* and *language*.

The idea of 'grammar' - popularised in the 19th century by Owen Jones' *Grammar of Ornament* and Charles Blanc's *Grammaire des Arts du Dessin* – found its ways into design through the Beaux Arts tradition and the formalist pedagogy inherited from the Bauhaus (Jones, 1987). Unfortunately, neither of them provided a clear understanding of what grammar could be within design. 19th century writings on the subject such as those of Owen Jones (1856) and Christopher Dresser (1973) openly show that their idea of grammar was more about the enunciation of particular examples, mostly-unconnected general principles[71] and personal beliefs about composition than the formulation of interconnected and comprehensive rules to control the totality of a design. The Bauhaus' approach, on the other hand, understood grammar in a so restrictive and abstract way (i.e. through the Gestalt laws of perception) that their alleged design elements (points, lines and planes) ended up being relationships hierarchically organised within other relationships instead of elements organised within relationships (Jones, 1987). These basic misunderstandings brought along many of the inconveniences that hindered a proper application of the notion of *grammar* to design. This situation was later overcome through structuralist parallelisms between language and design (see 'The Saussurean set of relations' in section 2.2.3. for further details).

In relation to the notion of 'language', before Structuralism, it was mostly used to designate the system of human habits purposely created to communicate and coordinate activities through sounds and written signs (Carnap, 1975).[72] To the extent of having authors suggesting that non-verbal representations (e.g. visual objects) could not be understood as related to language since they (Langer, 1957): (1) Do not have anything similar to a vocabulary (i.e. elements with a permanent meaning), (2) have no syntax (i.e. fixed equivalences for translation of elements), and (3) their referents cannot be grasped bit by bit (as happened with sentences) but at once. Thus, language was defined as *discursive* by nature whereas activities such as art and design were considered as *non-discursive* (Langer, 1957).

Such a scenario changed with Structuralism since it assumed human consciousness to be mainly linguistic (Hawkes, 1977; Lotman, 1982), and semiotic systems like that of objects as similar to that of language (Jacobson, 1960; Uspenskij, 1962; Rossi-Landi, 1975) or built on top of the system of language (Barthes, 1972; Lotman, 1982). A threefold understanding of syntax was also developed to

[71] Except for those design principles about colour, which tend toward a kind of systematization.

[72] The writings of the logician Rudolf Carnap on this subject were published in 1939. He incorporated as part of his views theoretical propositions such as Charles Morris' dimensions for the study of signs (cf. Carnap, 1975).

encapsulate design objects. Indeed, these latter began to be understood as part of 'second-order' sign systems and syntax defined as based on time (for the case of language), space (for manifestations such as painting) or both of them (for manifestations such as films) (Guiraud, 1999). Thus, for semioticians, the term 'language' came to encompass any system of communication using signs arranged in a particular way (Morris, 1946; Lotman, 1982), and 'cultural systems' began to be understood as *languages* defined by particular combinations of different kinds of codes (Gandelsonas, 1974). Such a metaphorical use of the term *language* is hereafter seen as appropriate since 'language' stricto sensu and the 'language of figurative signs' are understood as having functional similarities (Uspenskij, 1962; Maltese, 1972; Rossi-Landi, 1975). This new approach became so influential as to even pervade the semiotics of cybernetic orientation, where 'language' was defined as a "set of conceptual linguistic units" (Vétrov, 1973: 82), where the term 'conceptual' refers to the act of finding sense within any organised system, and the term 'linguistic' is used to highlight the idea that such units are not just organised as part of a system but also produced by it – as happens in our natural languages.

But despite of its influence and level of development, some of the strongest criticisms to the structuralist approach in design have been about the use of its linguistic-based terminology, seen by some as hard to apply to non-verbal manifestations, and its supposed emphasis on 'structures without history' or static in time (Kinross, 1986; Walker, 1989; Krippendorff, 1992). As the first criticism has been already dealt with in Chapter 1 (see 'Semiotic methodology and design'), we will focus on the second one. As it was mentioned before in this section, the structures of structuralists have an intrinsic dynamic nature (Piaget, 1971). Thus, they are not static. Indeed, Lévi-Strauss has asserted that Structuralism and history do not oppose but complement each other, since structuralists are concerned with the ability of systems to transform themselves while retaining certain structure, and "...historians are concerned with how such systems, originate, reproduce themselves, change and decay" (Walker, 1989: 139).

The real roots of the non-historical impression of these structures are in an underestimation of historical changes that happen at a very slow pace. Let us not forget that for historians like Fernand Braudel (1958) the periodicity of history can assume three forms: that of *events* with a rapid rate of change (e.g. a battle), that of a longer duration based on *conjunctures* and *cycles* which may take five, ten or even fifty years (e.g. a government system), and that of phenomena with even longer duration, which Braudel defines as 'structures' (e.g. a design typology).[73] With this in mind, it is hard to see how Structuralism can be a non-historical or anti-historical approach. As a matter of fact, what Structuralism indirectly propounds is a methodological renovation by acknowledging the presence of historical transformations of longer duration than those to which historians are mostly accustomed (Greimas, 1966).

Differently from Structuralism, the *pragmatist approach* does not focus primarily on conventional sign systems but on any sign system. Indeed, while Saussure's approach focuses on the social function of signs, the Peircean one concentrates on their logical function (Taboada and Napoli, 1977). This is why the pragmatist approach aims to relate belief and action to the meaning of things without the mediation of sets of pre-existent and unobservable relationships. Meaning is then seen as derived from the experiences that arise from acting in various ways (Mautner, 1997). In this respect, Charles Sanders Peirce (1974) reminds us that no cognition is absolutely precise because it is hard to be totally certain about what a sign is standing for as well as what signs actually elicit in the mind of their interpreters. Thus, our perceptual universe is understood by him as a progressive construction mediated by signs in the form of percepts (i.e. outcomes of perception, called 'Semes' by Peirce). Indeed, in Peirce's semiotics, a sign is something that, once known, leads us to know more about it in a cumulative way – i.e. helping us to get an ever greater knowledge of certain meaning thanks to chains of interpretations (Eco, 1989). This is particularly important to explain the way cultural meanings come to life provided that they are linked to a practical order where ideas are explained by other ideas (Eco, 1995).

73 According to Braudel (1958) the *long duration* (Longue Duree) category has been already used by some historians of economics. In his view, 'structures' are "...stable elements for a great number of generations" since they encompass limits imposed on humankind by: geography - e.g. it is not the same to live in the coast than in the mountains, ways of cultural domain - e.g. the Western culture, aspects of productivity - e.g. the Capitalist system, and even mental frameworks - e.g. religions and philosophical principles (Braudel, 1958: 47).

Finally we have the *behaviourist approach* of Charles Morris. Behaviourism has been defined as the psychological theory or method of inquiry that holds that "...nothing except what the organism does and says..." can be taken to establish correlations between stimuli and reactions (Mautner, 1997: 64). In this sense, Morris' main concern is about finding "...a behavioural way of formulating what is commonly meant in saying that a sign 'stands for' or 'represents' something other than itself" (Morris, 1946: 8). To this aim he stands on Peirce's theory but differently from it he assumes that what the sign elicits in the mind of its interpreter is a 'disposition to respond' instead of a percept. This does not imply that 'private (mental) experiences' have no place as part of sign processes but that such 'experiences' are not considered to be crucial under the behaviourist approach (Morris, 1985). Thus, the main difference between this approach and the two aforementioned is that the subject of study (i.e. meaning) does not rely on hidden forces or hidden relations for its definition (as in the case of Structuralism), neither does it explore the role of mental constructions as an active and determinant part of our interaction with our surroundings and the materiality of their objects (as happens in the pragmatist approach).

The introduction of these three semiotic approaches to the theory and practice of product design has nothing to do with their historical order of appearance. Most authors have agreed that semiotics really began to be used in design theory between the 1950s and 1960s (Gandelsonas, 1974; Krampen, 1979b; Kinross, 1986; Walker, 1989; Julier, 1993; McDermott, 1994; Mangieri, 1998a). They link the semiotics of design to Structuralism due to the relevance gained by writings such as those of Roland Barthes, Jean Baudrillard and Abraham Moles, and the notoriety achieved by the Structuralist school of thought thanks to the events of the French May of 1968 (Gandelsonas, 1974; Krampen, 1979b; Walker, 1989; Julier, 1993; McDermott, 1994; Mangieri, 1998a). However, there are other authors who, tracing the beginnings of semiotic studies in design academies, hold a totally different view on this matter. Indeed, for Gillo Dorfles (1968) and Susann Vihma (1995), for instance, semiotic studies really began at the Hochschule für Gestaltung of Ulm (1953-1968), where a blend between the Peircean and the Morrisian semiotics was brilliantly developed by Max Bense (Bonsiepe, 1995b; Betts, 1998).[74] But, there is an even older antecedent in the 1939 writings of Charles Morris and the role he played at the New Bauhaus of Chicago (1937-1946) (Findeli, 1990).

2.2.3. THE SAUSSUREAN STRAND

Ferdinand de Saussure (1857–1913) developed his theoretical approach as part of a series of lectures on linguistics delivered at the University of Geneva between 1906 and 1911. He did not explicitly use the term 'reference' in his theorisations, but his understanding of this subject can be said to comprise three distinctive and complementary aspects: one about the nature of the components of signs, another about the parts comprising human communication (particularly the verbal one), and a third one about the kinds of relationships present in signs. These three aspects are elucidated by Saussure within the framework of linguistics even though they are also applied to other fields of study nowadays.

The Saussurean sign

Saussure's views on meaning stem from his desire to change the old conception of linguistic signs (i.e. words) as being the result of uniting a 'thing' (generally physical) and a 'name' for a new conception where 'words' (signs) are understood as resulting from the combination of a psychic and a quasi-psychic entity: a 'concept' and a 'sound image' (Saussure, 1980). This latter is outlined by Saussure as being the mental trace of the physical sound of a word. Thus, neither his 'concept' nor his 'sound image' are fixed to any particular substance (Sebeok, 1986). To the extent that even his 'sound image' is substitutable by any other material substances such as writing.

Besides this, Saussure also marks a distance between his ideas and the previous ones by renaming his 'concept' as **signified** (*signifié*, in French) and his 'sound image' (or mental trace of the physical) as **signifier** (*signifiant*). Such a theoretical distance is also established through his understanding of linguistic signs (words) as

[74] Tomas Maldonado's (1961a) definition of 'language' as the sign system mediated by words clearly shows the pre-eminence given to Charles Sanders Peirce's ideas at the Ulm School of Design.

resulting from conventions (codes), i.e. as having no natural links between their *signifieds* and *signifiers*. This presupposition of codes as a necessary condition for the linguistic sign brings about three basic consequences. Firstly, signs are seen as being both intentionally and artificially produced (Eco, 1995). Indeed, no natural[75] signs (e.g. symptoms) are really considered as part of Saussure's theory of signs and those signs that could be considered as such are also seen as arbitrary (conventional).[76] This becomes quite obvious in his definition of *Semiology* (his equivalent for 'Semiotics') as the science that studies the life of signs within society (i.e. the life of signs defined through conventions) and his comparisons of sign systems conventional par excellence (e.g. symbolic rites, manners of courtesy, military signals and language) (Saussure, 1980). Secondly, different to the Stoic notion of sign, the expression of the sign (*signifier*) is understood by Saussure as just a constituent part of the sign playing the role of 'mediator' (Barthes, 1969), to identify, evoke and transmit the *signified* (concept) (Guiraud, 1976). In this sense, *signified* and *signifier* should be both simultaneously present since the consideration of any of these two in isolation can only lead to *signifiers* without meaning or *signifieds* that cannot be expressed (Pérez de Medina, 2002a). Thirdly, Saussure's notion of the sign emphasizes, more than any other thing, the relationship between his *signified* and *signifier*. This happens given that, for Saussure, his *signified* is not the 'concept' of a real world object (Bird, 1977), but a relational notion outlined according to the boundaries imposed by a particular culture (Fiske, 1990); and his *signifier* a means defined by agreement to convey meaning.

Thus, the Saussurean approach to reference can be outlined as standing on two main premises. Firstly, an understanding of the referent (that to which the sign alludes to) as that indirectly grasped through the *signified* (concept) (Malmberg, 1967), provided that this latter is moulded by conventions.[77] And secondly, a characterisation of signification (the process of meaning production) as the act of uniting a *signified* (concept) with a *signifier* (expression) based on conventions to create a sign (Barthes, 1969). Therefore, for the purpose of our research, the

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75 The adjective 'natural' is used here to refer to that which is not 'artificial' (i.e. man-made).

76 Saussure (1980) even asserts that onomatopoeic words (such as 'tic tac') and exclamations are both conventionalised, because the former are just an approximate imitation of the sounds they refer to, whereas the signifiers and signifieds of the latter are not necessarily link naturally.

77 Indeed, all our concepts are somehow influenced by the social context we live in.

Saussurean view of reference will be delineated as having to do with the designer's or user's interpretation of ideas culturally rooted and expressed through *signifiers* legitimised by conventions.

This way of understanding Saussure's views on reference have found its way in design through the writings of authors such as Roland Barthes, Umberto Eco, Luis Prieto and Jean Baudrillard (Bird, 1977; Krampen, 1979b). According to Barthes, the *signifiers* of objects are material units (i.e. colours, materials, shapes, etc.), whereas their *signifieds* have to do with the way in which the object's beholder or user understands it (Barthes, 1964b). In this sense, "...every object is at least the signifier of a signified" (Barthes, 1964b: 183), where what we grasp is not a *signifier* expressing a *signified* but the correlation of both (Barthes, 1972). To this Barthes adds that, differently from the linguistic signs, the understanding of objects as signs is at first determined by their function and only later by other kinds of significations (Barthes, 1964b and 1969). Thus, for him, the referents of signs such as those in design products are not physical things in themselves but social agreements about ways of doing things (i.e. functions) or looking at them (e.g. as signs of status, power, etc.). Indeed, he baptised the signs present in our utilitarian objects as **function-signs** (Barthes, 1969).

These *function-signs* are theorised by him as having two sides. One where the function of the object becomes the sign of that function (the object standing for its function), e.g. a raincoat as a sign of protection from the rain; and another, where the function of the object (as a sign) is re-defined to signify something else, e.g. a raincoat of certain colour as a sign of what is fashionable at the moment. The former is called **denotative meaning** (or denotation) and the latter **connotative meaning** (or connotation). Denotative meaning is the taxonomic, value-free and objective side of function-signs; whereas connotative meaning envisages the symbolic and subjective side of these signs (Barthes, 1964b). Thus, while denotation refers to 'what' things are, connotation alludes to 'how' things are evaluated or seen by us (O'Sullivan et.al. 1994). In design terms, *denotation* has been interpreted as having to do with *what* the product is – i.e. if it is a chair, a telephone, etc. – whereas *connotation* is related to *how* the product comes to be what it is, based on the designer's choice of shapes, materials, colours, etc. (Hjelm, 2002).[78] As connotation implicitly contains denotation, it is envisaged as being built on top of denotation (Barthes, 1969; Moles, 1975; Quarante, 1992), defining in this ways a **second-order semiotic system** – since the first-order semiotic system is denotation.

In Barthes' (1972) view, however, connotation is only one of the two kinds of import derived from this second-order semiotic system. The other import is called by him **Myth**. Myths are representations of culture-specific ideas about matters like honesty, duty, notoriety, family, and work (O'Sullivan et.al. 1994), expressed through anonymous utterances of the press, advertising, and consumer goods (Barthes, 1977). As such, they are the means used by the dominant classes to manipulate culture-specific views to their own advantage (Fiske, 1990). The difference between connotation and myth is then in the way they place denotative meanings into the value system of a culture.

Connotation is evaluative and works at the level of the sign's form, "...changing the signifier [expression] while keeping the same signified [concept] (O'Sullivan et.al. 1994: 286). *Myth*, on the other hand, is 'conceptual' and works at the level of the sign's content (O'Sullivan et.al. 1994), changing the signified (concept) while keeping the same signifier (expression) – see figure 8. Indeed, in Barthes' myth, the *sign* of the first-order system (denotation) is taken as a *signifier* (expression) for the second-order system while the *signified* (concept) of that first sign is only partially emptied[79] and filled with another *concept* (Barthes, 1972).[80] Therefore, myth does not obliterate the old concept and the old referent of a function-sign. It only leaves both of them out of contingency in order to allude to something else. This is why, from the perspective of myth, the glass surfaces of an automobile such as the Citroën D.S.19 can be seen as more than mere 'windows' to become "...vast walls of air and space" (Barthes, 1972: 89). The dynamics behind *myths* is then one of

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78 Let us not forget that even our subjectivity is somehow moulded by the culture where we live (Barthes, 1987).

79 This happens in such way because the *signified*, now used as a *signifier*, retains part of its original concept (Barthes, 1972).

80 From a denotative standpoint, myth has to do with the sense of naturality with which the new signified (or modified concept) is presented, whereas - from a connotative standpoint - myth has to do with the ideology supporting such a conceptual deformation (Barthes, 1977).

deformation instead of one of substitution,[81] where one sign is sufficient to stimulate us, either as decoders or encoders, to construct the chain of concepts of which myths are normally made of (Fiske, 1990).[82]

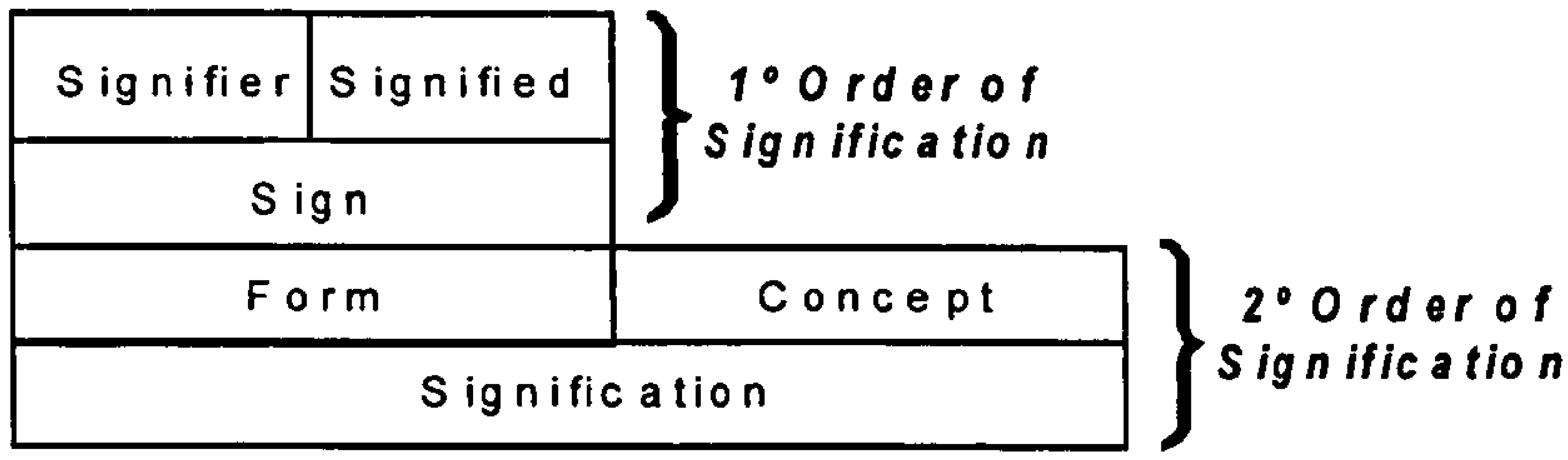

Fig. 8 – Roland Barthes' notion of Myth (1957).

Barthes' adaptation of the Saussurean sign to explain the meaning of utilitarian objects has been confirmed in various ways by different authors. Indeed, Umberto Eco (1994b)[83] has suggested that the signs of utilitarian objects such as those of design are articulated to signify cultural meanings (i.e. functions) instead of signifying physical referents. This led him to propose two kinds of functions for design objects: those that products actually designate (denote) or **primary functions**, and those that products subjectively evoke (connote) or **secondary functions**. This idea of primary and secondary functions in design products was also revived in the 1990s.

An example of this is the model developed by G. Pasman and W. Muller (1995) at Delft University of Technology for the study of historical antecedents in the typology of products. In their view, the *primary functions* of a product are those practical functions commonly outlined as part of solution principles, whereas the *secondary functions* of a product include "...all possible connotations regarding character, style and socio-cultural behaviour" (Pasman and Muller, 1995: 2). Another interesting application of the idea of primary and secondary functions was also developed by Uday Athavankar (1997) at the Indian Institute of Technology,

[81] Indeed, the changes derived from myth are considered as evolucionary instead of revolutionary (Fiske, 1990).

[82] Something is considered as metonymic when its meaning is derived from associative relations based on: cause and effect, contiguity in space or in time, part for the whole (synecdoche), among others.

[83] These ideas were originally published in 1968. The date above presented corresponds to the 5th Spanish edition of Eco's *Struttura Assente.*

but this time for the study of cultural identity in design. According to him, the appearance of design objects has to do with the creation of two kinds of meaningful links: **primary links** or those features helping to express what the product is about (i.e. formal clues typical of that kind of object), and **secondary links** or those features that help to generate sub-classes of a product through the incorporation of aspects such as place, style, user and epoch.

With a different emphasis to the above, Luis J. Prieto (1971) reminds us that at the core of each utilitarian object there are always two ideas: that of a 'performed operation', and that of the 'choice of a utensil' to perform it. The former refers 'what' such operation is about or **denotative communication**, whereas the latter alludes to 'how' it is performed or **connotative communication**. In this sense, Prieto coincides with Barthes in his understanding of denotation as a matter of definition and connotation as a matter of choice.

Corrado Maltese (1972), on the other hand, places the utilitarian object in a semiotic space between that which makes the object suitable for a particular operation and that which makes it appropriate for certain socio-cultural context. Thus, he realises the presence of three different levels of reference in the signs of utilitarian objects. The first of these levels is called by him **'Functional-Instrumental'** and it alludes to the actual operation these objects ought to perform. The second level or **'Representative'** has to do with the way in which the object reflects its context of use. And Maltese's third of level or **'Transpositive'** refers to the transplantation of functions and features among different objects to enrich or re-define their configuration and perception. These three levels (Functional-Instrumental, Representative, and Transpositive) are indeed parallels of Barthes' denotation, connotation and myth, provided that they encapsulate equivalent concerns.

Focusing his attention on the structural arrangement of the elements comprising objects, Abraham Moles (1975) has pointed out that in order to understand the nature of such arrangements two levels of study should be considered: a **semantic** or denotative one and an **aesthetic** or connotative one. The former is linked to the function and utility of the object and therefore to a repertoire of practical needs. The latter, on the other hand, is built on top of the object's function and aims to express the object's time, place and users, among other things.

Besides these propositions, there are also two interesting re-interpretations of Barthes' ideas that ought to be mentioned here. One has been formulated by the German theorist Wolfgang Fritz Haug and the other by the Mexican scholar Tulio Fornari. Taking the study of goods in terms of use-value[84] and Barthes's myth as a foundation, Haug (1989)[85] develops a *Law for the Aesthetics of Goods.* As part of this, he suggests the existence of two types of **aesthetic promises of use-value** for product design: one objective and one subjective. The former refers to the sensible data or physical features of the product (i.e. what the product actually does), whereas the latter alludes to the personal expectations built in the mind of the consumer about the product based on its physical features (i.e. what people think the product might do for them, how they think it might change their lives).

Tulio Fornari (1989), on the other hand, takes denotation and connotation as two sides of the **Informative Value** present in any design product and divides these values into self-concerning and extra-concerning. **Self-Concerning Informative Values** refer to the use of denotative and connotative meanings directly linked to the product and the circumstances in which it was produced. These values relate to aspects such as: the functional properties of the object, its gender (for men or women), its status (luxurious, standard, moderate), its geographical origin (regional, national, continental), and its chronological characterization (futurist, contemporary, antique). Differently from these, **Extra-Concerning Informative Values** refer to meanings stemming from products and circumstances extraneous or different to those of the product at stake, such as the values encapsulated as part of allusions to other products (e.g. a radio that looks like a doll), and animated or unanimated things (e.g. anthropomorphism, zoomorphism). In this sense, Fornari's Extra-Concerning Values might easily be characterised as alluding to design metaphors or to Maltese's Transpositive Level for meaning construction.

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[84] The term *'use-value'* comes from classical economy. It alludes to the perception consumers have of what is useful in a product (Haug, 1989).

[85] This is the date of the Spanish edition of Haug's book. The original German edition is from 1980.

The works reviewed up to this point help to extend Barthes' interpretation of the Saussurean sign. There are other works based on Barthes' views. Some of them even more recent than those here presented. However, they are just paraphrases of the views already introduced (cf. Selle, 1975; Taboada and Napoli, 1977; Quarante, 1992; Pineda et.al., 1998; Sánchez, 2001; Sanz and Lafargue, 2002). On the other hand, Barthes' interpretation of the sign is not the only one based on Saussure's work. A different and quite comprehensive interpretation of it is also provided by Jean Baudrillard in his *'Système des objets'* (1994). Indeed, he does not define the 'functional' side of utilitarian objects in terms of the object's capacity to perform tasks but according to its capacity to be acceptably inserted into an order of things (or system). This leads Baudrillard to envisage the relationship between the *functional* (essential) and the *non-functional* (accessory) aspects of these objects as one of opposition (a dialectic relation) instead of one of integration. Besides Baudrillard's view, there are also positions in between Barthes' and Baudrillard's such as those of Gillo Dorfles in Italy and Ernst Boesch in Germany.

For Gillo Dorfles (1968) the object's **'functional symbolism'** relies on its capacity to signify or express functions through its aesthetics. Similarly, Ernst Boesch (1990) has pointed out that the functionality of objects is not a matter of practicability but of symbolism, where *connotative meanings* "...fill the *denotative* framework with the contents of our personal action" (Boesch, 1990: 54). From the perspective of both authors, the 'magic' signs stamped on the surface of a sword, for instance, are not mere decorations but symbols that "...reinforce the user's intentions and views of the world" (Boesch, 1990: 52). This is an approach that brings forward an idea of function closer to that suggested by Jan Mukařovský (1942) in his typology for the object's functions. That is to say, one in which the object's function is understood as a comprehensive system of tasks that includes what the object directly and indirectly does, its practical and theoretical nature, and its symbolic and aesthetic sides (see figure 9). Dorfles' and Boesch's approaches also bring forward that very human tendency to impose a blend of personal and social views on our understanding of the world, that is, our tendency to impose **frames of interpretation** on things to ease our distinctions between the meaningful and the merely perceptual (Greimas, 1978). Such 'frames of interpretation' are, for the case of utilitarian objects, "...almost always institutionalised by use or convention"

(Dorfles, 1966: 3). To the extent that objects which are understandable for some people can be completely occult and mysterious for others.

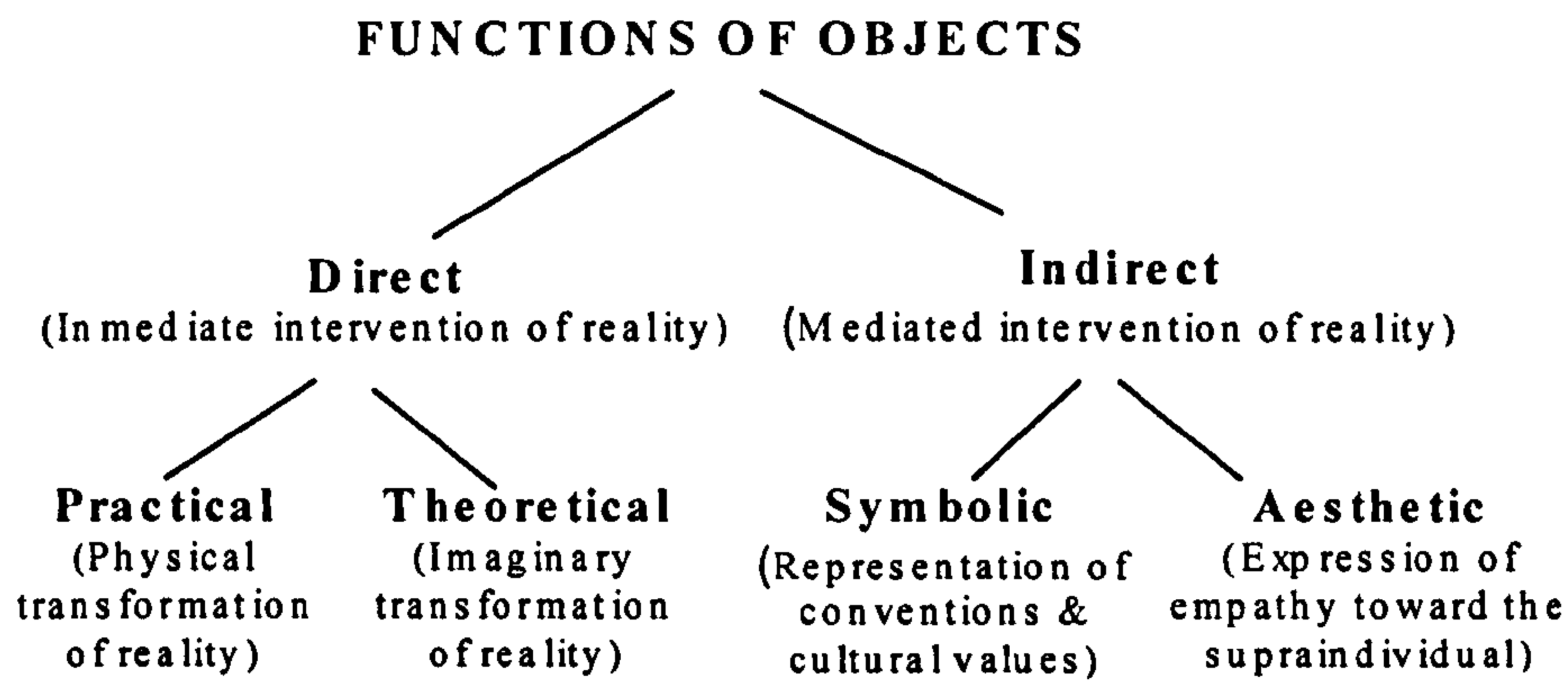

Fig. 9 – Jan Mukařovský's typology of the object's functions (1942).

The Saussurean system

A second way of looking at Saussure's approach to reference comes from his understanding of human verbal communication (*langage*, in French)[86] as comprised of two parts (Saussure, 1980): a social, essential and stable one – designated by him with the term **langue** (translated into English as language) - and an individual, accessory and contingent part or **parole** (speech in English). Both *language* and *speech* are understood by him as mutually interdependent. To the extent that *language* is seen at the same time as a product and an instrument of *speech* (Barthes, 1969) and *speech* as the germ of all the changes in *language* (Saussure, 1980). Thus, in Saussure's approach the 'circuit of discourse' between two speakers is constituted by an active dimension - i.e. *speech* - and the power to understand what is 'said' or communicated – i.e. *language* (Bird, 1977). So that the meaning of stable (conventional) signs can also change by virtue of the way people use them.
On the other hand, Saussure understands the 'circuit of discourse' as a matter of extra-linguistic phenomena linguistically structured. That is to say, as a circuit only

[86] 'Human verbal communication' is used here to translate the French 'langage', and avoid the common mistake of translating the French 'langue' as 'language'. Let us not forget that, for Saussure, 'langue' is not equivalent to 'language'. Indeed, 'langue' is the French expression for *language without parole*. Therefore, 'langue' is less comprehensive than 'langage' and it should not be translated as 'language' (Barthes, 1969).

dealing with that part of reality that has been translated into words (i.e. abstract representations of things).

Bearing these considerations in mind, the application of Saussure's notion of *language* to the system of objects (and therefore, its application to design) came about through the work of theorists such as Roland Barthes, Jean Baudrillard and Abraham Moles. Barthes (1969) sees the different models, styles, colours, and forms of objects as equivalent to the components of *language* (i.e. vocabulary and grammar) but in the system of objects, and the consumers' choices and use of utilitarian objects as equivalent to *speech*. Furthermore, he defines the 'language' of objects as a **logo-technique**, that is, as a sign system used by people that do not take part in the development of its products (Barthes, 1969). Indeed, the system of product design has been traditionally 'commanded' by decisions unilaterally made by certain groups (clients, manufacturers and designers) about the needs and wants of consumers (Taboada and Napoli, 1977; Lacruz-Rengel, 1997).

Another interesting interpretation of the Saussurean system is in Barthes' proposition of different **orders of signification**. In other words, the understanding of signification as taking place at two levels: that of denotation (or first-order signification) and that of connotation and myth (or second-order signification). These notions have been applied and extended by authors such as John Fiske and John Hartley, and Paul-Alan Johnson.

Based on a study about TV messages, Fiske and Hartley (1978) suggest the consideration of three orders of signification for the study of meaning: the two already suggested by Barthes, and a third one called by them the **order of ideology**. This third order of signification takes Barthes' connotations and myths as units of a bigger kind of organization that "...reflects the broad principles by which a culture organizes and interprets the reality with which it has to cope" (Fiske and Hartley, 1978: 46). As such Barthes' *ideology* comes to life when signs enter the realm of inter-subjectivity, encapsulating the way in which connotations (ways of materializing things) and myths (changes of meaning keeping the existing materializations) "...fit together to form a coherence pattern or sense of wholeness" within a particular society (O'Sullivan et.al. 1994: 287). In this sense, ideology is a sort of meta-language or meta-discourse about the nature of the creations developed in the previous orders (see figure 10).

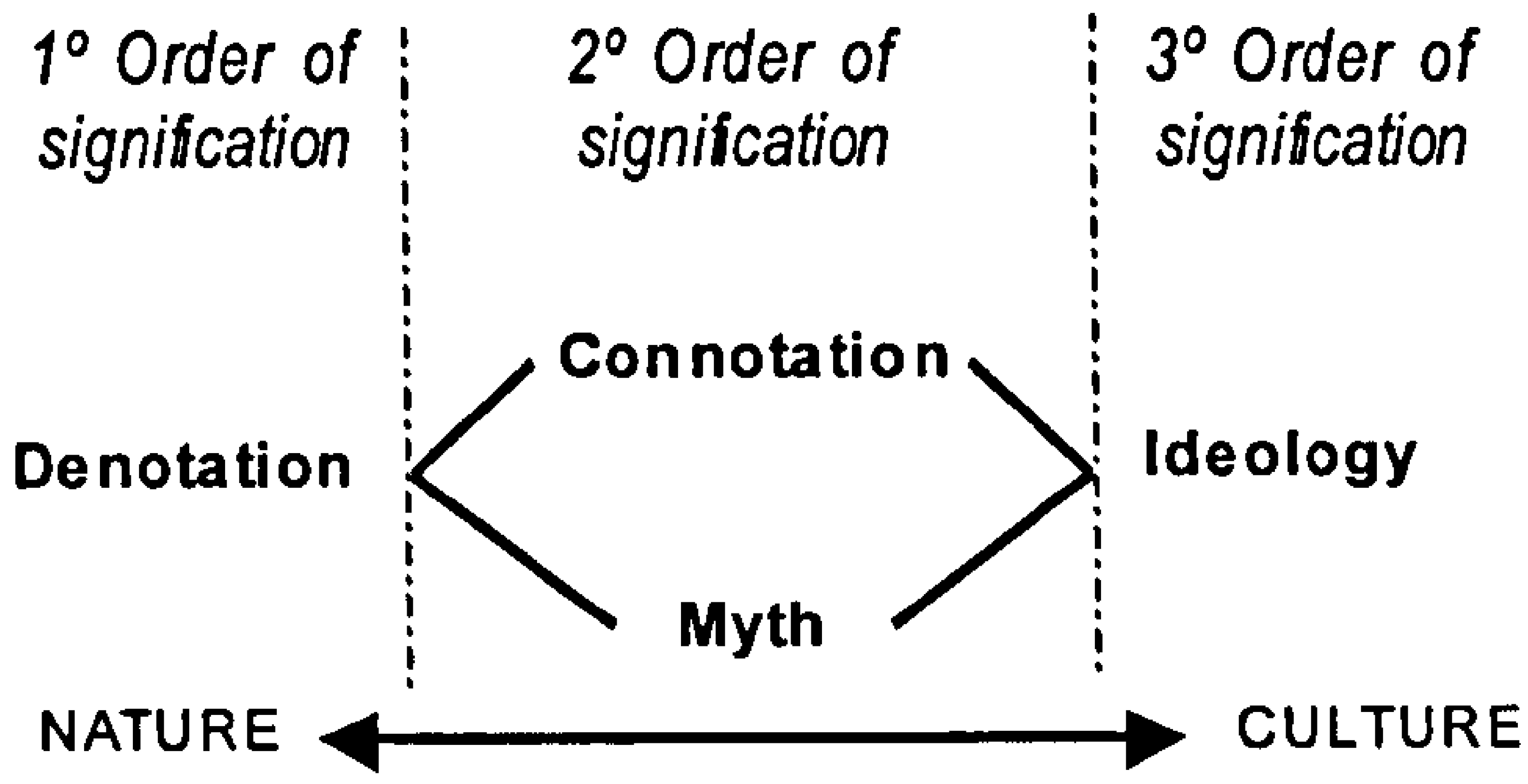

Fig. 10 – The three orders of signification according to Fiske and Hartley (1978).

Following Barthes, Paul-Alan Johnson (1999) devised a model of the conceptual 'universes' of design. To this aim, Johnson took the *signifiers* (forms, colours, etc.) of Barthes' first order of signification as physical stereotypes (called by him 'types'), Barthes' *signifieds* as culturally defined concepts (or 'culture'), and the combination of *types* and *culture* as the conceptual source of artefacts. The order of signification so defined is called by Johnson the conceptual universe of **'craft'**. This universe is in turn the basis from which a second conceptual universe or **'design'** is built. Here, the definition of artefact previously achieved is taken as a design 'situation' to be distilled by the attitude of a designer in order to create a design proposal or 'work'. The result of this second universe (i.e. the 'work') can also be taken to define a third conceptual universe: that of **'critic'**. This latter derives from the consideration of the 'work' of the second universe as the 'corpus' from which critical reviews or 'constructs' are produced to generate a critic 'statement' (see figure 11).

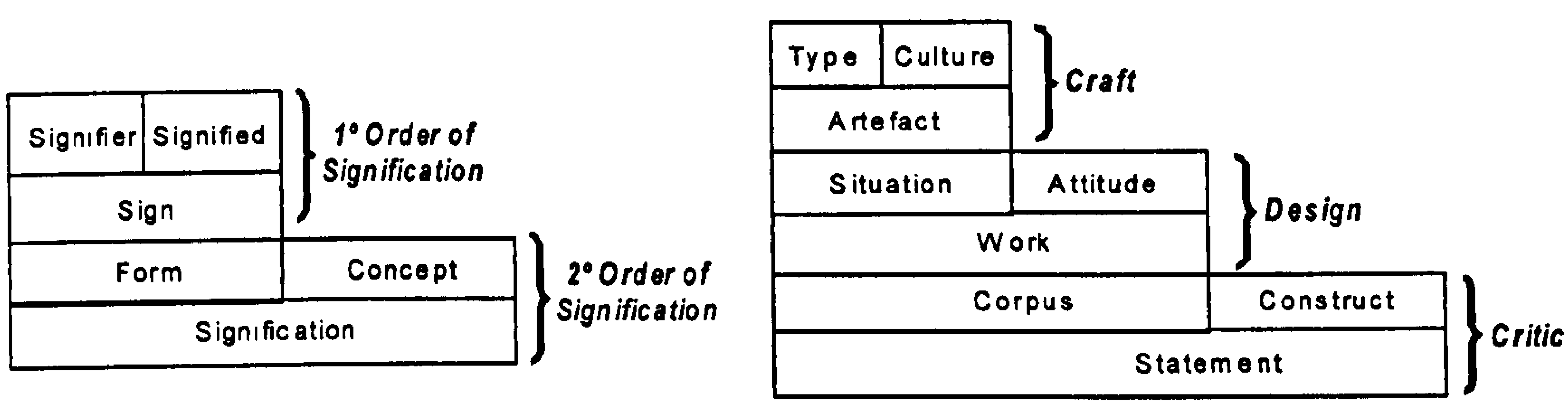

Fig. 11 – Barthes'orders of signification and Jhonson's universes.

Similar in some respects to Barthes' views and those of his followers, Jean Baudrillard (1994) has suggested a quite comprehensive view of the system of utilitarian objects.[87] To this aim, he established a set of conceptual oppositions between the system of use and that of production, the functional and the dysfunctional sides of objects, the essential and the accessory in objects, and their objective and subjective sides. Based on these, he divides the system of objects into four grand co-existing sub-systems. Each of them named after the nature of their scope. Thus he suggests: a **functional system** or that about the technical structures used for positioning objects - including the role culture plays as part of it; a **dysfunctional system** or that about the place society assigns to those objects considered as outside of the prevailing order - such as collectors' items, exotic and out-of-fashion objects; a **meta-functional system** or that dealing with the role played by the sublimation of the irrational and accessory within the system of objects; and finally a **socio-ideological system** or that in which different models of the same type of object are psychologically and sociologically separated or grouped.

Differently from Baudrillard, Abraham Moles (1975) developed a study of objects based on the taxonomies applied to them within sociology and psychology. To this aim, he approached the system of objects through a method of reasoning characterised by: an understanding of that system as a language (*à la mode* structuralist), the separation of the semantic (denotative) side of objects from their aesthetic (connotative) side, and an appraisal of objects through the study of their repertoires, their causes for 'evolution' and the possible codes derived from the relation between people and objects (i.e. people's needs) and among objects in themselves (e.g. formal and spatial relations). Standing on the idea of objects as mediators of human activity and design as the organizer of the structure prevailing in such mediators, he sees the system of objects as divisible into two areas of work: **functional complexity** and **structural complexity**. The former deals with the diversity of human acts and their possible combinations during the use of objects, whereas the latter has to do with the arrangement of the elements or parts of those objects used to perform such human acts. This is why, *functional complexity* relates the conception and organization of objects to their functions (practical functions),

[87] Baudrillard's work is considered by some authors the most systematic criticism ever made of the system of objects from the structuralist perspective.

whereas *structural complexity* links objects to their super-functions (circumstantial functions based on people's interests and traditions).

This idea of relating objects to super-functions is indeed also at the basis of Baudrillard's view. To the extent that his four grand sub-systems could be equated to **systems of super-functions,** bearing in mind that Baudrillard's definition of the 'functional' has more to do with the way in which an object becomes part of a system than with its performance. In this sense, it would be hard to find a utilitarian object that does not belong to certain system (Barthes, 1964b), since such objects are always somehow institutionalized by use or convention (Dorfles, 1966). In this sense, the semantic appraisal of utilitarian objects such as those of design is only possible in conjunction with their syntactic and pragmatic connections (Oehlke, 1990). That is to say, through the establishment of relations between such objects and the existing repertoires of them and, most importantly, between such objects and specific users and contexts (Selle, 1975).

Finally, we ought to mention a different interpretation of the Saussurean system developed by Seppo Väkevä (1990) to describe the "ways of signification of material objects" (see figure 12). According to him, the application of Saussure's **level of language** to the study and development of objects involves three aspects: the *production of artefacts* (in relation to other natural or artificial objects), the *production of goods* (or formulation of artefacts to fulfil needs) and *the way in which we express about objects* through words. The application of Saussure's **level of speech** for objects, on the other hand, is seen by him as comprised of: *personal interpretations* (emotions and memories elicited by objects), *the use of objects* (actions embodied by an object and each of its components), and what he calls *'the language of objects'* (social messages of status, lifestyle, etc. associated to sets of objects and even in some cases to single objects).

The six aspects above mentioned are defined according to their location alongside two theoretical axes: one whose poles are the *cultural* and the *individual*, and another whose poles are the *arbitrary* (non-conventional) and the *contractual* (conventional). Consequently, the *production of artefacts* is defined as cultural-arbitrary, the *production of goods* as cultural-contractual, *our personal* *interpretations of objects* as individual-arbitrary, and *our use of objects* as contractual-individual. Such a pristine model, however, does not provide any account of the reversibility and relativism characteristic of semantic systems since, for instance, neither personal interpretations are totally culture-free nor is the language of objects exclusively located at the level of speech.

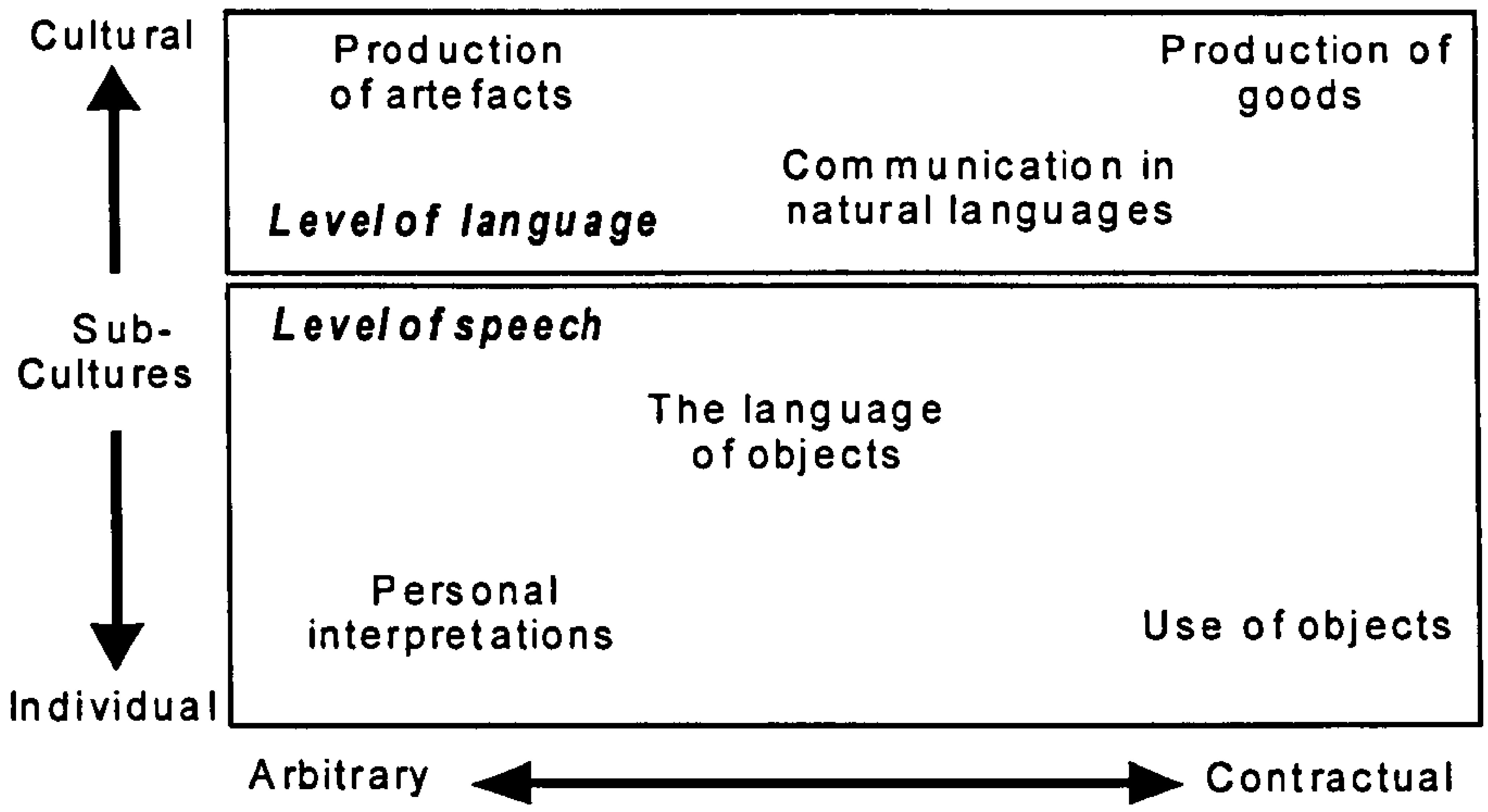

Fig. 12 - Ways of signification of material objects according to Väkevä (1990).

The Saussurean set of relations

The third way of looking at Saussure's views on reference has to do with his proposition of certain types of relation for the study of signs. According to Saussure, any science dealing with equivalences between things from different orders should study the relations among co-existent things, and the changes in each of such things throughout time (Saussure, 1980). With this in mind, he suggests the use of two kinds of relation for the study of linguistic signs (words): One dealing with the way in which the words of a sentence are combined or **syntagmatic relation,**[88] and another revolving around how such words are chosen and substituted by other words without changing the general meaning of the sentence or **paradigmatic relation** (also known as *Associative relation*).

Thus, *syntagmatic relations* unveil the meaning of signs based on the way they are organised as part of a whole to make sense, whereas *paradigmatic relations* reveal

88 The term Syntagm is used by Saussure (1980) to allude to a set of signs.

the meaning of signs standing on their similarities with *signifieds* (concepts) or *signifiers* (expressions) extraneous to the whole they constitute (Jakobson, 1960).[89] This is the reason why syntagmatic relations are said to take place *in praesentia* and paradigmatic relations *in absentia*. These two types of relations have been theoretically modelled in the form of two interrelated perpendicular axes, where the horizontal one is conceived as committed to the passage of time and used to represent the syntagmatic relations among signs, whereas the vertical axis is understood as contingent and used to symbolize the paradigmatic relations of signs (cf. Jakobson and Halle, 1971).

These two types of relations have been used in art to study the meaning of works. In these studies, the *paradigmatic relations* of a painting, for instance, have been identified as those having to do with its **external meanings** (Marchán, 1981), that is, with its theme, the allegories, symbolisms or conventions used by its author, the ideological issues involved, and so on. The *syntagmatic relations* of the work of art, on the other hand, are identified with those aspects defining its **internal meanings** (Marchán, 1981). In other words, the way in which the components of the work (lines, forms, colours, visual textures, etc.) connect to each other in order to create an 'effect' in terms of proportion, rhythm, contrast, hierarchy, etc.

Within product design, the **syntagmatic relations** are understood as those defining the basic configuration of objects – e.g. a telephone as a set of certain elements, whereas the **paradigmatic relations** are defined as those reflecting the choices (of physical means) made by designers to formulate products or the choices made by the consumers to satisfy their needs through the selection, use or acquisition of certain products (Barthes, 1969; Taboada and Napoli, 1977; Llovet, 1979). From this perspective, the system of objects is comprised of **syntagms** or *sets of different function-signs* articulated as part of single objects, and **paradigms** or the particular *function-signs* chosen to constitute a syntagm. Thus, a telephone, for instance, is "...a syntagm with a special set of paradigmatic elements" (Hjelm, 2002: 14): buttons, colours, displays, etc.

89 Paradigmatic relations are conceived by Jakobson and Halle (1971) as 'metaphoric' in nature, whereas syntagmatic relations are defined by them as 'metonymic'.

Clear examples of how this sort of relations have been incorporated to design are: Pierre Boudon's (1971) Endogenous and Exogenous Nets, Jordi Llovet's (1979) In-Textual and Contextual elements, and Pineda, Sánchez and Amarilles (1998) typification of the stylemes (culturally-determined ways of organising the form of objects) present in products. Indeed, for Pierre Boudon (1971) the reality of objects is located at the crossroad of two nets or systems of reference: an exogenous and an endogenous one. In the **exogenous net,** objects are defined according to the conditions needed to make possible their operation. In the **endogenous net**, on the other hand, each object is defined based on the rules or laws of combination governing them as particular types of object (e.g. what makes a bed to be what it is). These rules can be internal (about the configuration and assembly of the object's parts) or external (about the object's configuration in relation to particular times and places of use). Thus, while the exogenous net defines the object in terms of how its practical function is envisaged, the endogenous net offers a description of its geometry and physical configuration.

For Jordi Llovet (1979) design objects are 'texts', similar to those of language, constituted by two kinds of elements: in-textual and contextual. **In-textual elements** are those considered as immanent and indispensable for the definition of the object. They are exclusively outlined by the utility of the object and therefore, common to all the objects responding to the same definition or type of object. Differently from these, the **contextual elements** are those derived from the facts and situations surrounding the object's utility, i.e. elements alluding to meaningful aspects such as space, time and user. Both types of elements are, according to Llovet, articulated (interrelated) in design following a similar pattern to that described by the linguist Roman Jakobson (1960) for the elements of a poem. That is to say, as part of a situation where "the speaker selects words and combines them into sentences according to the syntactic [structuring] system of the language he is using" (Jakobson and Halle, 1971: 73).

This latter idea is extrapolated to design as a way to describe the decisions carried out by designers (cf. Llovet, 1979). Following this, the designer first *selects* the set of functions or syntagm that will constitute the product. Then he/she selects the paradigms (particular manifestations of each function) that will integrate the proposed syntagm. Finally, the designer *combines* the paradigms so selected to achieve the product's final proposal. So that the idea of 'durability', for instance, can be represented in a product by certain forms, certain materials or even certain finishes, depending on the paradigm of durability chosen by the designer, and change according to the syntagm (way of combining those forms, materials and finishes within the product) in use.

Beyond the above interpretations of the Saussurean set of relations, there are also authors who have exclusively focused their attention on the nature of the paradigmatic relations. Such is the case of Pineda, Sánchez and Amarilles (1998) for whom the material manifestations of such a type of relations in design or 'stylemes' can follow three main directions: that of **contextual stylemes** (or those associative relations where the forms selected allude to the material surroundings and circumstances of the product), that of **paradigmatic stylemes** (or those associative relations working around forms considered as characteristic of a type of product), and that of **positioning**[90] **stylemes** (or those associative relations where formal aspects previously proposed by designers and already accepted by the public are incorporated as part of a new product).[91]

The proposals here reviewed lead us to realise, after Barthes (1969), that the syntagmatic and paradigmatic relations can be used as 'analytic tools' for decoding the system of utilitarian objects as well as 'generative tools' to outline the way in which different meanings are encoded in those objects. As an analytic 'tool', syntagmatic relations can help designers to visualise the possible segmentations within the configuration of a product; whereas paradigmatic relations guide the way in which a product and its parts are classified. In generative terms, on the other hand, the realisation of the possible syntagmatic relations helps designers to define strategies for the combination of function-signs within products, whereas the realisation of paradigmatic relations eases the selection and exchange of function-signs in products.

[90] The term *'positioning'* is here used as in marketing (e.g. product positioning, brand positioning).

[91] Clear examples of *positioning stylemes* can be found in products developed under the streamlining of the first half of the 20th century, and the *toy-look* of some Alessi's products during the early 1990s.

2.2.4. THE PEIRCEAN STRAND

Differently from Ferdinand de Saussure, the pragmatist philosopher Charles Sanders Peirce (1839-1914) did not have the opportunity to develop his theory of signs as a permanent lecturer of a university. He taught at Harvard University in 1864-65, 1869-70 and 1870-71, and at the John Hopkins University between 1879 and 1884. Therefore, his theory of signs took some time to be recognised by the academic community.[92] In Peirce's view, all our thinking and knowledge takes place through signs (Peirce, 1904). Consequently, his idea of our mind is inextricably linked to the 'world' outside it since, for him, the only knowledge we can have of things comes from externally manifested signs (Verón, 1996a). This may be the reason why Peirce defines science as a sort of behaviour provided with intention (cf. Tordera, 1978). His approach to meaning has been taken as a basis to understand semiotics as a rigorous science of cultural phenomena (Eco, 1995), even though Peirce did not define semiotics as a science but as a doctrine.

The core of Peirce's theory of reference is outlined through his definition of the sign process, which he calls **semiosis**. He describes his semiosis as the relationship among three different elements to produce sense. The first of these elements is the 'sign', which he names **representamen**. It is defined as "...something which stands to somebody for something in some respect or capacity" (Peirce 1897: 22). The second element of his semiosis is precisely that 'something' instead of which the *representamen* is standing for, called by him **object**. His third and final element is the **interpretant**. It is the psychic by-product or effect that the sign generates in the mind of a person or organism about the 'object' above defined. In other words, Peirce's semiosis is the process by which a *representamen*, an *object* and an *interpretant* are in reciprocal relation to one another so that the mere consideration of two of these elements does not make sense (Peirce, 1904). Another important element of Peirce's theory is what he calls **ground**. It is the aspect or respect through which the *representamen* represents its 'object'. Let us not forget that signs can only represent their 'objects' in some respect, i.e. partially. Otherwise, signs and their 'objects' would be the same thing and no act of 'standing for' or reference would take place. Hereof Peirce's notion of 'ground' is implicit in any *sign*.

[92] Peirce's ideas really began to be valued by the academic community after his death in 1914, especially in 1931 when Harvard University published his Collected Papers (Tordera,1978).

This triadic process of mutual influence or **semiosis** is consistent with the broad idea behind *signification*, i.e. the act where something stands for something else according to some sort of relation (Sebeok, 1986). It is also an idea revisited by Ogden and Richards (1923) in their famous semiotic triangle, where the equivalent to Peirce's 'interpretant' is called 'reference' (see figure 13). However, the real implications of Peirce's approach for the understanding of reference only become explicit once his *representamen*, *object* and *interpretant* are clarified through the study of their types.

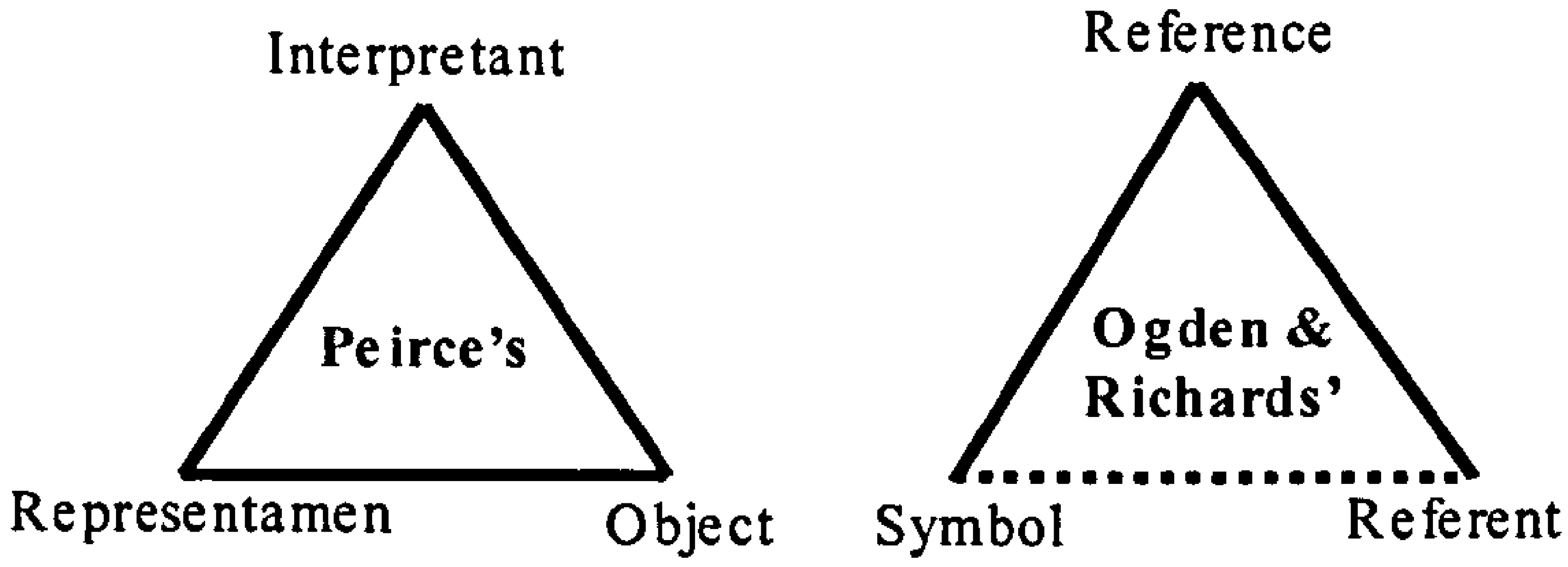

Fig.13 – Comparison between Peirce's and Ogden and Richards' semiotic triangles.

The Peircean Sign

Charles Sanders Peirce understands meaning as inextricably linked to the establishment of categories to assess any experience or imaginable condition (Tordera, 1978). This way of thinking seems to have originated from his reading of Kant's *Critique of Pure Reason* (Bürdek, 1994), to such an extent that Peirce's categories are said to be an attempt to objectivize the Kantian ones (Tordera, 1978). The categorical consideration of actual and imaginable things as part of his theory of meaning drew Peirce to realise, among other things, that signs may or may not have a tangible manifestation. This is the reason why it is not casual to find in his semiotic triangle the term 'representamen' substituting that of 'sign' since the *representamen* is not the only sign present in his semiosis. Indeed, each of the components of Peirce's triangle ends up being a sign provided that they are representations of something else (Verón, 2002). In this sense, every *interpretant* is a sign of that to which it alludes to (Verón, 1996a), as the *object* of his triangle is a sign of that part of reality the interpreter can access to (Pérez de Medina, 2002a). Thus, similarly to Peirce's *representamen*, his *interpretant* and *object* are signs but of a different nature. With this in mind, a logical starting point to clarify Peirce's understanding of reference (i.e. his view about the act of standing for) is through the categories he uses to classify signs.

According to Peirce (1908), signs generally stand for three sorts of things: ideas or *possible things*, facts or *existent things*, and what he defines as the co-existent or *needed things* (i.e. things susceptible of being agreed among people, such as habits and laws). These three universes of reference led Peirce (1904) to understand signs as part of three ways of being also understood as ways of signifying (Merrell, 1998) or universal categories (Bense and Walther, 1975). These three categories are known as: **Firstness** or that where the way of being of something is considered in itself without referring to something else (i.e. through the qualities of things, and therefore as a mere possibility since it is only based on appearances), **Secondness** or that way of being where something is defined in relation to a second thing lacking intentionality (i.e. through 'raw' interactions framed in time and space, and therefore capable of defining what a single thing actually is), and **Thirdness** or that way of being where something is outlined in relation to a second and a third thing (i.e. in terms of what things ought to be according to certain probability or need). These universal categories are thus equitable to other categories such as those of perception, experience and thought in the theory of the knowledge (Bense and Walther, 1975).

Keeping in mind his three categories, Peirce develops what he considers to be the three kinds of relations taking place among the three elements or correlates of his semiosis (the *representamen* or first correlate, the *object* or second correlate and the *interpretant* or third correlate). Each of these relations produces in turn trichotomies of signs (see figure 14) in the form of typological instances of Peirce's Firstness, Secondness and Thirdness (cf. Peirce, 1897). Such relations and signs can be summarised as follows:

a) <u>Relations of comparison</u> or those based on what is acting as a *representamen*. That is to say, a **qualisign**, if it is a quality (i.e. a tone); a **sinsign**, if it is a thing or event (i.e. a token); and a **legisign**, if it is a law or general thing established by people (i.e. a type).

b) Relations of performance or those based on the kind of *ground* used to define the relation between the representamen and its object. Thus, a sign can be classified as: an **icon,** if the ground resembles in some respect the *object*; as an **index,** if the ground is a casual or factual connection with the *object*; or as a **symbol,** if the ground is something resulting from an agreement or rule of convention.

c) Relations of thought or those based on how the *object* of a representamen is conceived in its interpretant. From this perspective, a **rheme** is a sign derived from interpreting the *object* as a possibility, the **dicent** is a sign resulting from envisaging the *object* as something with real existence, and the **argument** is a sign derived from understanding the *object* not as a single thing but a law.

	Relations of Comparison	**Relations of Performance**	**Relations of Thought**
Firstness	Qualisign	Icon	Rheme
Secondness	Sinsign	Index	Dicent
Thirdness	Legisign	Symbol	Argument
	Representamen	**Object**	**Interpretant**

Fig. 14 – Charles Sanders Peirce's basic categorisation of signs.

The best known application of this categorization of signs to design is that outlined by Max Bense in 1969 as part of his *Introduction to the Information-theory Aesthetics* (1972). Here, he develops a quite comprehensive theory of reference for aesthetic processes interpreting Peirce's semiosis as a sign process aiming at a coordination (*'Zuordnung'*, in German) resulting from the mutual relation among a **medium,** an **object** and an **interpretant,** i.e. a semiotic triangle similar to that of Peirce but with its 'representamen' renamed as 'medium' (see figure 15). In this new triangle an *object* is designated by a *medium* through the mediation of an *interpretant,* defining in this way a model to describe any phenomenon of signification, communication and invention in design (Pérez-Carreño, 1998).

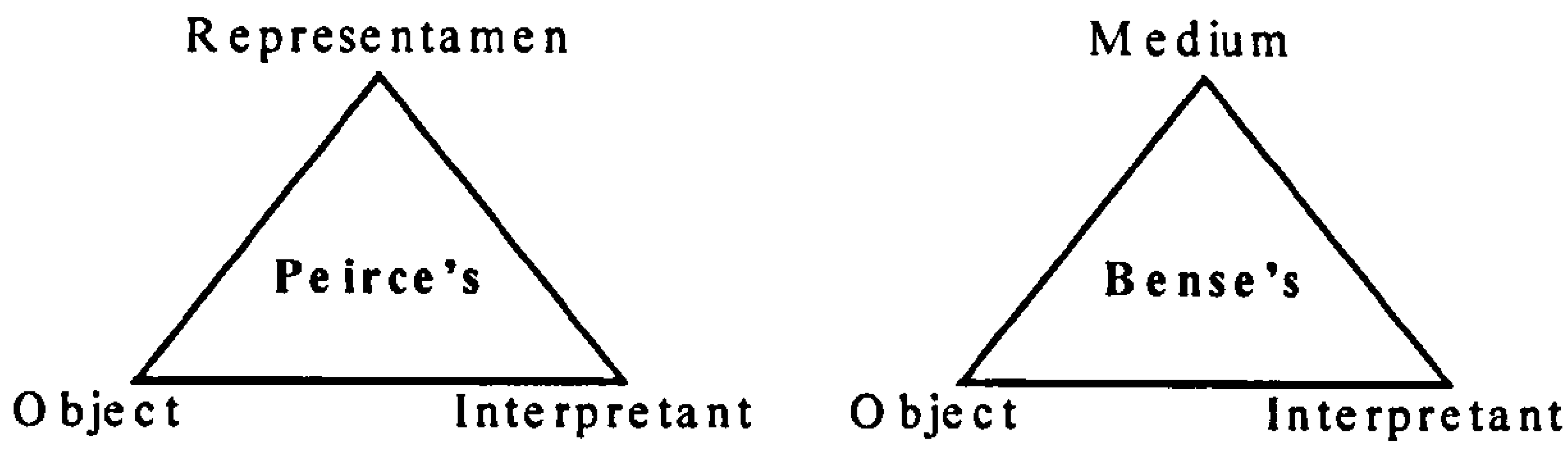

Fig. 15 – Comparison between Peirce's and Bense's semiotic triangles.

Standing on his semiotic triangle, Bense (1972) formulates what he considers as the three functions of all signs acting as part of aesthetic processes (Bense and Walther, 1975).[93] These functions are **communication, realisation**, and **codification**; and they are conceived by Bense as corresponding to acts of reference linked to the *medium*, the *object*, and the *interpretant* of his triangle respectively. Such references are produced following three types of sign operations (see figure 16):

1. Adjunction or the consecutive attachment of singular signs to a series of signs based on similarities in their *objects* or *interpretants*. For example, the addition of signs such as smooth finishes and rounded forms to a white kettle based on their capacity to stand for cleanliness.

2. Iteration or the formulation of new signs through the production of new *interpretants* based on existing *interpretants* (i.e. through the re-interpretation of existing interpretations). For example, the use of the colour black instead of white in kitchen appliances to reinterpret the idea of cleanliness as the hiding of dirtiness.

3. Superisation, that is, the creation of **supersigns** or signs of a more complex structure through the use of adjunction and iteration.

[93] Bense (1972) shares with Charles Morris the idea that there is no such a thing as an aesthetic sign. Therefore, he focuses instead on aesthetic sign processes.

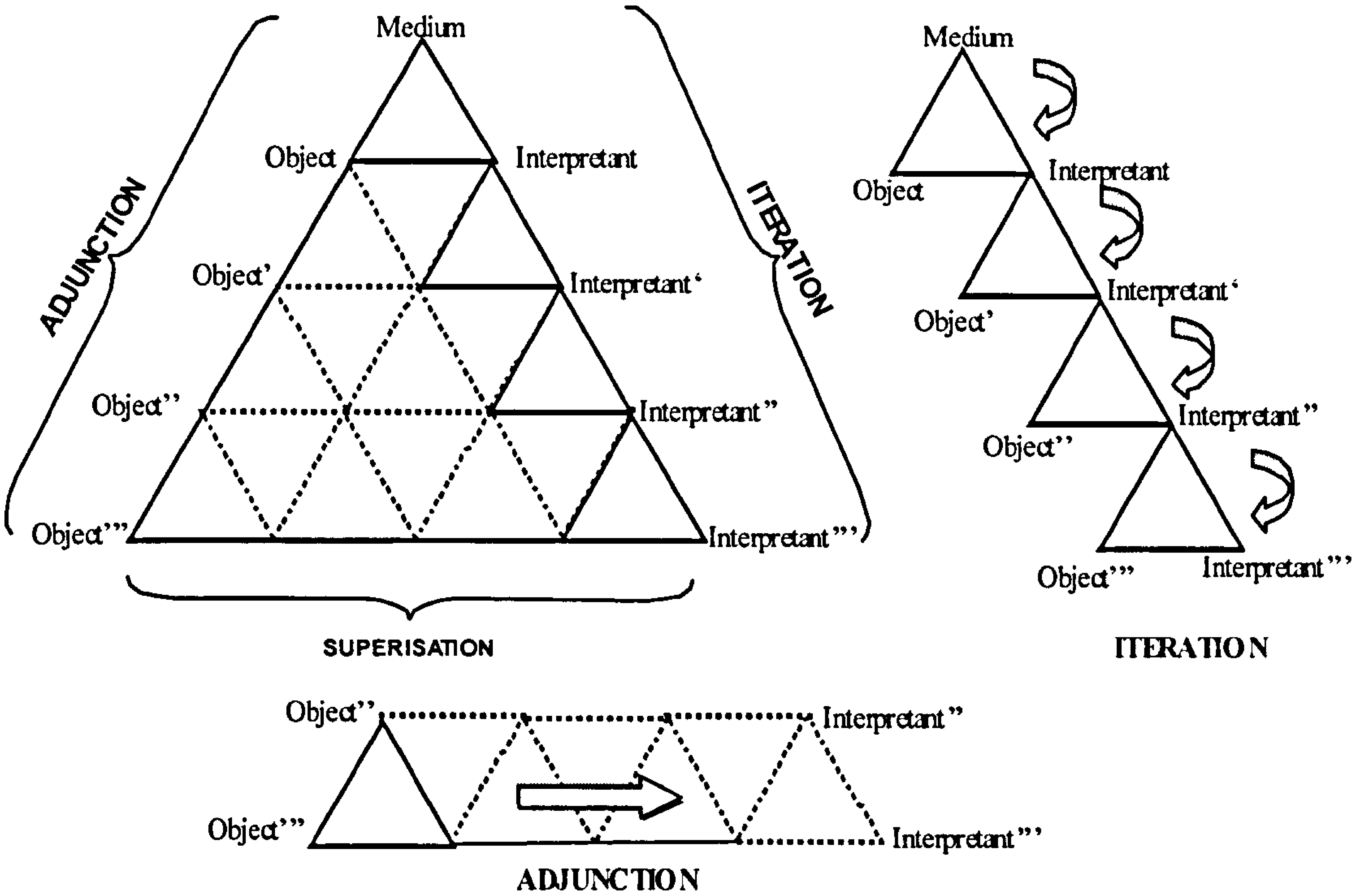

Fig. 16 – Bense's sign operations for the generation of references by the encoder.

These sign operations generate different types of apperceptions (acts of recognition, identification or comprehension) in the beholder/user. These apperceptions turn the bits of information present in the artefact into signs (representations) according to a sequence that begins with the awareness of **references about the *medium*** (i.e. about the nature of the representamens used), followed by the realisation of **references about the *object*** in the artefact (i.e. about the way in which connections are made to express what the artefact is standing for), and ending with the grasp of **references about the *interpretant*** (i.e. about the effects/interpretations elicited by the signs comprising that artefact). These three kinds of references are in turn subdivided into types of signs. They are: qualisigns, sinsigns and legisigns for the references about the *medium*; icon, index and symbol for the references about the *object*; and rheme, dicent and argument for the references about the *interpretant* (see figure 17). This list of signs, however, only reflects Bense's basic adaptation of Peirce's theory for the case of aesthetic processes since other signs, resulting from combinations among these nine basic types, are also suggested by him. But, given the scope and nature of the present research, only the basic types of signs are here mentioned.

	Media Reference	Object Reference	Interpretant Reference
Firstness	Qualisign	Icon	Rheme
Secondness	Sinsign	Index	Dicent
Thirdness	Legisign	Symbol	Argument

Fig.17 - Bense's types of signs used to produce references in aesthetic processes.

Of all the types of references before presented, those designated by Bense as *references about the object* seem to have become the most popular among aestheticians and design theorists, especially those of iconic nature. This may be due to the relevance assigned to icons in aesthetic studies. Indeed, as we shall see later in this research, the first theorisations about the semiotics of aesthetics revolved around iconic references (see the 'Morrisian dyadic dimensions' in section 2.2.5). Bense even developed a classification of icons into four categories quite applicable to design products. Such a classification is based on what icons allude to. Thus, his **topological icons** refer to figurative properties of things, his **structural icons** allude to the way in which something is structured (including Gestalt constructions as part of it), his **material icons** refer to the material features of things, and his **functional icons** to the functional aspects of things (Bense and Walther, 1975). Thus, he provides icon types to stand for different aspects of a product.

Guided by a different concern[94] and following the idea that icons are propositions about mental images (cf. Maldonado, 1974),[95] Tomas Maldonado substantiates a classification of icons into 'hard' and 'soft' (Maldonado, 1979). He defines **hard icons** as those whose cognitive consistency is guaranteed by an indexical import, i.e. icons which have been produced as marks or imprints. Whereas, **soft icons** are defined by him as special icons whose cognitive consistency has nothing to do with

94 According to Maldonado (1979), semiotic studies are only focused on icons as imprints letting aside the possibilityof studying icons based on their cognitive value.

95 For Maldonado (1974), iconicity is contagious. Insomuch that *visual icons* contaminate the words used to describe them and *verbal icons* contaminate the images by which they are represented. Such a contagious nature is according to him born from the assumption that icons are propositions about mental images.

marks and imprints, but with the sort of similarity derived from activities such as modelling, simulating, categorising and classifying. Dual distinctions such this, however, are quite rare in appraisals of design provided that iconic outcomes and iconic processes are normally presented in united form. Clear examples of this situation are the types of iconic references suggested by authors like Susan Wittig, Donald Bush, and Susann Vihma.

Based on architectural design, Susan Wittig (1979) identifies the existence of three types of iconic self-references (representations of design by design in itself) which are also applicable to product design. These are: **metalingual references** or those focused on the design code (i.e. 'design depicting design'), **metaderivational references** or those centred on the way in which the components of the design code are materially realised (i.e. 'design depicting the making of design'), and **metacommunicative references** or those emphasizing the socio-cultural clichés associated to design messages (i.e. 'design depicting the context surrounding design'). Donald Bush (1990), on the other hand, has proposed two types of references for design in the form of *anthropomorphic icons*. They are: **body reflectors** or icons that resemble forms of the human body and its constituent parts, and **negative body icons** or those resembling 'moulds' in which body forms could be cast (e.g. shoes, gloves and caps).

Close to the ideas of these two authors, Susan Vihma (1992) has suggested a categorization of the iconic references in product design standing on the idea that iconicity basically functions at two levels: that of the product's general form and that of its formal details. With this in mind, Vihma proposes the following six categories of **iconic references**: the *tradition* of *form* or the product's proper form (e.g. the scissor-like form in scissors), *similarity of colour* (e.g. the white colour of many kitchen appliances), *similarity of materials* or evocation derived from the use of materials (e.g. a golden picture frame as evoking luxury), the *metaphorical reference* or likeness of form between two different objects (e.g. the form of beetles as insects and that of the vehicle produced by the Volkswagen), the *stylistic reference* or identification of a product with certain groups of forms (e.g. the military–look), and the *environmental reference* or that working through the reproduction of features seen as representative of certain environs (e.g. leisure products).

Following similar ideas to those in Vihma's stylistic and environmental references, Angela Dumas (1994), from the Centre for Design Management of the London Business School, developed a design strategy called **'totem building'**.[96] Such a strategy aims to generate design proposals through the use of object-based and context-based metaphors. This design strategy, however, is not inspired in Vihma's work but in findings about human categorization from cognitive psychology.

Beyond these ideas about iconic references, Susan Vihma (1995) has also formulated an approach to the indexical and symbolic references of design products. She has realised the existence of nine modes of indexical references and five modes of the symbolic ones. Her modes of **indexical references** are: the trace left by a tool (as an index of how the object was manufactured), the form and details of a product pointing to certain action (pushing, grasping, turning, etc.), the marks of use (traces of abrasion in the form and colour of the product), traces indicating the quality of materials (marks of endurance against particular circumstances), references derived from tactile interaction (those related to the product's temperature, weight, etc.), the lights and sounds that complement the feedback coming from the product's displays, the smell of the product, and finally, the graphism that supports the actual function of the object. In relation to **symbolic references**, Vihma outlines the following: the graphic symbols and lettering applied to the product, the social conventions associated to the use of certain colours, the form of objects culturally agreed, the functional agreements expressed in the positions and postures of design products when they are used (e.g. direction to open lids or turn knobs), and the symbolic associations assigned to certain materials and substances.

Vihma's work has the virtue of being one of the few attempts undertaken to introduce such theoretical complexities in practical and accessible terms to designers. Nevertheless, her so-called 'modes of reference' lack the sort of

96 In the anthropological jargon a 'totem' is "...a plant, animal or object which is the symbol of a social group" (Abercrombie, Hill and Turner, 1994: 431). Dumas' use of 'totem' is closer to the Peircean understanding of symbols as signs capable of being partially composed by signs of other types (icons and indexes).

systematic coherence which is expected in taxonomical appraisals of design. On the other hand, her focus on description and numerous 'modes of reference', leaves us with the impression that such 'modes' are only few of an endless list of possible cases. Indeed, she seems to be more concern with particularities seen in products than with general issues. In this respect, authors like Sven Hesselgren and Arthur Berger have shown that, in order to be coherent, semantic categories in design need always to be addressed in the simplest possible terms. As a matter of fact, Helsselgren (1969) outlines the study of meaning in architecture (called by him 'Architectural Semantics') using only three grand categories (spontaneous, associative and conventional meanings), whereas Berger (1989) uses only four categories to study the production of meaning in visual communication (i.e. resemblance, signification, cause and effect, and convention). Another way to achieve taxonomic coherence is by narrowing the scope of study as happens in Wittig's and Bush's proposals.

Finally, it is worth mentioning that the idea of people's apperceptions as ways of defining acts of reference in design products has also been envisaged outside semiotics. Looking at the informative qualities of design products, Ingo Klöckler realised the existence of three basic kinds of information as part of them (Klökler, 1980 in Vihma, 1995): **information about existence** (the product expressing its material presence as an artefact), **information about origin** (the information the product provides about its: designer, manufacturer, country and culture), and **information about quality** (about how the product communicates its function, use and maintenance). Similarly but standing on the meaning of the words people use to refer to artefacts, I also realised the presence of four referential dimensions in our understanding of products (Lacruz-Rengel, 1997 and 1998). They are: EXISTENCE or ontological dimension, which is expressed in the word 'object' whose is 'something standing on our way'; ORIGIN or aetiological dimension, which is referred through words about how our material things are made, such as artefact, handcraft, and product; PURPOSE or teleological dimension, which is expressed through words such as utensil, tool, and machine; and finally KNOWLEDGE or gnoselogical dimension, which is outlined through words that clearly define what things are, such as car, telephone, and knife.

The Peircean Object

According to Peirce a sign stands, in some respect, for the 'object' of his semiosis. Such an 'object' is not a physical one, as mistakenly suggested by some authors (cf. Hjelm, 2002), but a theoretical/semiotic one (Merrell, 1998). This is why neither the representamen nor the interpretant can represent the *object* in all its 'respects'. Indeed, most of the time Peirce alludes to his object in two ways: as something internal to his representamen or **immediate object**, and as something external to his representamen or **dynamical object** (cf. Peirce, 1908).[97] The former is the *object* such as it is represented in the representamen (Peirce, 1904), that is, a percept (Peirce, 1974), an *object* somehow accessible to direct perception but distinctive from actual objects (Merrell, 1998). The latter or *dynamical object* is the *object* of Peirce's triadic relation (Peirce, 1904), the *object* located in one of the points of his triangle (Peirce, 1974), that is, an object independent from direct perception but 'real' since for Peirce reality is always beyond our knowledge of it. In this sense, the *immediate object* is nothing other than an indication of the *dynamical object*, whereas this latter acts as a framework for the identity of the *immediate object* (Tordera, 1978).

Thus, besides the 'semiotic reality' (that derived from sign processes), for Peirce there is a reality whose nature does not depend on our representations (Verón, 1996b). This dual conception of reality was taken by Max Bense in the 1960s as a starting point to understand design as the result of a kind of **co-reality** (*Mit-Realität* in German). In his view, this co-reality emerges in design when our ideas of reality are superseded by new blends between the reality of the *contingent* (aesthetic) and the reality of the *necessary* (functional) in the form of new products (Bense, 1960). This idea of co-reality is also present in the theoretical proposals of other authors. Like Bense, some of them have understood co-reality as a blend of the functional and the aesthetic sides of product design (Moles, 1975, Bonsiepe, 1980). Others have re-interpreted it as encapsulated in the two types of information present in

[97] In some of his writings, Peirce uses the term 'Dynamoid object' to allude to his '*dynamical object*'.The latter has been preferred here giving that it is the term mostly used by those dedicated to the study of Peirce's ideas.

design messages (Moles, 1966),[98] the two types of complexity commonly present in the analysis of utilitarian objects (Moles, 1966 and 1975),[99] and the two types of communication that take place through products (Maldonado, 1961a).[100] The persistence of such a notion in these authors' work is not casual at all since they taught at the Ulm School of Design were the ideas of Peirce were taken as an important inspiration to systematize design studies (Bonsiepe, 1995b; Betts, 1998).

Peirce's notion of co-reality also inspired semioticians in general to speak about 'triadic objects'. That is to say, about objects which relate all three elements of Peirce's triangle without being one of them, and whose existence stems from the fact of being holders or carriers of signs (Bense and Walther, 1975). Within design, triadic objects were called 'design-objects' and their application for the analysis of products was developed by Max Bense. Such an initiative began in the 1950s when Bense formulated a semiotic triangle to explain the world of the advertising poster or *Plakatwelt*. In this triangle the design-object was seen as derived from the triadic relation between a *medium* that acts as the representamen, a *merchandise* that acts as the 'object' and a *value* seen as the interpretant (Bense & Walther, 1975). Following this experience, Bense came out in the 1970s with a clearer definition of design-objects. He envisaged them as semiotic triangles in which the place of the *medium* is reserved for signs alluding to MATERIAL (references of the matter), the place of the *object* for signs about FORM (references of the object), and the place of the interpretant for signs about FUNCTION (references of the interpretant) - see figure 18.

With this new model of *design-objects* in mind, Bense realises that each of the three points of his new triangle is in turn defined by a triadic object of its own, which he calls: technical materiality, technical object, and technical function (Bense and Walther, 1975). The **technical materiality** is a triadic object that belongs to the

98 According to Moles (1966), aesthetic activities such as design are comprised by two types of information: *Semantic* and *aesthetic*. The former is logic, utilitarian, and translatable; whereas the latter is contingent, non-utilitarian, and untranslatable (Moles, 1966).

99 For Moles (1966 and 1975) the analysis of utilitarian objects implies the consideration of two types of complexity: one *functional*, based on people's use of products, and one *structural*, focused on the arrangement of the product's different parts.

100 According to Maldonado (1961a), communication in design products can assume two forms: one *operative* which aims at evoking action, and one *persuasive* which aims at influencing the behaviour of an interpreter.

universe of the possibilities or *Firstness*. It emerges from a triadic relation whose 'object' is an *icon*, its medium is a *qualisign* (a quality or tone), and its interpretant is a *rheme* (a mental representation of a material quality) - see figure 19. As such it alludes to that part of design dealing with the "...iconic representation of material qualities open to any interpretation" (Krampen, 1979b: 159). In other words, it refers to the contribution of the product's material qualities to its interpretation. The **technical object**, on the other hand, is a triadic object whose nature is that of facts or *Secondness*. It is derived from a triadic relation whose 'object' is an *index*, its medium is a *sinsign* (a token), and its interpretant is a *dicent* (a representation based on actual existence) - see figure 19. As such the *technical object* refers to that part of design dealing with the indexical representation of products in the form of tokens. Finally we have the **technical function.** It is a triadic object that belongs to the realm of thoughts and agreements or *Thirdness*. Consequently, it originates from a triadic relation whose 'object' is a *symbol*, its medium is a *legisign* (a type), and its interpretant is an *argument* (a representation with status of law) - see figure 19. Therefore, it alludes to that part of design dealing with the representation of types of products whose interpretation is restricted by conventions.[101]

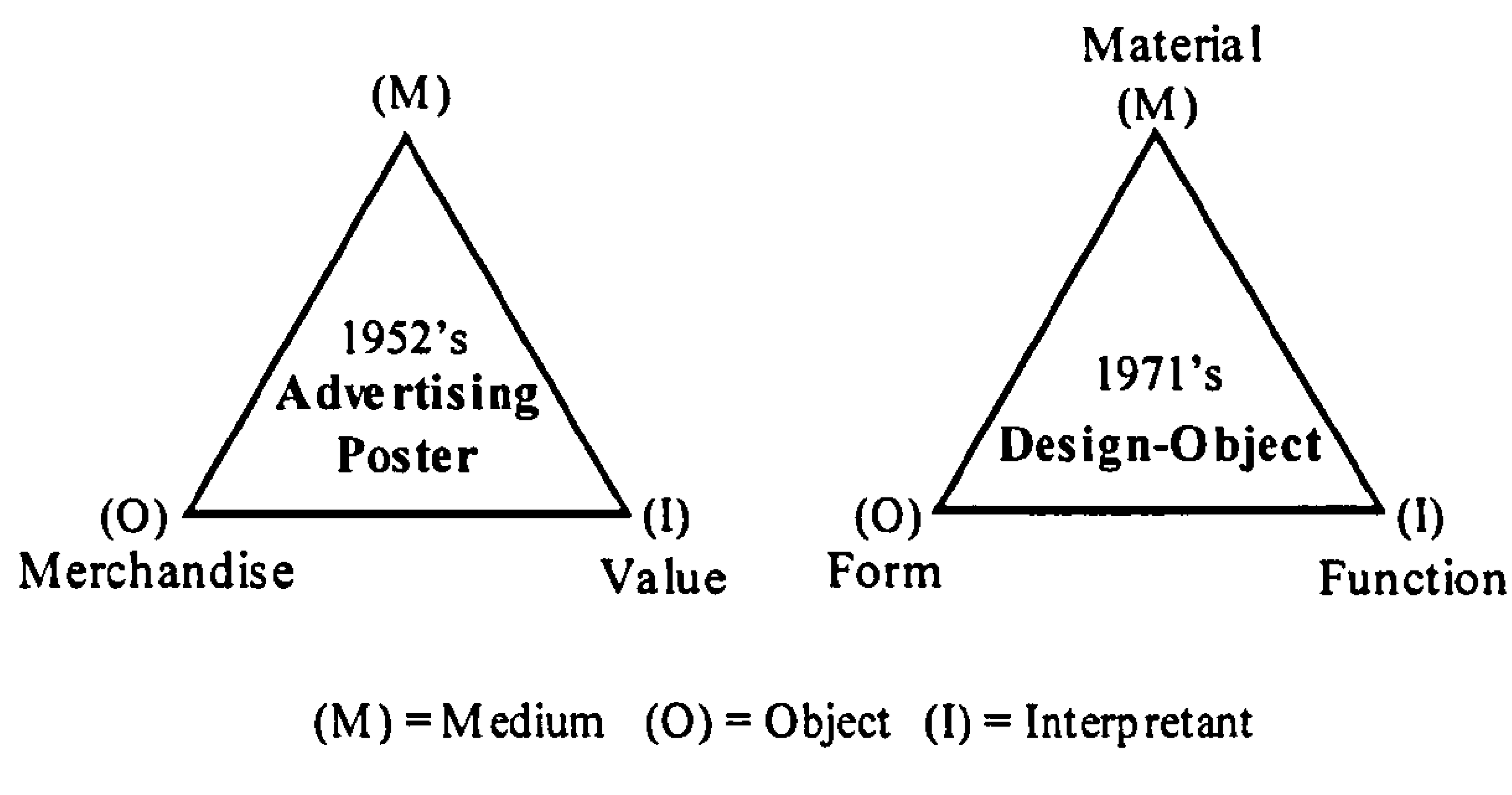

Fig. 18 – Bense's ways of understanding the triadic object.

Bense's approach to *triadic objects* is unique in design theory given that other authors tend to focus only on the references of the *object* (i.e. icon, index and symbol) without resolving the relation between these and the references of the matter and those of the interpretant. This situation, however, does not make their

[101] For instance, the definition of a spoon as "...a concave surface for holding liquids, with a handle attached to facilitate movement of the liquid and to provide protection for human hands in case the liquid is hot" (Moore, 1976: 12).

contributions less interesting. Among these authors are Danielle Quarante, Susann Vihma, Charles Jencks, and myself. In Quarante's (1992) view, the types of signs derived from Peirce's *relations of performance* (i.e. icon, index and symbol) are the key to define when a design proposal has a stylistic, formalist or functionalist emphasis (for details see 'The Morrisian dyadic dimensions in section 2.2.5). Vihma (1995), on the other hand, uses the signs of Peirce's relations of performance as the way to explore the presence of particular kinds of references in design products (see Vihma in 'The Peircean sign'). Differently from Quarante and Vihma, Jencks (1981) and myself (1997) have been concerned with the sequence in which iconic, indexical and symbolic references take place in the creation of design products throughout their life span. For Jencks this sequence begins with the realisation of indexical references, followed by the use of iconic references, and the application of symbolic references at the end; whereas in my view such a sequence should be arranged the opposite way (see section 2.2.8 for details).

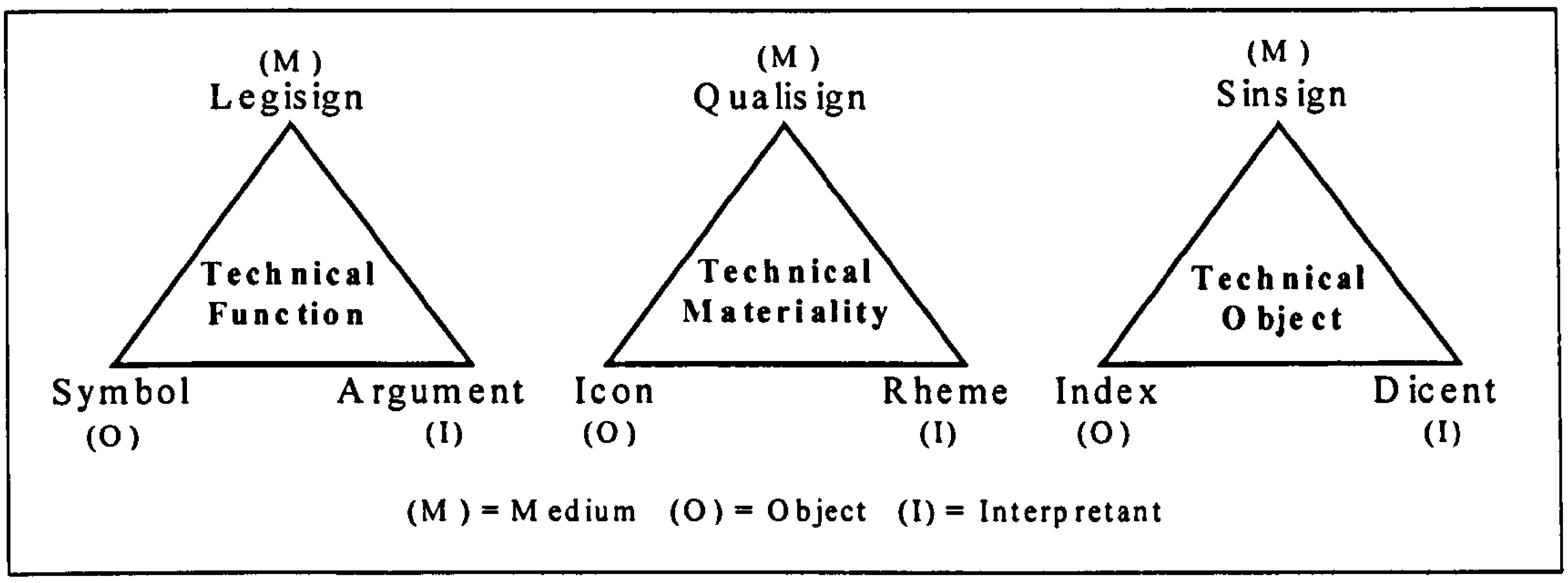

Fig. 19 –Bense's sub-types of *triadic objects*.

Finally, it is worth noticing that the notion of 'object' suggested by Peirce is commonly used in design but with different names. Indeed, it is somehow present in the motto 'form follows function', when 'function' is seen as the abstract principle inspiring different ways of giving form to artefacts (cf. Arnheim, 1978). It is also present in the definition of 'form' defended by authors such as Charles Moore (1976), for whom an artefact can have billions of possible *shapes* but only one *form*. More recently, the recognition of an abstract notion or 'system' from which ideas for artefacts are created is another example of it (cf. Norman, 1988) – see figure 20.

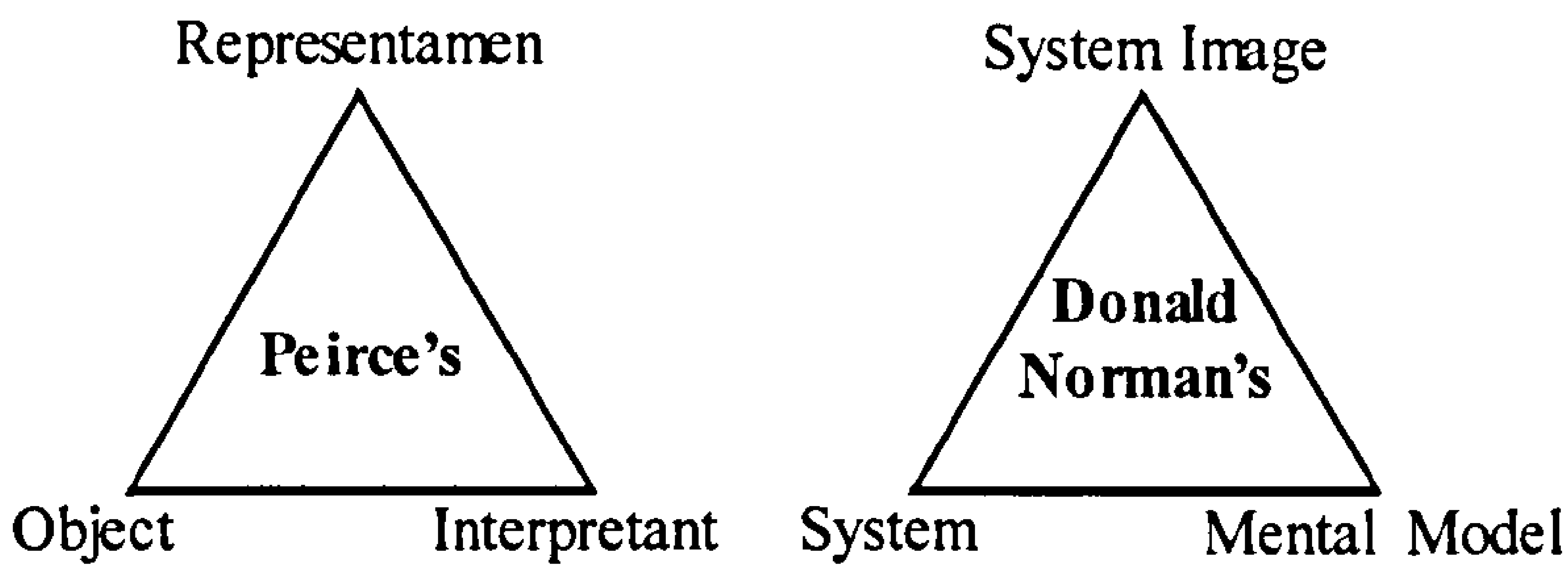

Fig. 20 – Comparison between Peirce's triangle and Norman's idea of artefacts.

Max Bense's proposal also counts with theoretical parallels in the philosophy of art. An example of this is in Nelson Goodman's *Routes of reference* (1984). Like Bense, Goodman understands reference as covering all cases of standing for. Furthermore, Goodman's definitions of denotation, exemplification, and expression in art share some important commonalities with Bense's technical function, technical materiality, and technical object respectively, so that the latter could be understood as instances of the former.[102]

The Peircean Interpretant

The term '*interpretant*' was chosen by Peirce for his third correlate because this correlate functions similarly to an interpreter who translates things from one language to another (Merrell, 1998). Indeed, for Peirce our understanding of reality is inevitably mediated by interpretants, so that our mental life is a huge chain of them beginning at our most basic conjectures and ending at the level of our habits and dispositions for action (Eco, 1994). With this in mind, Peirce divided his interpretant into three types: immediate, dynamical and final. They encapsulate his three ways of signifying: that of possibilities (Firstness), that of facts (Secondness) and that of probability and need (Thirdness) (Merrell, 1998).

The **immediate interpretant** is the interpretant such as it is represented (Peirce, 1904), that is, as a sort of immediate sensation (Merrell, 1998) or qualitative

[102] For Goodman (1984), *denotation* is equivalent to labelling (naming), depicting and describing things; *exemplification* is defined by him as a 'denotation by inversion' (a return reference from what is denoted to its labels, depictions or descriptions); and *expression* is defined as the metaphorical possession of things using means such as marks and symbols.

impression produced in the mind of an interpreter without alluding to any particular context or situation (Bense and Walther, 1975). In this sense, the *immediate interpretant* is the possible meaning or interpretability of the representamen before having any interpreter (Peirce, 1909). Differently from this, the **dynamical interpretant** is the actual effect that a representamen produces in its interpreter (Peirce, 1974). This is a real and singular event determined by that which is individually experienced in each act of interpretation (Peirce, 1909). The **final interpretant**, on the other hand, is the interpretative result that each interpreter is destined to achieve if the sign is sufficiently considered (Peirce, 1909). As such it encapsulates the whole semantic field of Peirce's *object* (Tordera, 1978). This is the reason why it is continuously searched through different *dynamical interpretants*.

The most comprehensive application of this part of Peirce's theory to design is perhaps that of Max Bense (1972) in his *Information-theory Aesthetics*. He begins this theoretical exploration by contending that there are three kinds of states of the world: physical, semantic and aesthetic. **Physical states** are about the way things are, comprised by physical things, characterised as causal events and defined as *reality in itself.* **Semantic states** are about conventions, comprised by meanings, characterised as communicative events and defined as an *external reality.* **Aesthetic states**, on the other hand, are about the things we make, comprised by carriers (art works, design products, etc.), characterised as creative and defined as *co-reality.* Design – as any other aesthetic creation – comes to be the result of the way in which the physical and semantic[103] repertoires are put together to generate an aesthetic state, that is, a state of order.

This state of order can be, according to Bense, of three types: chaos-genetic or highly mixed/disordered, regular or structured, and irregular or arbitrarily configured as part of a singular Gestalt. These types allude to three referential orders revolving around Peirce's object: *symbolic order* (for the chaos-genetic one), *iconic order* (for the regular one), and *indexical order* (for the irregular one). And each of these orders corresponds respectively to the following **references of the interpretant** or modus of behaviour: final-teleological behaviour, emotional-

[103] The semantic elements of a repertoire are called *'Semantemes'* by Bense (1972) and comprise motifs, tendencies and contents.

analogical behaviour, and apophantic[104]- digital[105] behaviour. Thus, from this view, what design creates are different states of order which, according to their nature (mixed, structured or arbitrary), tend to be more normative, interpretative or descriptive.

Other authors working with Peirce's interpretant have either develop new views by re-interpreting it in different terms to those of semiotics or focus their views on the recognition of the interpretant's place in designing. An interesting example of the first case is in the work of Mihaly Csikszentmihalyi and Eugene Rochberg-Halton (1981). Working from a psychological perspective, they envisage the interpretant as a way to allude to the memories, thoughts and emotions evoked by people's things. In their view, the meanings people assign to their cherished possessions come from psychic activities in the manner of communicative sign processes between people and things, which they call 'transactions'. Each transaction is theorised as a triadic sign process comprised by a person, a thing and a mode of transaction, and three modes of transactions are defined based on Peirce's three ways of signifying – see figure 21.

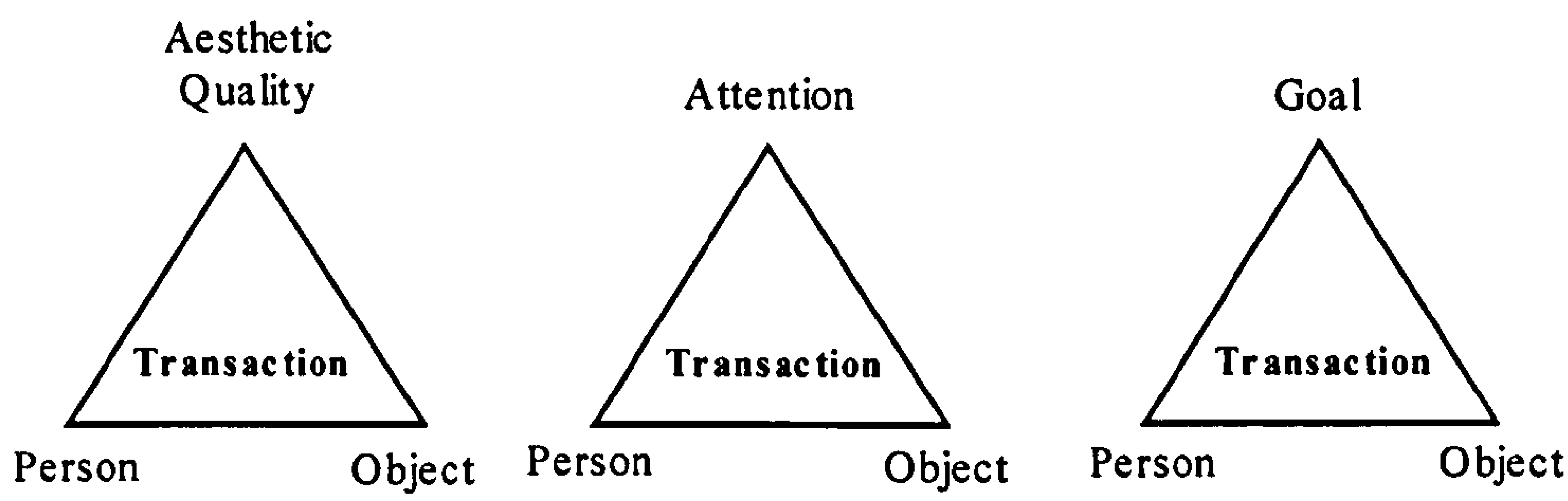

Fig. 21 – Modes of transactions between people and things according to Csikszentmihalyi and Rochberg-Halton (1981).

The first mode of transaction refers to the consummation of experiences through the perception of the qualities of things. These qualities play the role of mediating signs of consciousness linked to specific situations and contexts, and hence capable of

104 *Apophantic* = something having an attributive nature (from the Greek *Apophantikós* = put something in the light or make something to be known). It is the name given by Aristotle to the propositions that announces something, either real or false (Quillet, 1969: Vol. 1).

105 The term *Digital* is used within semiotics to describe something as 'arbitrary' - as opposed to 'analogical', i.e. to things linked to something else naturally – (cf. Fiske, 1990).

modifying people's formed habits and mental schemes of thought. Thus, this kind of transaction alludes to our **cognitive awareness** of what things are about in experiential terms so that the original purpose of things is normally denied in favour of different and new ways of looking at them. Things are indeed seen as having their own story and a living quality for their owners, since they have helped their owners to create new experiences. Examples of these transactions are those derived from people's interaction with plants and books.

The second mode of transaction has to do with the channelling of psychic energy (flow) through the **attention** devoted to things. Indeed, "...most of our interactions with possessions consist of habitual patterns of attention" about those things we consider to be significant to possess (Csikszentmihalyi and Rochberg-Halton, 1981: 181). In this respect, the attention we assign to objects reflects the 'order of things' we live by, bringing out the affective side of our consciousness. This happens in two ways: "...by providing a familiar symbolic context..." in which the identity of the owner is reaffirmed, or by engaging ourselves in activities that focus our psychic energy on particular things (Csikszentmihalyi and Rochberg-Halton, 1981: 187). Examples of this mode of transaction are in the role assigned to music stereo players in youngster's activities and the interest displayed by elders toward pictures.

The third mode of transaction between people and things has to do with the role of intention in the meaning of our cherished possessions. From this view the meaning we assign to things "...help to socialize and influence [our] conduct toward certain ends and goals" (Csikszentmihalyi and Rochberg-Halton, 1981: 188). It is a mode of transaction that revolves around that active aspect of our conscious life known as **conation** (from the Latin *conari* = to try or strive). Examples of this mode can be found in our preference for certain meanings and things to motivate actions such as being in touch with the people or places we love. Thus, "the possessions one selects to endow with special meaning out of the total environment of artefacts are both models of the self as well as templates for further development" (Csikszentmihalyi and Rochberg-Halton, 1981: 189). Thus, differently from Bense's, Csikszentmihalyi's and Rochberg-Halton's account of the interpretant cast some lights on how design products are perceived by their owners based on cognition, attention and conation.

Similarly to Csikszentmihalyi and Rochberg-Halton, the design academic Thomas Ockerse (1984) has asserted that our knowledge of Peirce's object is sharpened by the interpretant provided the fact that it helps to clarify the who-what-where-when-how and why of the object together with questions about functions, interpreters, contexts and values. The interpetant is thus understood as "...the critical mediating filter [for designing], since its function is to truly correlate the pragmatic conditions of the sign" (Ockerse, 1984: 271). Taking this idea even further, Susann Vihma (1997) has pointed out that our meaningful interpretation of products is active and creative since it also "...adds something to perception and is partly subjective" (Vihma, 1997: 41). Therefore, interpretants are more than just 'filters' for our interpretation of products, they are also catalysts of new interpretations as suggested by Bense and Csikszentmihalyi and Rochberg-Halton.

2.2.5. THE MORRISIAN STRAND

Charles William Morris (1901–1979) was an American philosopher involved with the Vienna Circle of logical positivism, and an active member of the Unity of Science Movement (a movement holding that all sciences share the same language, laws, and method or at least one or two of these features). His theoretical approach to reference is inspired by the writings of Charles Sanders Peirce[106] and the theory of action of George Herbert Mead, and his work is perceived as an attempt to formulate a scientific explanation of semiotics (Bürdek, 1994). Besides this, Morris is the first renowned semiotician attempting to unveil the nature of design through his understanding of aesthetics, science and technology as different but interlocked in every product (Morris, 1939b).[107] In terms of reference Morris' theory can be summarised through his understanding of semiosis, his three types of dyadic relations for the study of semiosis, and his definition of the modes of signifying.

[106] Some authors see Morris' work as a misleading dyadic reading of Peirce's triadic semiotics (Halton, 1992).

[107] According to Morris (1939b), aesthetics, science and technology encapsulate three kinds of dicourses or ways of undertanding things. The *aesthetic discourse* is concerned with 'the vivid portrayal' of what value things have for us is or, the *scientific discourse* refers to the statemental or predictive character of things, and the *technological discourse* alludes to the devices by which our needs are satisfied.

The Morrisian understanding of semiosis

Morris (1985)[108] defines **semiosis** as the process in which something functions as a sign, this being comprised by four elements: a **sign vehicle** (something which acts as a sign), a **designatum** (that to which the sign refers), an **interpretant** (the effect produced by the sign vehicle in certain interpreter), and an **interpreter**. For him semiosis is "any situation in which one thing takes account of something else... through the mediation of a third something" (Morris, 1939a: 132). Thus, in Morris' understanding of semiosis the mediators are *sign vehicles*, the act of 'mediated taking account of' is the *interpretant*, and what is taken account of mediately is called the *designatum*.

Within this process, something is considered as a sign if, and only if, it is taken as a sign of something by some interpreter (Morris, 1985). This places any variation of the sign process in the interpretants, i.e. in the effects sign-vehicles cause in the interpreter. On the other hand, Morris' (1946) theory provides a direct account of true and false *references* (i.e. of ways of standing for) in sign processes since it assumes that not all signs refers to actual things. In order to describe this situation, he substitutes the *designatum* (that to which the sign refers) of his definition of semiosis for the term **significatum** to allude to both true or false referents, and the term **denotatum** to exclusively refer to true referents. With this in mind, Morris (1946: 18) points out that "while a sign must signify [i.e. must have a meaning], it may not denote [i.e. refer to true things]".

This theoretical distinction became especially useful to explain design as a **technical form** by contrast to art as an **aesthetic form**. Indeed, based on Morris, Bense (1960) suggests that the signs of the aesthetic world coincide with those of the technical world by the fact of being both initially determined by their *denotatum* (by the real things they refer to), but different from each other since art turns the initial denotation of something into the designation of something else (even fictitious things), whereas design always designates the same thing originally denotated (i.e. the function of the object) regardless of the way in which it is envisaged by the designer.

[108] This is the date of the first Spanish edition. 1938 is its original date of publication in English.

The Morrisian dyadic dimensions

The most quoted contribution of Morris to design theory is his division of semiotics into three different dimensions: semantic, syntactic and pragmatic. These dimensions are characterised as dyadic given that they relate the elements of Morris' semiosis by pairs. Indeed, these relations are (Morris, 1985): between sign vehicles and objects for his *semantic dimension*; between sign vehicles themselves for his *syntactic dimension*; and between sign vehicles and their interpreters for his *pragmatic dimension.* Each of these dimensions is also characterised through verbs to describe the kind of actions taking place as part of them. Thus, whereas in the semantic dimension signs *'designate'* or *'denote'* something; in the syntactic dimension signs *'imply'* the presence of other signs, and in the pragmatic dimension signs *'express'* certain things for their interpreters.

These dimensions are not so distant from Peirce's views on semiosis. Indeed, they can be understood as a re-interpretation of Peirce's (1897) relations of *comparison*, *performance*, and *thought* for sign processes. On the other hand, the application of Morris' dyadic dimensions to design is almost as old as their original formulation provided that it was Morris himself who realised that these three dimensions were related to the aesthetic, scientific and technological discourses of products (Morris, 1939b). In this respect, the *scientific discourse* is identified with the semantic dimension because "it brings into prominence the relation of signs to the objects denoted"; the *aesthetic discourse* is related to the syntactical dimension since it focuses on the distinctive ways in which signs structure themselves; and the *technological discourse* is identified with the pragmatic dimension because it "...emphasizes the efficacy of the signs in the practice of the users" (Morris, 1939b: 411).

With such antecedents, Morris' dimensions found their way into design studies without much difficulty. Indeed, they have been used in two basic ways: to describe specific aspects of design, and as an inspiring force to develop comprehensive models about designing. Clear examples of the first kind can be found in the writings of authors such as Susann Vihma, Horst Oehlke, Sigfried Maser, Gui Bonsiepe, and Abraham Moles; whereas examples of the second kind are in the theoretical models created by authors such as Max Bense, Walter Schaer, Danielle Quarante, and Matthias Rauterberg and his associates.

For Vihma (1987), Morris' dimensions provide three types of criteria for the analysis of design products. These criteria are: *syntactic* when they refer to the structure and composition of the product's form, *semantic* when they allude to "...the substance of the relationship between the form [of the product] and its functions" (Vihma, 1987: 179), and *pragmatic criteria* when they deal with the interpretation of the product's form in a particular context (consumption, ecology, etc.). Similarly, Horst Oehlke (1990) uses Morris' dimensions to describe design as comprised of three semiotic levels: a *syntactic level,* centred on the formation of structures and the construction of forms; a *semantic level,* which works with the meaning of products and forms; and a *pragmatic level*, which covers all aspects related to the consumption and possession of products. For Sigfried Maser (1987b), on the other hand, design should be understood as a complex process with three basic kinds of considerations based on Morris' dimensions. They are considerations about: the material resources required for realisation of design or syntactic considerations, ideas about such a realisation or semantic considerations, and values, aims and purposes associated with the realisation of design or pragmatic considerations. Each of these three types of considerations are in turn visualised as tackling different aspects of design problems: the *syntactic ones* to address their methodical concerns, the *semantic ones* to unveil the reality behind design problems, and the *pragmatic ones* to define the normative aspects of this kind of problems (i.e. goals, intentions, values, interests of the productive and of the consumer's sides).

Morris' dyadic dimensions have also been explored separately. Examples of these are the proposals of Gui Bonsiepe and Abraham Moles. For Bonsiepe (1978) the syntactic side of product design has to do with **intra-figure**[109] **relations** or formal relations among the parts of a product, and **inter-figure relations** or formal relations among products that belong to the same type, family or system. These two types of relations are thought as means to help designers achieve formal coherence (i.e. harmony and compatibility) among products and between them and systems of

109 The term 'figure' is used in theoretical studies to refer to the physical manifestation of 'form'.

products. The outcomes of these relations are characterised by Bonsiepe as art of five basic types of formal realization based on studies about symmetry (cf. Wolf and Kuhn, 1960) – see figure 22 for details.

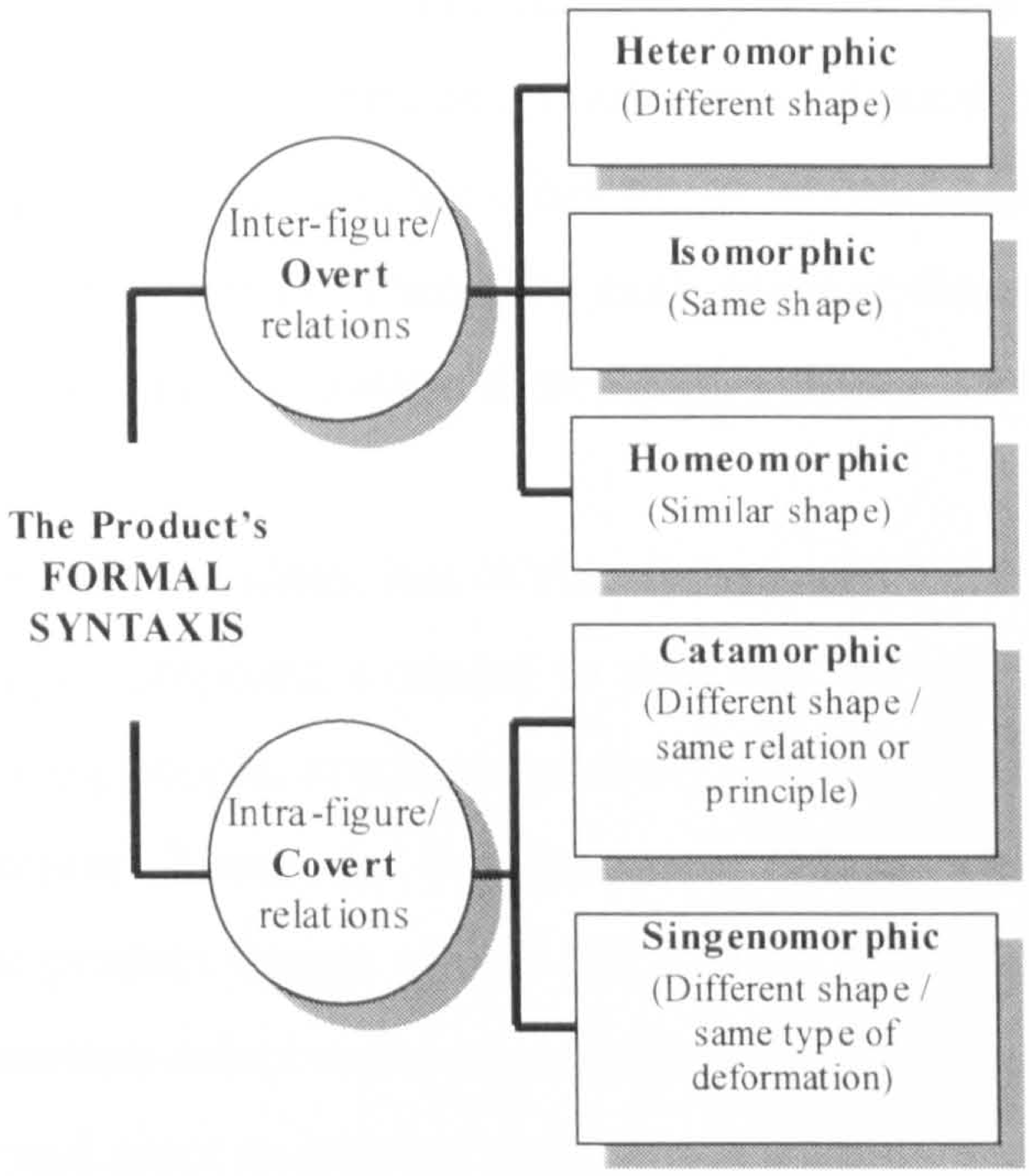

Fig. 22 – A way to understand the product's formal syntaxis based on Bonsiepe (1978).

Working with Gestalt theory, Abraham Moles (1975) enunciates what he considers as the **syntactic laws** governing the interaction and arrangement of artefacts in our surroundings. These laws refer to aspects such as our tendency to group artefacts spatially from a functional and aesthetic standpoint (Law of Order by Proximity), and considerations about: our accessibility to them (Law of Accessibility), the role of people's lifestyle in the spatial arrangement of artefacts (Law of Optimal Density), and the influence artefacts exert on each other spatially and in terms of changing people's global perception of space (Law of Volumetric Limitation and Law of Irradiation). Since the context of artefacts is also important in our construction of their meaning, these laws somehow complement theoretical considerations such as those of Bonsiepe.

In relation to the models of designing developed based on Morris, Max Bense's is perhaps the best-known of all. This was formulated in the 1970s as a new way to study product design and its outcomes. Bense's model combines theoretical contributions from Peirce and Morris, comprising three inner dimensions embraced by Morris' pragmatic dimension (Bense and Walther, 1975). The first of these inner dimensions or **Hyletics** (from the Greek Hyle = matter) and it refers to the technical materiality of the product (its material qualities). As such it is a dimension with no equivalent in Morris' approach. The remaining two dimensions, on the other hand. refers to the artefact and its form as a matter of configuration or **Morphetics** (from the Greek Morphé = form), and the other to the technical construction and function of the product or **Synthetics**. Therefore, both of these dimensions resemble aspects of Morris' semantic and syntactical dimensions (Vihma, 1995) – see figure 23.

Not very far from these ideas, has Walter Schaer (1983), a graduate from the Ulm School of Design, proposed a model to describe the dynamics of overt and tacit interactions among people, artefacts and their environments, as part of his views on Design Interaction Research. To this aim Schaer suggests three functional dimensions for product design clearly inspired on Morris' work. The first of these or **Human Function** refers to the connection between people and products (i.e. how people create and react to products within social-economic, cultural-aesthetic and physiological-practical parameters). His second dimension or **Production Function** alludes to how the product's ideation and materialisation are linked to its planning and manufacturing. And his third dimension or **Technical Function** focuses on "...the artifact's syntactic relation to its own parts and to its external non-human physical environment" (Schaer, 1983: 206) - see figure 23.

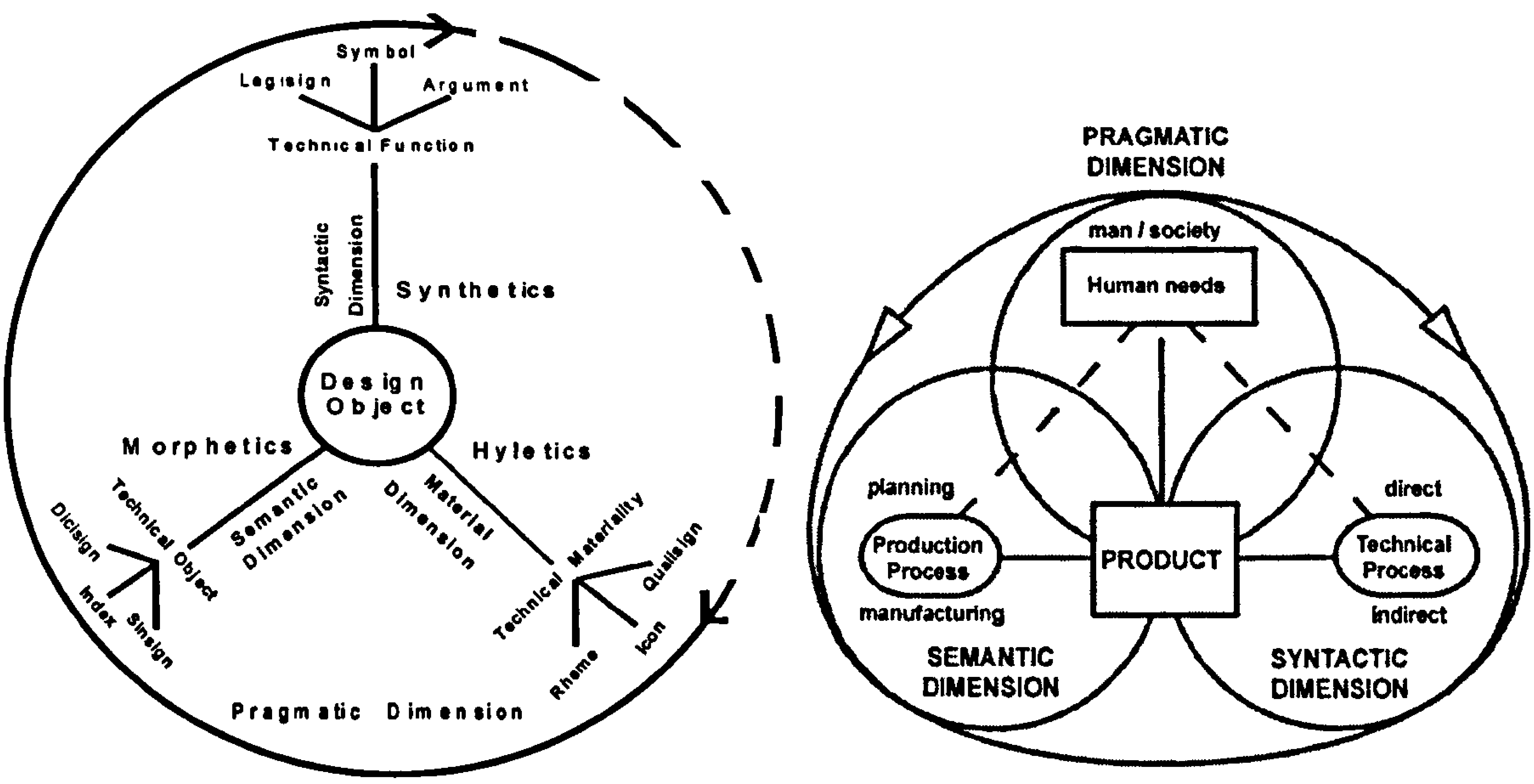

Fig. 23 - Comparison between Bense's (to the right) and Schaer's* (to the left) models for designing [*Source: Landry, 1990: k3].

Differently from these authors, Danielle Quarante (1992) has taken Morris' dimensions as a basis to explain the three main types of emphasis commonly assigned by critics to design solutions, that is, their characterisation of products as being **stylistic, formalist** or **functionalist**. In her view, design solutions are: primarily stylistic, when they emphasize the symbolic and affective sides of design; primarily formalist, when they are strongly conditioned by formal schemes or formal vocabularies; and primarily functionalist, when their configuration is clearly defined based on their function. In semiotic terms, Quarante relates the stylistic approach with Morris' semantic dimension, the pre-eminence of a formalist approach with his syntactic dimension, and the development of functionalist solutions with his pragmatic dimension.

In contrast with such a fragmented view of Morris' dimension, Mathias Rauterberg, Ben Salem and Dirk van de Mortel (2005), from the Technical University of Einhoven, have seen the simultaneous consideration of the three Morrisian dimensions as a need to guarantee the development of any successful product. In their view, situations such as: (a) the mere exploration of syntactic (formal) combinations, (b) the generation of useless concepts (functionally speaking) to create new forms, (c) the failure to introduce new types of interaction in products, (d) the focus on concepts and forms disregarding the way in which people use artefacts, and (e) the excessive trust on intensive marketing and advertising to extent the scope of use of a product (without actually modifying its form and concept), are the result of taking into account only one or two of the three Morrisian dimensions.

There are also models about design that despite of being inspired in different ideas to those of Morris' end up considering the same sort of dyadic dimensions. This is the case of a model for the study of products' precedents devised by G. Pasman and W. Muller (1995) at Delft University of Technology – see figure 24. According to them, the *form creation phase* of product design should be understood as involving: (a) A relation between form and function, called by them **Proto-typical,** where the features commonly used to represent a product are seen as conventions to define it functionally; (b) a relation between the use and function of the product, called by them **Behavioural-typical,** which deals with the incorporation of other conventional aspects in the product such as style, character and socio-cultural behaviour; and (c) a relation between form and use, called by them **Solution-typical**, where the visuo-spatial organisation of the form and material qualities of the product are assessed as features.

Another quite influential contribution of Morris for design theory lies in his understanding of the products of human activity (design products included) as part of a co-reality (Lacruz-Rengel, 2002a). This is indeed an idea already explored by the followers of Peirce. Nevertheless, the idea of co-reality did not become clear until authors like Morris realised that aesthetic signs do not exist. In this respect two ideas are crucial to define Morris's views on co-reality: his ideas about aesthetic signs, and his understanding of the interaction between aesthetics, science and technology.

Following the tradition of all the symbolic aesthetics of the 20th century (Calabrese, 1987), Morris begins his understanding of **aesthetic signs** by defining them as iconic signs whose task is supported by non-aesthetic signs (Morris, 1939a). However, a detailed assessment of this idea soon led him to realise that "no sign is as such [a]esthetic" since the aesthetic condition of a sign does not reside in the sign itself but in the way it is used (Morris, 1946: 195). This new idea found its way into design theory through the work of Max Bense (1960), for whom design and art have to do with the act of passing from the signs of a reality to the signs of a co-reality (i.e. to reality as envisaged by designers and artists). The essence of the aesthetic in design came then to be understood as stemming from the mediation of non-aesthetic factors in the definition of the aesthetic ones (Bonsiepe, 1980); this being the reason why the success of aesthetic sign processes ought be assessed as a matter of **social eligibility** (Llorens, 1979).

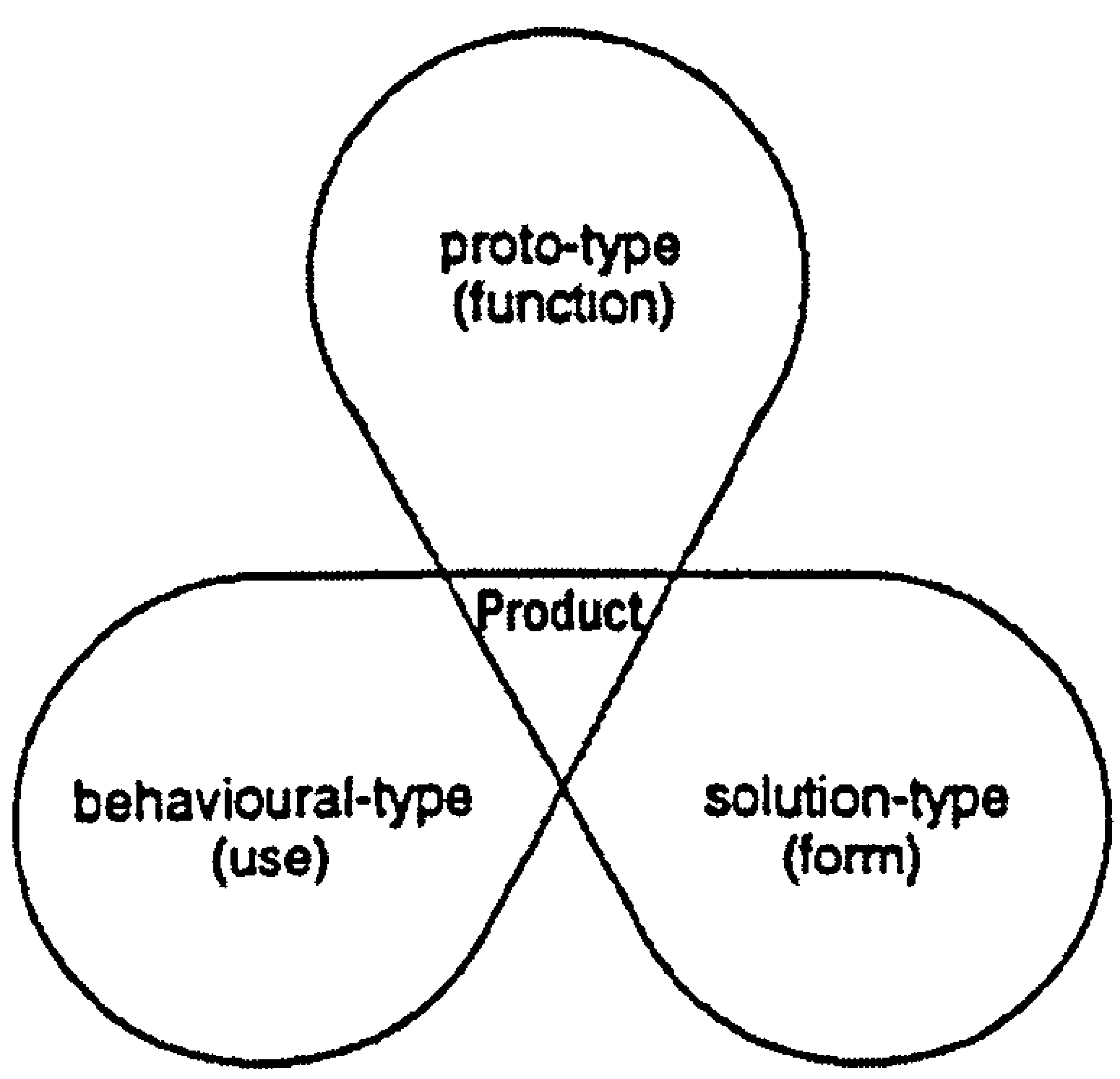

Fig. 24 – Pasman & Muller's typological model for form creation in product design (1995).

That is to say, in terms of whether the ideas and new views about reality propounded by designers can be accepted and shared by the users and beholders of their creations.

The mediation of non-aesthetic factors in the creation of aesthetic works was also appraised by Morris through his understanding of the relation among his aesthetic, scientific and technological discourses (Morris, 1939b). For him each of these discourses has a main function: the aesthetic one presents values, the scientific one designates things through statements, and the technological one prescribes behaviours. With this in mind, he indirectly alludes to co-reality as the simultaneous presence of these three discourses in every product of human activity (even though in different proportions), so that the function of each discourse requires the fulfilment of the other two in some respect to be accomplished. Thus, Morris concludes that the aesthetic is not limited to their valuative function since it is also capable of designating and prescribing (Morris, 1946). This is an idea somehow present in the models formulated by Bense, Schaer and Rauterberg et.al.

The Morrisian modes of signifying

One of the ways in which Morris studied sign processes was through the realisation of major modes of signifying. This idea, however, has a long tradition in semiotics, this being reflected in theoretical distinctions such as those between cognitive and non-cognitive signs, cognitive and instrumental signs, referential and expressive signs, and between referential and evocative signs. But, what is distinctive of Morris' view is his understanding of the modes of signifying as emerging from: (1) the nature of the environment in which the organism operates, (2) the relevance of this environment for the fulfilment of the organism's needs, and (3) the ways in which the organism acts upon that environment (Morris, 1946). This part of his general theory is inspired by George H. Mead's theory of action (Morris, 1974). Indeed, Morris and Mead were both members of a philosophical group known as the Chicago School of Pragmatism (1894 – 1904).

For George H. Mead (1934) the development of the individual's self and of his/her self-consciousness are social constructions,[110] and our disposition to act takes place through three phases, called by him: perceptual, manipulative and consummating. These phases correspond to the three basic requirements of any action (Morris, 1974): the gathering of information in order to act or **perceptual phase**, the pondering and selection of the information so gathered to define a course of action or **manipulative phase**, and the implementation of those acts considered to be the most appropriate to deal with the situation at stake or **consummating phase**. Similarly, the objects and situations of our surroundings are also conceived by Mead as having perceptual, manipulative and consummating properties. These properties are taken by Charles Morris to define types of signs and, in turn, modes of signifying. Thus, for Morris (1974), signs can be: *designative*, when they stand for the observable properties of objects or situations; *prescriptive*, when they represent ways of manipulating objects and situations in order to satisfy certain needs, and *appraisive*, when signs stand for those things that can be accomplished in relation to certain objects and situations.

Bearing this in mind, Morris realises that sign-vehicles (those things used as signs) can also refer to: spatio-temporal regions or *locatum*, characteristics of an object or *discriminatum*, response sequences in themselves or *obligatum*, and preferences or *valuatum* (Morris, 1946). Following these references, signs are then typified by Morris according to their ways of signifying as: *where* signs or **identifiors**, *what* signs or **designators**, *how* signs or **prescriptors**, and *why* signs or **appraisors**. These types of signs can be considered as Morris' most detailed contribution for a theory of reference, even though they have been rarely used in design. They only use of these signs known as part of this research is in a model developed by Rafael Lacruz-Rengel and Ivan Leon-Trujillo for the assessment and formulation of graphic interfaces for websites (Leon-Trujillo, 2004).

Such a model takes Morris' notion of *designators* to identify the signs about the features and components of the interface, his notion of *prescriptors* to allude to the signs for commands or routes of actions in the interface, and his notion of

[110] As a matter of fact, for George H. Mead the actions of each individual in a society are seen as derived from a symbolic negotiation with his/her human surroundings.

appraisors to encapsulate all the indicative and feedback signs which allow us to know the status of the different components of the interface – see figure 25. Besides this example, we should acknowledge the presence of theories within design quite close to that of Morris, even though they are not inspired by his work. Indeed, there are aspects in Horst Rittel's (1964) adaptation of Kenneth Boulding's *Image theory*, and in Helga and Hans-Jürgen Lannoch's (1989) *notion of semantic space* used to tackle similar aspects (see section 2.2.7. for details).

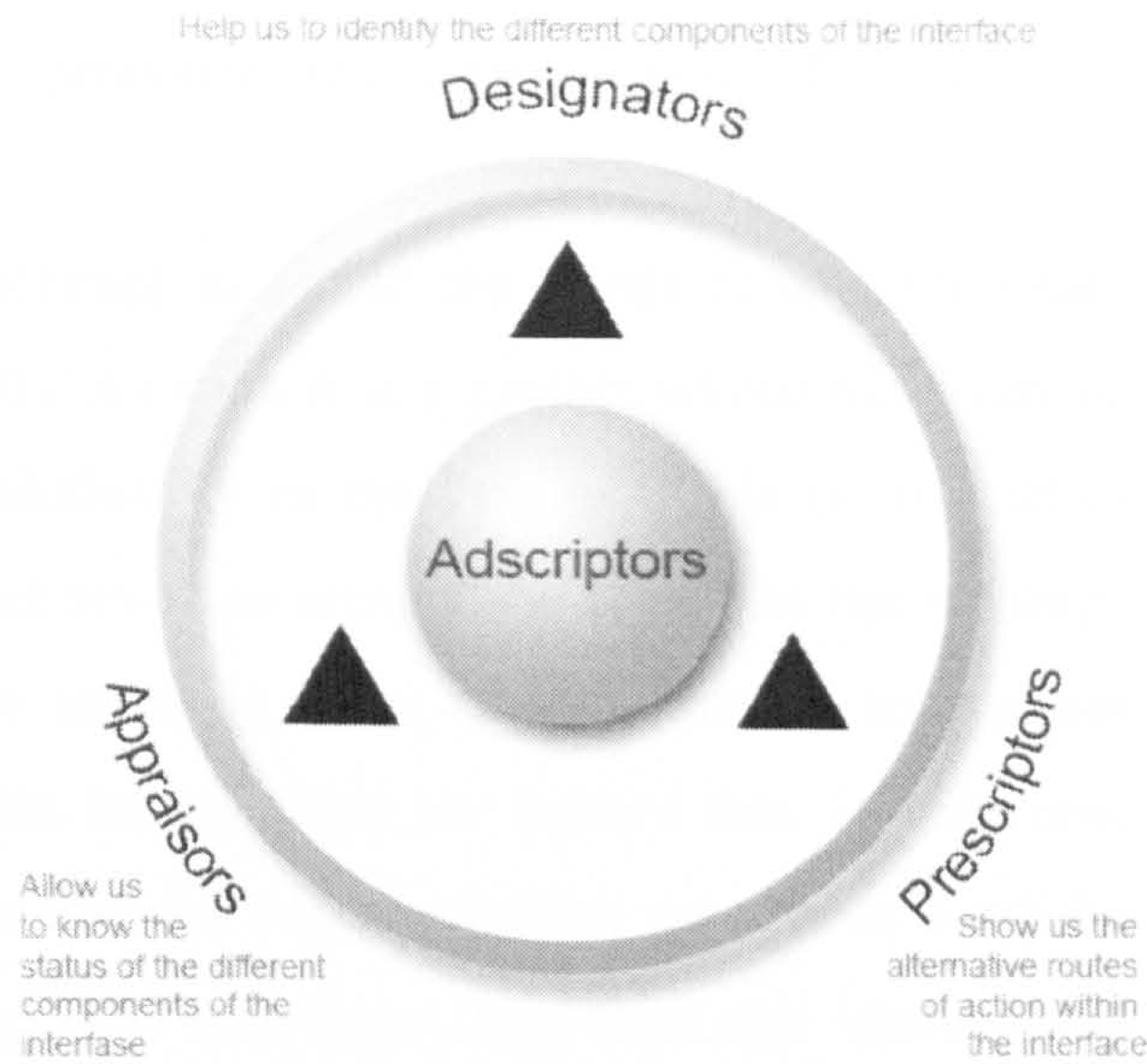

Fig. 25 – The Lacruz-Rengel's and Leon-Trujillo's model for graphic interfaces in websites
[Source: León-Trujillo, 2004]

2.2.6. The Roman Jakobson's model and the blended semiotic views

There are many theoretical proposals to understand the construction of meaning in artefacts but not all of them are based on the ideas of Saussure, Peirce or Morris. Some proposals even combine ideas from semiotic approaches rather different (but not contradictory) and from different fields of study. These proposals are here understood as blended semiotic views. Clear examples of them are in the work of the Russian linguist Roman Jakobson, the psychologist Irvin L. Child, and the anthropologist Jacques Maquet.

Jakobson's work is partially inspired by the ideas of Ferdinand de Saussure, but most importantly by his study of rhetoric and his interest in the communication process. His best known contribution is a model of communication for language not only concerned with the process itself but also with the meaning and internal structure of the message (Fiske, 1990). This is model also applicable to the study of modes of communication different to that of language (Guiraud, 1999), since for Jakobson (1960) language shares many properties with other systems of signs.

Jakobson's model derives from his attempt to locate the poetic among the other functions of language (Jakobson, 1960). As such it is a project whose roots can be traced back to his work with Jan Mukařovský in the Prague Circle of linguistics during the 1920s.[111] Jakobson's model revolves around the idea that the message does not and cannot supply all the meaning of a communicative transaction (Hawkes, 1977). To support this claim he identifies six factors that, in his view, affect the construction of the message and the communicative process as a whole. Besides the *addresser,* the *message* and the *addressee*, Jakobson also identifies as factors: the *context* or that to which the message refers to, the *contact* or physical channel/psychological connection between the addresser and addressee that enables communication, and the *code*, fully or partially common to the addresser and the addressee (Jakobson, 1960).

With these factors in mind, he defines the communicative functions related to each of them (see figure 26). He begins with the most obvious of all functions: that of referring to something (a context) during the communicative transaction or **referential function**. Then he proceeds to identify: the **emotive function** or expression of the addresser attitude toward the message,[112] the **conative function** or need of eliciting certain reaction in the addressee, the **phatic function** or act of affirming, maintaining or halting communication, the **metalinguistic/metalingual function** or need of checking the understanding of the message through verifications about the code that is being used,[113] and finally, the **poetic function** or that comprising the selection and combination of terms for the construction of messages. These six functions are simultaneously present but with one of them predominating over the others (Bird, 1977).

[111] Jan Mukařovský published in 1942an essay on *"The place of the aesthetic among others functions"*.

[112] For David Berlo (1969) it may also allude to the addresser's attitude toward the addresse and even toward him/herself (how he/she sees him/herself during the communication).

[113] In modern logic two levels of language are acknowledged: the language that speaks about objects or 'object language' and the language that speaks about language or 'metalanguage'. In terms of speech, Jakobson (1960: 356) sees his *metalinguistic function* as having to do with "whether the addresser and/or the addresse need to check up whether they use the same code" (e.g. when any of them say: "I don't follow you!").

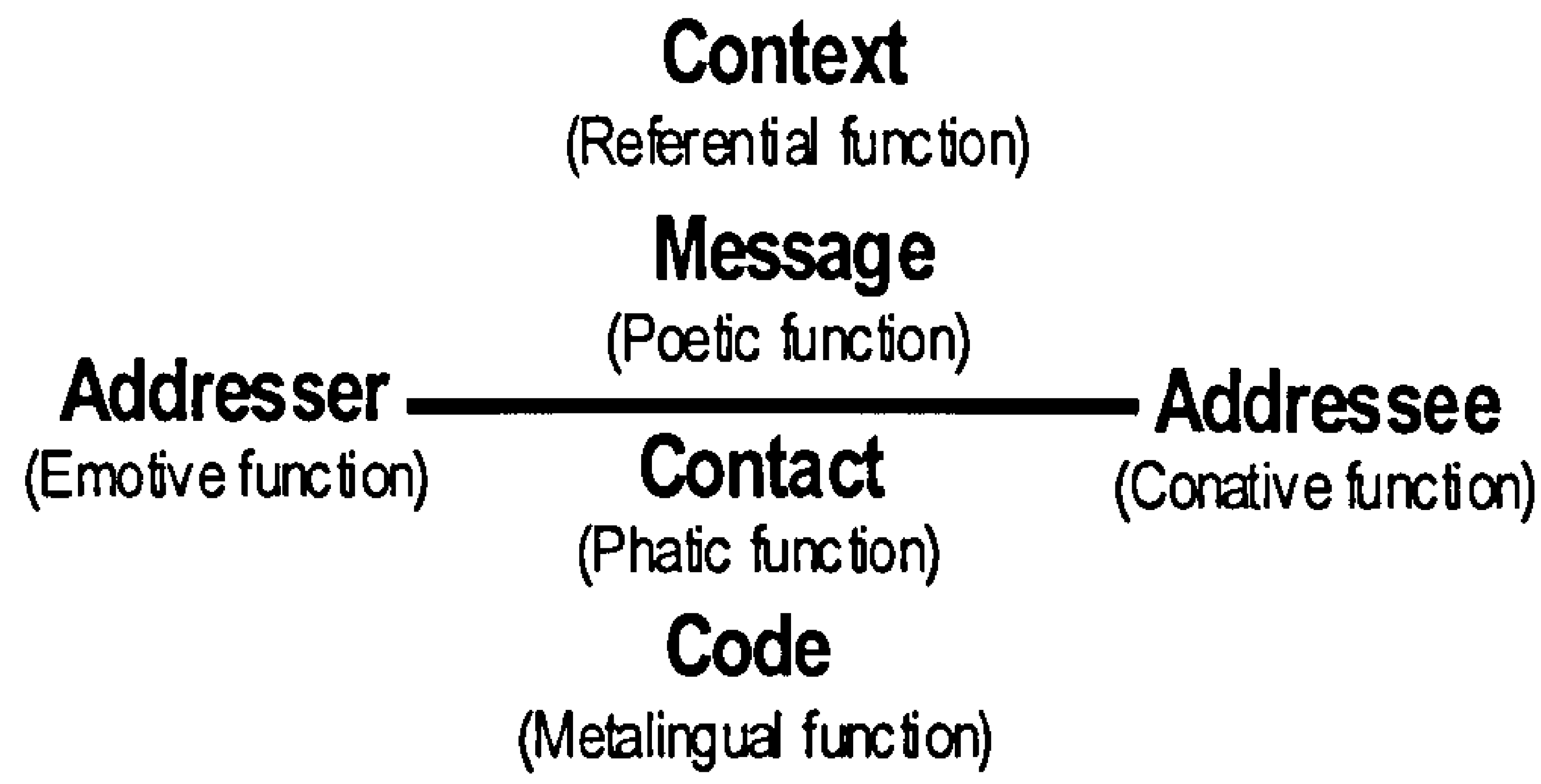

Fig. 26 – The model of Roman Jakobson for the communication process (1960).

Of these functions, the poetic one has been used by Jordi Llovet (1979) to explain the mechanism underlying the act of designing. In his view, design is located at the crossroad of two complementary operations: that of selecting the elements involved in the creation of an artefact, and that of combining or arranging these elements as part of a coherent whole. Other authors like Clive Ashwin, Chel Negrin and Tulio Fornari have considered all six Jakobsodian functions as equally relevant to design. In this direction, Ashwin (1984) has shown how Jakobson's functions are useful to describe the communicative nature of design drawings. Negrin and Fornari (1992), on the other hand, have applied them to study of the act of designing as a matter of communication. To this aim they modify the names of most of these functions to make them more accessible to designers, and provide examples of their presence in different aspects of product design. Thus, Jakobson's poetic, emotive, conative and phatic functions are re-named as the **auto-referential, expressive, influential and contact functions of design** respectively; whereas his **referential** and **metalinguistic** functions keep the same name.

The works of Llovet, Ashwin, and Negrin and Fornari show how Jakobson's ideas have been applied to design. However, the most important of Jakobson's contributions for the present research is his realisation of different types of references. Indeed, each of his functions 'refers' to a part of the communication process (Jakobson, 1960). Thus, he indirectly ends up enunciating the six types of reference present in any communicative transaction, that is, references to: a context, the attitude of the addresser, the sort of effect which is expected, the channel of communication that is being used, the code in which the message is framed, as well as references to the way in which the message is/was built. This particular fact turns Jakobson's model into one of the more comprehensive semiotic approaches to the study of reference, and one of the most accessible in terms of terminology. Similar considerations to those of Jakobson can also be seen in later semiotic models such as that developed during the 1990s by Rune Möno for the communicative functions of products.[114]

Similarly to Jakobson, the psychologist Irvin Child (1969), from Yale University, developed an interesting way to study the meaning of 'aesthetic works' (including design by extension).[115] His approach is a blend of the theoretical views of Ogden and Richards (1923), Charles Morris (1946) and Roman Jakobson (1960). For Child (1969) the meaning of our experiences with aesthetic works is essentially of two types: referential and expectational.

Child's **referential meaning** derives from Jakobson's referential function of language. Consequently, it is defined as the act of referring to something during the communicative or interpretative transaction that takes place between the appreciator and the aesthetic work. Child broadens his referential meaning by proposing the existence of three subclasses of it: conventional, iconic and exemplary. His **conventional meaning** is characterised by the presence of a deliberate agreement in the beholder's interpretation of things. His **iconic meaning**[116] is defined by some kind of resemblance between the means used in the aesthetic work and the things such a work is intending to express. His **exemplary meaning**, on the other hand, takes aspects of the aesthetic work as "...implicitly referring to the concepts of which they are examples" (Child, 1969: 858).[117]

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[114] In Möno's view, products have four main communicative functions : **to describe** their purpose, **to express** their properties (including how it is supposed to be felt by the user), **to exhort/signal** or trigger an intended behaviour in the user, and **to identify** or be easily recognised by the user as well as be associated to positive experiences of the user (Möno, 1992; Pettersson, 2001).

[115] Child's use of the term 'work of art' includes "...music, literature of all kinds, plays, dances, etc., as well as paintings and other objects to be seen" (Child, 1969: 853). In this sense, his definition of 'work of art' can also be taken to refer to what nowadays is known as aesthetic works, i.e. man-made creations with a strong emphasis on the generation of aesthetic experiences in their appreciators.

[116] According Child (1969), his notion of *iconic meaning* is based on the work of Charles Morris.

[117] There are instances in which it is hard to tell whether some aspects of an aesthetic work are *iconic* or *exemplary*, since in some cases they are both.

Differently from the *referential meanings*, Child's **expectational meanings** are those in which aesthetic works are taken as signs of the expectations they are capable of arousing in their appreciators. Following Charles Morris's dyadic dimensions of meaning, Child understands these meanings as having to do with three types of expectations: (1) those focused on the materiality of the object or **syntactic expectations**, (2) those centred on inferences (ideas about things) or **causal expectations**, and (3) those focused on the effects of certain objects in people or **pragmatic expectations**. In this sense, Child's proposal is a clear attempt to explore in depth Jakobson's *referential* and *conative* functions.

Besides these kinds of proposals, there are also theoretical blends which emerge from the criticism of existing proposals. This is the case of Jacques Maquet, from the University of California. In his book *The Aesthetic Experience* (1999), he formulates types of signs to study artefacts based on his criticism of Charles S. Peirce's theory. For Maquet, some of the terms used by Peirce to describe his triadic model of signification and his best known types of signs (i.e. icon, index and symbol) are deceptive for the interpretation of aesthetic artefacts (i.e. those created to please our senses, including design products). According to him, Peirce's 'object' can be confused with actual objects, and his 'interpretant' fails to make explicit the context from which it emerges. Consequently, he suggests the use of 'meaning' and 'semiotic context' as substitutive terms for 'object' and 'interpretant' respectively (see figure 27).

In relation to Peirce's types of signs, Maquet argues that he prefers to use the term **image** instead of icon, since it is a more straightforward way to allude to the visual similarity between things; the term **referent** instead of symbol to refer to conventional signs;[118] and the term **symbol** to allude to signs identical in part to what they represent (i.e. non-arbitrary). This particular point of view turns his 'symbol' into a type of sign theoretically located between his *referents* and Peirce's *indexes* but definitely closer to the latter. Such a peculiar taxonomic characterisation allows Maquet to suggest **indicators** as his fourth type of sign. That is to say, signs whose meaning emerges from incidental/metonymic associations. In this respect, Maquet's *indicators* and *symbols* can be understood as modalities of Peirce's

[118] In Linguistics, the *referents* of speech (the things people talk about) reflect the agreements between the subjects involved.

indexes (see figure 28). This particular division of signs into four types is, in Maquet's view, quite useful to study the levels of discursive thought present in aesthetic artefacts. To this aim artefacts are firstly assessed as *images* (to direct people's attention beyond the mere materiality of objects), secondly as *indicators*, thirdly as *symbols* and finally as *referents*.

Charles S. Peirce	Jacques Maquet
Sign	Sign
Object	Meaning
Interpretant	Semiotic context

Fig. 27 – Comparison between Peirce's and Maquet's elements of signification.

Charles S. Peirce	Jacques Maquet
Icons	Images
Indexes	Indicators
	Symbols
Symbols	Referents

Fig. 28 – Comparison between Peirce's and Maquet's types of signs.

The three blended semiotic views presented in this section may not be the only ones. However, they exemplify how varied their theoretical sources of inspiration can be. They also show that, no matter how different the theoretical strands of semiotics are, it is always possible for the researcher to bring out the best of each and combine their contributions as part of new ways of modelling situations.

2.2.7. Non-semiotic theories of reference for utilitarian objects and products

The study of reference in utilitarian objects and products has not been a subject of exclusive interest to semiotics. Some important theories about reference have also been developed as part of aesthetic, practical, creative, and communicative inquiries about the nature of design products. In this sense, the present section will succinctly introduce the six best-known non-semiotic theories of reference for utilitarian objects and products.

The functional aesthetics theory

Perhaps the oldest non-semiotic theory about reference in utilitarian objects is that supporting the existence of a special kind of aesthetics focused on the functional side of artefacts. Its roots are said to be in the way in which the Greek philosopher Socrates (469–399 BC) conceived beauty (Huisman and Patrix, 1971).[119] That is to say, as the suitable adaptation of things to their purpose (Estrada, 1988). This is a thesis whose most fervent advocates were 18th-century thinkers such as George Berkeley, David Hume and Francis Hutcheson (Maldonado, 1993).

In the written history of Western design, the oldest known attempt to encapsulate Socrates' thesis is the maxim 'Strength, Utility and Grace' formulated by the Roman architect Marco Lucius Vitruvius in the year 25 BC (Lambert, 1993). In the particular realm of the product design, the theoretical writings of Owen Jones (1856)[120] and Christopher Dresser (1973) during the 19th century helped to assign a privileged place to the object's *adaptation to its purpose* in the generation of beauty. Nevertheless, it was only with the application of the word 'beauty' to the field of engineering and the publication of Paul Souriau's *"La Beauté rationnelle"* in 1904, that such a thesis became the exclusive focus of attention for theorists and aestheticians (Eyot, 1980).[121] Indeed, Souriau pointed out that artefacts of industrial production - such as machines, pieces of furniture and tools - were capable of achieving beauty when their configurations appropriately express their function (Huisman and Patrix, 1971). The problem was, according to him, that most people were not able to appreciate such beauty (Eyot, 1980).

This contentious view on beauty caught the attention of aestheticians, philosophers and anthropologists during the first half of the 20th century, who took the task of defining the extent to which such a thesis was tenable. In this direction, Pierre Francastel (1948) points out that every human action aiming to transform matter brings along aesthetic values associated to utilitarian tasks. Therefore, in his view, such a thesis is plausible provided that industrially produced objects are not merely derived from technology but also from highly social ends which force them to adapt to collective needs and the taste of people. Similarly, Mikel Dufrenne (1964: 195)

[119] As Socrates did not produce any writings, what we know about his ideas comes from the writings of philosophers such as Plato and Xenophon (Estrada, 1988).

[120] Owen Jones (1853: 5) seems to paraphrase Vitruvius' maxim when he writes: "As Architecture, so all works of the Decorative Arts, should possess fitness, proportion, harmony…".

[121] Soriau's ideas caused such an impact because of the historical circumstances in which his theoretical proposal was announced. Indeed, it was the time when beauty was associated with the idea of goodness and the theory of 'Art for the sake of Art' was already in place (Eyot, 1980).

argues that since "humanization and aestheticization go hand in hand", the technical object and the consumer goods are also vested with aesthetic value. Indeed, for authors like Arnheim (1964), the difference between the artistic and the useful object is just a matter of how their aesthetic forces manifest. That is to say, as internal forces manifesting outside, for the case of artistic objects, or as external forces projected upon the inside, for the case of useful objects.

Thus, **functional aesthetics** came to be defined as the simultaneous search for more beautiful and efficient forms (Leroi-Gourham in Eyot, 1980), whose understanding could only be achieved by the consideration of three essential aspects in our assessment of utilitarian objects (Leroi-Gourham, 1993): the nature of the functions these objects have been created to fulfil, the material solutions derived from the technological achievements of the society in which these objects are developed, and the styles associated to the functions of these objects by the ethnic group for whom they are created. These three aspects, indeed, outline what *functional aesthetics* is about in terms of reference, that is, about activities translated into functions, choices of materials, and the use of technologies (know how), and their relation to stylistic and symbolic issues. This is the reason why in order to understand this theory we need to compare artefacts fulfiling the same functions in different cultures or compare the way in which different functions are translated into artefacts within the same culture (Leroi-Gourham, 1993).

The theory of objects as extensions of man

One of the most popular theories about the creation of objects in cultural studies (Hall, 1973; Toffler, 1983; McLuhan, 1987; McLuhan and Powers, 1989; Baudrillard, 1994; Kerchove, 1999; Eco, 1999) as well as within the design community (Dorfles, 1972; Ricard, 1982; Morgantini, 1983; Verstock, 1987; Bush, 1990; Mangieri, 1998b; Groot 2000; Juez, 2002) is that alluding to artefacts as extensions of man. The origins of such a theory are said to be in the writings of Aristotle (384-322 BC) (Dorfles, 1972). Nevertheless, it was Marshall McLuhan who formulated it in the terms we know it nowadays. Indeed, for him, "all *media* [man-made objects] are a reconstruction, a model of some biologic capability speeded up beyond the human ability to perform" (McLuhan and Powers, 1989:

87), so that, for instance, the wheel is an extension of our feet as the hammer is an extension of our fist.

Within this theory, the idea of 'objects as extensions of man' has been interpreted in different ways, even though they are not always mutually exclusive. Indeed, for some authors the idea of 'objects as extensions' is applicable to any artefact used by people to accomplish their daily activities (Hall, 1973; Ricard, 1982), while for others it is more about metaphors of human activities (Morgantini, 1983; McLuhan, 1987; Kerchove, 1999; Juez, 2002) or objects that resemble humans in some respect (Verstockt, 1987; Bush, 1990; Leiser, 1992). Hereof another term to designate these objects is that of 'prostheses'. Following this term, Maurizio Morgantini (1983) has divided artefacts into: (1) **prostheses of the limbs** - e.g. knives, spades, bows and arrows, (2) **prostheses of the senses** – e.g. telephones, television sets and machines to reproduce images and sounds, and (3) **prostheses of the mind** – e.g. computers, holography and virtual reality. Thus, these prostheses are like McLuhan's media "...active metaphors in their power to translate experience into new forms" (McLuhan, 1987: 57). To this aim researchers on interfaces have studied people's reactions to the use of human-like features in products - e.g. cars which talk to their drivers -[122] and have even used the term *'sociability'* to describe the capacity of products to elicit user reactions similar to those learnt from interactions among humans (Leiser, 1992). Some authors have also classified artefacts based on our particular rapport with them. Such is the case of Gillo Dorfles (1966), for whom artefacts can be understood as **integrative** (as instruments or prolongations of the self) or as **counterpositive** (as 'extraneous bodies' which should be either appropriated or discarded).

More recently, Umberto Eco (1999) has provided a classification of prostheses based on their relation with us. That is to say, in terms of: (1) their capacity to keep one part of our body doing what it did once or **substitutive prostheses** (e.g. an artificial limb, a walking stick, reading glasses, etc.), (2) their capacity to power up one of our natural courses of action or **extensive prostheses** (e.g. a magnifying glass, speakers, stilts, etc.), (3) their capacity to reach places never reached before or **intrusive prostheses** (e.g. equipment for medical exploration within the human

[122] The user reaction to human-like features such as this is called *'Presence'* (Leiser, 1992).

body), and (4) their capacity to help us do things we did not think were possible before or **magnifying prostheses** (e.g. the telescope, the microscope, the wheel, jars, bottles, etc.). Following this basic classification mixed subtypes can also be described such as **extensive-intrusive prostheses** (e.g. the periscope) and **magnifying-intrusive prostheses** (e.g. x-rays).

Differently from these approaches, there are authors such as Mark Verstockt (1987) and Donald Bush (1990) who have turned their attention to the way in which we humans take our own bodies as a reference to configure artificial objects. Indeed, for Verstock (1987: 120) "...the very idea of geometry is implanted in man's body, providing a conscious or unconscious – but in either case reliable – framework of reference". This happens in such a way as to provide the *homo faber* with clear examples of: *symmetry* (e.g. our face has two eyes as automobiles have two lights in their front), *basic units of measurement* (e.g. the span of a hand, the foot), *proportion* (e.g. the length of our eyes in relation to the dimension and location of different parts of our face), *active configurations and shapes* (e.g. a straight line while we walk, a circle while we dance), and *rhythm* (e.g. breathing, eye-blinking, stepping). To these examples Bush (1990) adds other organisational principles of form also inspired by the human body. Among them are: the differentiation of parts in objects like the parts of our body (base, body and head), the idea of objects as moulds of our body (e.g. shoes, gloves, caps, eyeglasses), and the idea of gender in objects (i.e. masculine-like, feminine-like or unisex objects). Thus, whether we understand objects as prostheses, as reproductions of human capacities or as products of the organisational principles above mentioned, this theory is a clear example of **anthropocentric reference** whose nature and actual implications still deserve further research.

The image theory

Another relevant non-semiotic theory of reference about utilitarian objects and products is that known as the **Image theory**. This theory was originally devised by Kenneth Boulding in his book *"The Image"* (1956), and the ideas behind it are the result of one year of academic exchanges between Boulding and a group of social and biological scientists gathered at the 'Center for Advanced Study in the Behavioural Sciences' of Stanford University.

According to this theory, our behaviour as humans is not a function of the stimulus we receive but of the '*image*' we have of things - i.e. the subjective knowledge we have about things based on our own experiences (Boulding, 1956 and 1958). Thus, our 'images' reflect what we – as individuals or as members of organisations - believe to be true (Boulding, 1956). These images are built up out of messages and as part of a structure containing a '*field*' and a '*value ordering*'" (Boulding, 1958). The *field* is defined by our images of space, objects, time, and relationships (Boulding, 1958); whereas the *value ordering* is outlined by our images of value, i.e. images "...concerned with the rating of the various parts of our image of the world, according to some scale of betterness or worseness" (Boulding, 1956: 11). In this sense, the core of Boulding's theory of reference rests on the assumption that our actions as individuals as well as those of our organisations (groups of individuals) are not triggered by 'facts' but by signs/messages filtered through changeable value systems,[123] where the signs/messages compatible with our existing images of the world are received easily, and where the meaning of each sign/message is understood in terms of the change it produces in our images.

Following these assumptions, our 'images' come to represent the different dimensions that can be activated during human action. These dimensions are outlined through the following ten types of images (Boulding, 1956):

1. Spatial image or idea of our location in the space around us.
2. Temporal image or the idea we have of the stream of time and our place in it.
3. Relational image or our idea of what is constant in the world around us.
4. Personal image or the picture we have of ourselves as part of collective life.
5. Value image or our scale for ordering and pondering what is better or worse.
6. Affectional image or our picture of what we like and dislike, love and hate.
7. Conscious image or our idea of what is conscious, unconscious and subconscious of our behaviour.
8. Certainty image or our picture of what is certain or uncertain, clear and vague.

[123] For Boulding (1956: 44) "a sign is a message which alters the image of the immediate universe around the organism".

9. *Reality image* or our idea of the level of correspondence between our images and the actual things they allude to.
10. *Public image* or our personal scale to determine whether our image is shared by other people or is individual.

This theory is introduced to design by methodologists such as Horst Rittel, Christopher Alexander and Amos Rapoport. For Rittel (1964: 18) this theory offers a possible foundation for a design theory about the differences between the designer's images of things and those of other people, since it is very important for the designer to reflect about his own image, and "...about his [or her] image of other people's image". Differently from him, Alexander (1964) takes the presence of 'mental pictures' in the design process as a means to explain the importance of eradicating personal biases from design solutions. For Rapoport (1969), on the other hand, the presence of people's images as part of our built environment is a clear sign that it is constituted by more than physical components. In this sense, he reminds us that "...the image of the non-designer may be as relevant as that of the designer" (Rapoport, 1969: 138).

More recently, Donald Norman (1988) revamped Rittel's standpoint on images through his distinction between the designer's and the user's conceptual models in the operative understanding of products. There is also a theory that, following a similar line of thought to that of Boulding, encapsulates and expands his initial proposal but this time as part of product design. This is present in what Willem Gilles (1991) one described as his *criterion of image* to explain the ways in which product user's appreciate form.[124] According to Gilles, products elicit mental images of two broad types in the user's mind: **images of general characterization** or those alluding to the physical properties of the product in themselves, and **referential images** or those used to stand for something else. These latter images are in turn divided into five subtypes which are defined in terms of the designer's intentions during the formulation of products. These subtypes are:

1. *Imitative images:* those giving the product the appearance of another product.

[124] In Gilles' view *image* is only one of the five criteria that should be considered to outline the way in which we appreciate form. The other four criteria are: usablility, form-colour taxonomy, fabrication finishes, and the object's aging process (Gilles, 1991).

2. *Deceptive images:* those used "...to make people believe that the object is something it is not (Gilles, 1991: 10).
3. *Associative images*: those using recognizable stereotypes to refer to *locations* (urban, rural, oriental, etc.), *time* (contemporary, traditional, futuristic, etc.), *style* (Art Deco, Bauhaus, Streamline, etc.) and *ambiences* (kitchen, office, airport, etc.).
4. *Metaphoric images:* those linking two different things based on some common aspect (e.g. the spout of a teapot with the form of an elephant trunk).
5. *Symbolic images*: those reflecting people's representative conventions (e.g. a crown to symbolize monarchy).

All these views on what images can elicit or refer to show the potential contribution of the *Image Theory* for the act of designing. Indeed, it is among the few theories of reference with a conscious emphasis on people's biases and stereotypes.

Visual rhetoric in Design

Visual rhetoric is another way of approaching matters of reference in design, even though there is no such a thing as a rhetoric theory of design in its own right. The origin of this approach to meaning (in general) is in the Greco-Roman tradition where *rhetoric* is defined as the art of using language well to address an audience (Mautner, 1997). As such its aim is to give language effectiveness to delight, persuade and touch the public (RAE, 1992). Thus, rhetoric is concerned with "...the functional organisation of verbal discourse and messages", using logical and aesthetic means "...to affect interaction in both a rational and emotional way" (Ehses, 1989: 188). In order to achieve this end, *classical rhetoric* divide the construction of discourses or messages into five phases, normally enunciated with Latin names. They are: (1) *Inventio* or discovery of ideas relevant to achieve persuasion; (2) *Dispositio* or arrangement of those ideas into an effective whole; (3) *Elocutio* or stylistic treatment given to the ideas, involving in turn: *Aptum* (appropriateness to subject matter and context), *Puritas* (correctness of expression), *Perspicuitas* (comprehensibility of expression) and *Ornatus* (deliberate adornment of expression); (4) *Memoria* or memorization of the arguments that will be used in the speech; and (5) *Pronunciatio* or appropriate delivery of the speech. Of all these phases, *Elocutio* is perhaps the best known since it is as part of this that the rhetoric devices - known as 'rhetoric figures' - are incorporated to the stylistic construction of messages. We refer to devices such as *metaphor* (or comparison between things of unlike nature), *metonymy* (or substitution of terms based on causal, spatial and chronological links), *antithesis* (or juxtaposition of contrasting ideas), *irony* (the expression of things using an opposite meaning), *personification* (or use of human qualities for inanimate objects), *synecdoque* (or substitution of a more inclusive term for one that is less inclusive or vice versa), and *hyperbole* (or exaggeration of things).

The way in which rhetoric is understood and used in design nowadays has its origins in the Ulm School of Design (Kinross, 1986). Here, the idea of a **visual rhetoric** began to emerge in the 1960s as part of a search for new ways to study communication (Bonsiepe, 1961). The obliteration of the old anthropological belief by which utilitarian objects were understood as having nothing to do with communication, encouraged scholars such as Tomás Maldonado and Gui Bonsiepe to modify verbal rhetoric in order to formulate a new rhetoric of visual character for design (Maldonado, 1961b; Kinross, 1986). To this aim, Bonsiepe (1961) studies the origin, function and characteristics of verbal metaphors based on semiotics. The idea behind it was to take such a prominent figure of verbal rhetoric to show that a visual parallel of it could be developed. As a result of this study, Bonsiepe (1961) realised that: (a) The best way to build rhetoric figures such as metaphor was by relying on the sensitiveness of our own feelings, (b) that the exchange of referents (things alluded) within rhetoric figures do not obliterate the primary referents of those things to which they are applied, and (c) that the selection of a code relevant for the audience is a fundamental condition to use rhetoric figures. He then concludes that some verbal rhetoric figures can be used by analogy in the visual field, but such figures must be understood and use in connection with the aims of each communicative transaction.

This new approach to rhetoric was possible given that semiotics was already part of the curriculum at Ulm (Vihma, 1995) and the fact that it shares with rhetoric the interest for the study of messages through their parts and organisation (Greimas and Cortés, 1982). The support from semiotics to these studies was such that rhetoric figures were classified and studied as derived from either syntactic or semantic operations (Bonsiepe, 1998b). However, it was always clear that semiotics and rhetoric were two different things, especially in terms of meaning construction since semiotics has to do with the construction of all possible kinds of meanings, whereas rhetoric is only concerned with the persuasive ones (Greimas and Cortés, 1982). On the other hand, semiotics understands the public as a 'specific reader' of messages, whereas rhetoric invites the public to participate in the construction of such messages (Tyler, 1992). In both approaches designers need to consider the public's ways of thinking and the cultural context, but while the main goal of semiotics in design is to evoke meanings, the main goal of rhetoric in design is to change the public's views or behaviours.

In this sense the rhetorical side of design can be outlined as comprised by three basic types of arguments (Buchanan, 1989): one about the manipulation of materials and processes to solve practical problems or **technological reasoning**, another about the way in which design products reflect the nature of their creators or **character**, and a third one about convincing people of how desirable and valuable certain things can be for their lives or **emotion**. With such a complex constitution, the rhetoric in design should keep looking for new forms of interaction to transform the practical, cognitive and emotional sides of products into active agents of our communicative processes (Branco et.al., 2004).

The theory of product language

Another interesting theory about the meaning of products is that of product language. It was initially outlined in the 1970s by Jochen Gros at the Offenbach School of Design (Dagmar, 1997). Since then, this theory has been and still is under development in the hands of the staff of the Offenbach School of Design (Dagmar, 1997). The formulation of such a theory was possible thanks to a set of circumstances taking place in Germany after the closure of the Ulm School of Design. Among them there are four that we ought to mention. Firstly, the creation of an intellectual space for the consideration of the relation between people and products within the positivistic and production-laden view of the German design critics, as a result of the 1968 student revolts in Europe (Burkhardt, 1989). Secondly, the search for 'a theory of design' in its own right propounded by design theorists such as Siegfried Maser (Dagmar, 1997), for whom the communicative language of products was the main methodological contribution of design to the creation of objects (Bürdek, 1994). Thirdly, there was a wide-range consensus in the 1970s about designating as 'product language' what was specific to design (Bürdek, 1997). And finally, the end of the intellectual mobility and overall view of the designer inherited from the School of Ulm as a result of the establishment of specialized departments at the German schools of design (Burkhardt, 1989).

With such a background, Jochen Gros carried out his first theoretical reflections on product language in the mid-seventies under the title of *Theory of Sensual Functions*. The intention behind this was to propound an idea of design more strongly imprinted with emotion (Burkhardt, 1989). In this first approach as well as in later reformulations, Gros focused on humanistic methods instead of the purposive rationalism of scientific thought. To this aim he incorporated to his theoretical views aspects from perceptual and Gestalt psychology, the hermeneutic interpretation of symbols and the semantic school of aesthetics (Dagmar, 1997). As part of this theoretical quest, the functions of products were divided into **practical functions and functions of the product language** as a way to clarify that designers should know the former but act upon the latter (Bürdek, 1994). Therefore, what the *Theory of Product Language* actually covers are the aspects involved in the second type of function above mentioned.

Following a dual model to study language as comprised by a syntactical and a semantic side, Gros propounded a first division for the functions of product language into formal-aesthetic and semantics – see figure 29. The **formal-aesthetic functions** are related to those aspects of the product that can be directly observed irrespective of the meaning of their content (Dagmar, 1997). In this sense, these functions bear the composing character of the product (or formal arrangement of it), referring to design aspects such as rhythm, symmetry and proportion as well as their counterparts in Gestalt psychology. The **semantic functions**, on the other hand, are those aspects of the product directly related to the expression of its content. Hereof they help to build the meaning of products. These latter functions are in turn sub-divided into indicative and symbolic functions: a new division developed based on

Susanne Langer's distinction between sign and symbols (Bürdek, 1994; Dagmar, 1997).

In Langer's (1957) view, signs 'indicate' or evoke the existence of things, events or conditions; whereas symbols are the vehicles to 'conceive' those things, events and conditions evoked. Thus, while signs indicate *things*, symbols bring forward *meanings*. Following this line of thought Gros defines **indicative functions** as those dealing with the use of signs (textures, surface variations, forms, etc,) to elicit direct action in the product; i.e. indications of direction, stability, precision and so on. Differently from these, the **symbolic functions** direct users' attention to those aspects of the product's configuration specific to the context of use (a kitchen, an office, etc.), and to the historical and cultural circumstances in which they are used, such as the selection and combination of materials, finishes, colours and forms (Bürdek, 1994).

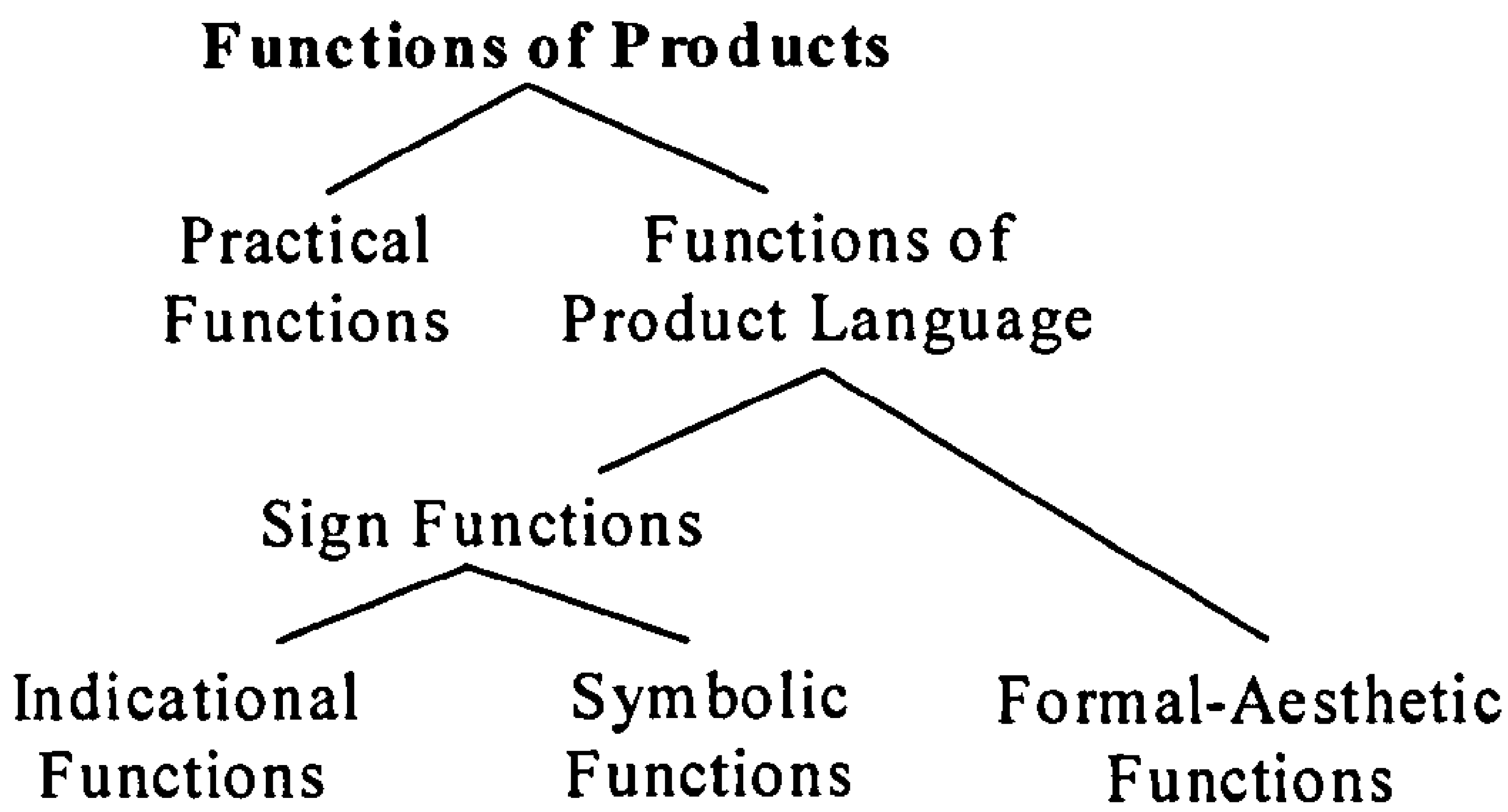

Fig. 29 - Functions of Products according to the Offenbach School of Design
[Source: Bürdek (1994), p. 179]

Of these two latter kinds of functions, the indicative ones seem to have received more attention from the Offenbach staff. Indeed, in the 1980s, Richard Fisher presented a sub-division for the indicative functions into *indications of essence* and *indications of practical functions* (Dagmar, 1997). The symbolic functions, on the other hand, are according to Bürdek (1994) the most complex of all and those in need of the strongest theoretical development, since – for him - the long standing functionalist view of design did not really take them into account. But whatever the case or the starting point for future developments in the theory of product language, it is clear that any new contribution will affect this theory as a whole, provided the fact that each of the three main functions originally outlined as part of it (formal-aesthetic, indicative and symbolic) somehow rely on each other for the attainment of any design goal.

Product Semantics and its theories

The theory of product language might be quite comprehensive in terms of reference as well as a way to understand the functions of products. However, its views are not shared by other non-semiotic theoretical approaches. One of these is that of *Product Semantics*.[125] This latter understands the meaning of products as rooted in the cognitive models people have about the use of products and about the activities and environments in which those products operate (Krippendorff, 1989 and 1990). In this sense, any emphasis on the functions of products is seen as suspicious, provided the fact that they tend to focus on the meanings present in the product itself instead of conceiving the meaning of products as derived from the interaction between subjects and objects (Krippendorff, 1989). Thus, differently to approaches where the meaning of products is seen as something invariant and static (as in the theory of product language), Product Semantics understands meaning as a dynamic construction provided the fact that meanings change according to the way in which people use products (Moles, 1975; Csikszentmihalyi and Rochberg-Halton, 1981), even though many of these meanings might have been initially learned.

As a theoretical position *Product Semantics* was initially developed in 1984 by Klaus Krippendorff and Reinhart Butter, two ex-alumni of the Ulm School of Design. In their view, "things (products) should make sense of themselves" and design is the means to make this possible. To this aim, Krippendorff has remarked the existence of a theoretical distance between Semiotics and Product Semantics. In this direction, he has argued that: (1) semiotic studies only deal with the meanings constructed as part of the product's surface (Krippendorff, 1990 and 1992), (2) that semiotics only accepts a limited notion of reference - where situations such as self-reference seem to have no place (Krippendorff, 1989), and (3) that semiotics mainly

[125] In the 1960s the swedish theorist Sven Hesselgreen (1969: 247) postulated "the study of meaning in architecture" under the name of 'Architectural Semantics'. Nevertheless, no direct theoretical link seems to exist between the formulation of 'Architectural Semantics' and 'Product Semantics'.

pursues the study of observer-free and culture-independent structures (Krippendorff, 1992).

Standing on this argument, Krippendorff (1992) describes the approach of Product Semantics as 'constructivist' by nature. That is to say, as one where the goal is not an objective reality but a reality that cannot be independent from our individual (personal) understanding of things. Indeed, it is the acceptance of such a relativism what has led him to realise that the views of Product Semantics about meaning cannot be structured standing on a single theory but on many. Thus, in Krippendorff's view it is wrong to assert - as some authors do - that Product Semantics "...is based on semiotic theory from different theorists like Saussure, Peirce and Barthes" (Ask, 1998: n.p.), neither it can be seen as a new version of the modernist tradition in design (Michl, 1990), since it is defined as opposed to semiotics and does not aim at universal values but to an understanding of the ways in which the diversity of possible users interact with products.

Bearing these considerations in mind, *Product Semantics* has been defined as a set of four different design theories working together for the "...study of the symbolic qualities of man-made forms in the cognitive and social contexts of their use and the application of the knowledge gained to the objects of industrial design" (Krippendorff and Butter in Krippendorff, 1989: 10). In this sense, two central ideas can be said to define the theory of reference behind Product Semantics. One is the acknowledgement of humans as constitutive and active participants of any semantic theory (Krippendorff, 1992). This implies that designers should stop to see themselves as authorities about how things should look and be used, in order to cooperate with the users in the definition of their practices of living, assuming that errors in the use of products are not to be blamed on users but to mismatches between what products actually do and what they symbolize to people (Krippendorff, 1990). The other central idea in Product Semantics' understanding of reference is the realisation that objects should always be seen as part of a context, because meaning is cognitively constructed by associating features of the object with features of its context of intended use, social context, and so on (Krippendorff, 1989). This amounts to saying that what something is, corresponds to the total sum of the imaginable or possible contexts in which it is placed since for Product

Semantics making sense of things is about overcoming the incomprehensible through the construction of hypothetical contexts (see figure 30).

This philosophy leads to a methodology characterised by (Krippendorff, 1990): (1) Having its starting point in the appreciation of existing practices, (2) a focus on anticipating the consequences of introducing improved or new artefacts in specific contexts, and (3) finding a way to systematically embody the designers' intentions in products. This methodology in turn has taken the proponents of Product Semantics to realise the presence of four basic contexts of study and four different theories as part of this approach (Krippendorff, 1989 and 1990). The contexts considered are (Krippendorff, 1989): **operational context** or that about the interaction of people with artefacts during use, **socio-linguistic context** or that about the ways in which people communicate about artefacts, **context of genesis** or that about the direct or indirect contribution of different members of society (designers, producers, users, etc.) to the development of products, and **ecological context** or that dealing with the way in which repertoires of artefacts help to determine or affect the formal characteristics, role and place assigned to products within a culture. Each of these contexts is respectively studied through theories of: psychological, socio-linguistic, and techno-economical nature as well as theories about the interaction among species of artefacts (Krippendorff, 1990) - see figure 31. To such an extent that Product Semantics is better characterised as a paradigm or general framework for different theories about the study of meaning in design products than as a single theory: a paradigm defined as being theoretically opposed to that of functionalism in design (Krippendorff, 1990; Krippendorff and Butter, 1993). Hereof Product Semantics has become a sort of theoretical umbrella for the development of different methods and theoretical contributions for designing.

Among these contributions we ought to mention methods such the 'Semantic Detour' developed by Reinhart Butter (1987 and 1990) and Hans-Jurgen Lannoch's (1990) 'Semantic Transfer', as well as Helga and Hans-Jurgen Lannoch's 'semantic notion of space' (Lannonch and Lannoch, 1989; Lannoch, 1990). In the *Semantic Detour,* design concepts are elicited or realised based on the verbalization of contextual aspects (type of user, place or situation of use, etc.) and desirable attributes, which are later transformed into concrete physical manifestations (properties of the product) using means such as metaphors. In the *Semantic transfer*, on the other hand, the adjectives generally used in associations of words to describe or characterise ideas (e.g. *hard* job and *hard* man) are assessed to define physical aspects or configurations (arrangements of those physical aspects) in design concepts (e.g. *hard* as alluding to the idea of 'on top' or 'underneath').

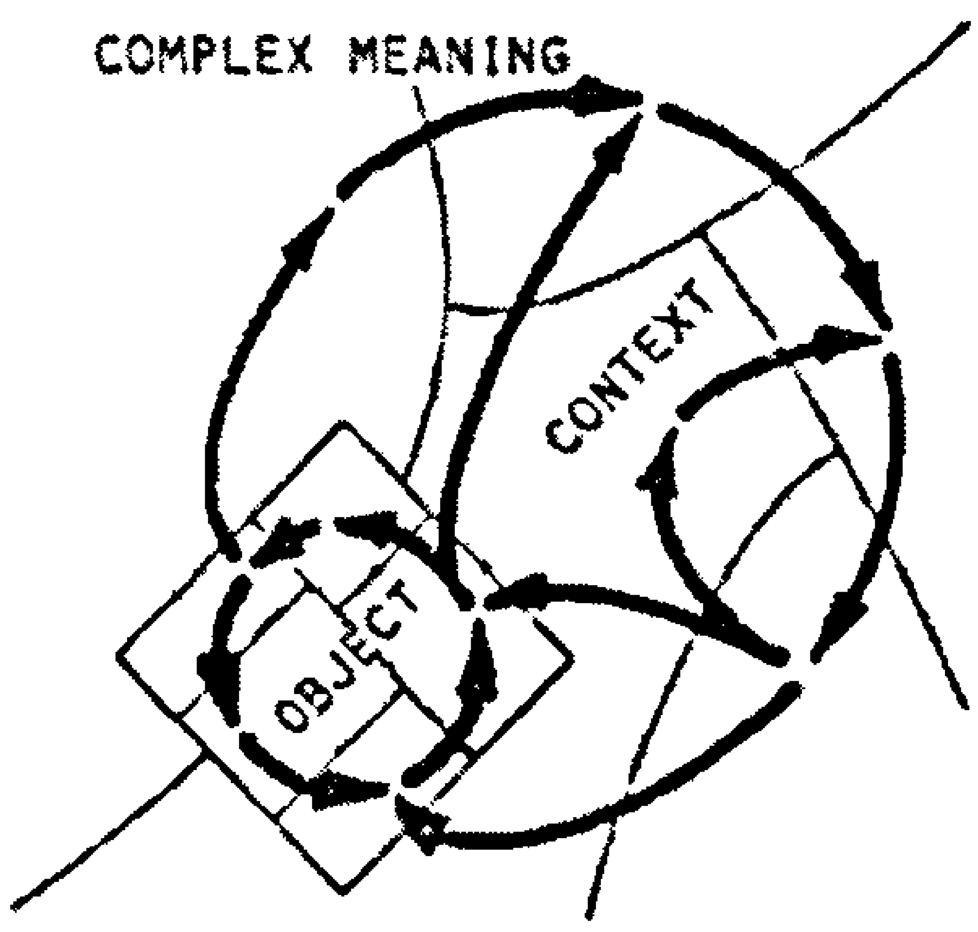

Fig. 30 – The role of context in the definition of meaning
[Source: Krippendorff, 1989: 13]

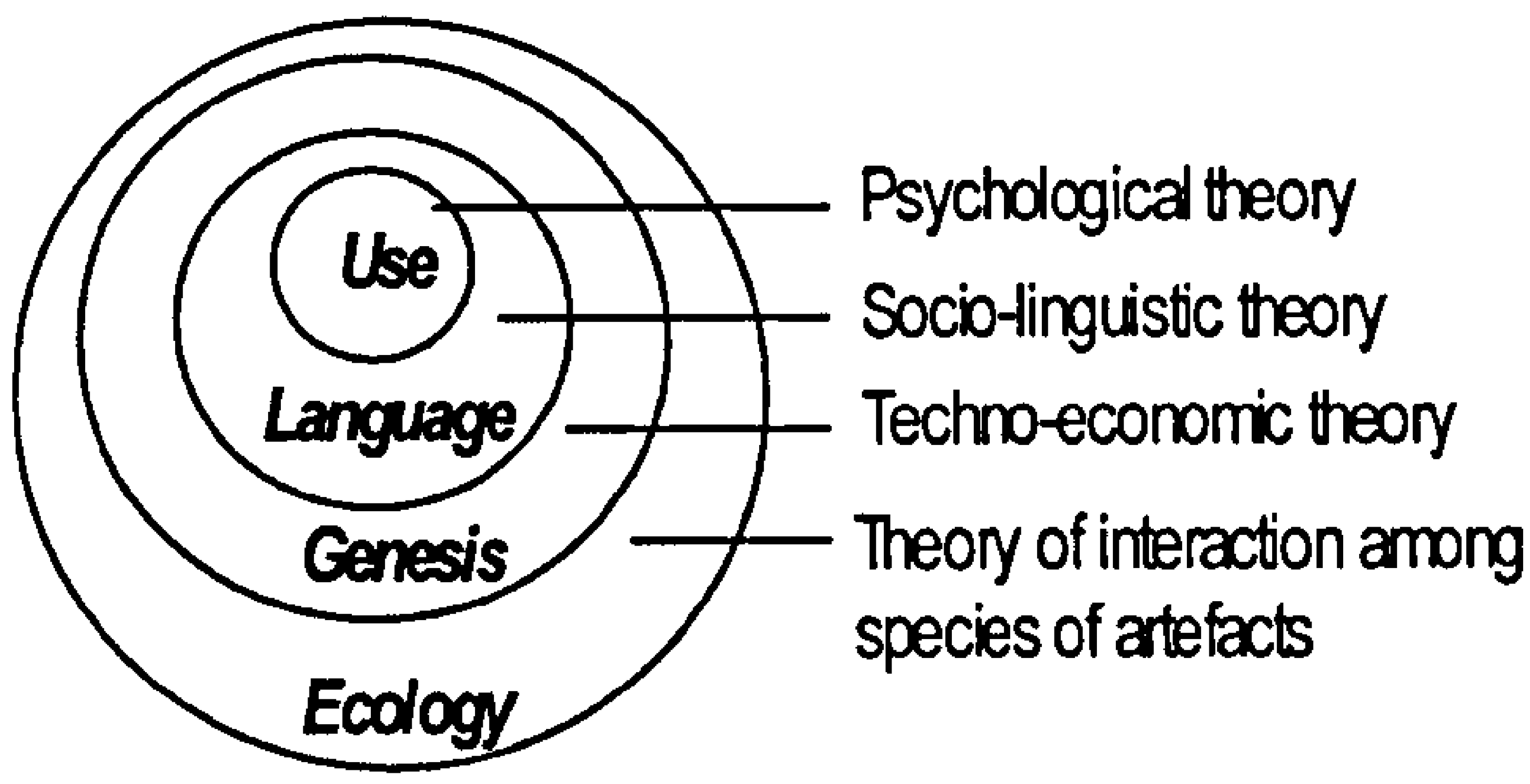

Fig. 31 – Contexts and theories involved in Product Semantics
[Source: Krippendorff, 1990: a11]

The *semantic notion of space*, on the other hand, is a sort of reaction to the largely mechanical and abstract notion of geometric space. That is to say, a reaction to the idea of space derived from analytical geometry and the principle of orthogonality that defines objects as three-dimensional constructions with no reference to particular observers (Lannoch, 1990). The roots of the notion of semantic space are then in the distinction between physical and mental abstractions (Lannonch and Lannoch, 1989). Both of them are described as processes of conceptualisation: *physical abstraction* as that beginning with the abstraction of observer-independent physical qualities based on the realisation of general commonalities, whereas *mental abstraction* is defined as an observer-dependent process where individual perceptions are taken as the starting point to progressively build deeper levels of understanding. Building on this distinction, Lannoch and Lannoch visualise the space of mental abstractions or semantic space as comprised of six interrelated dimensions,[126] inspired in types of linguistic expressions normally used to allude to the meaning of things. These are (Lannoch, 1990): (1) the *dimension of experiential*

[126] The authors of the notion of semantic space use the term *'dimension'* as a metaphor following the idea of dimensions present in the geometric space (cf. Lannoch and Lannoch, 1989; Lannoch, 1990).

qualities (qualities attributed to forms by individuals: hard, soft, rough, angular, etc.), (2) the *dimension of orientation* (assertions indicating the location of things in relation to an observer/user), (3) the *dimension of states* (conditions under which things operate or are defined), (4) the *dimension of comparative judgements* (deviations from an ideal or referent), (5) the *dimension of affordances* (accounts of what something can be used for), and (6) the *dimension of values and conventions* (evaluative statements from assumptions socially shared).

Having outlined the sort of ideas, methods and theories either involved or derived from Product Semantics, some critical remarks should be made. Firstly, it is hard to see how the comprehensive view proclaimed in the writings of Krippendorff will take form in an accessible way for designers since, judging by the methods above mentioned, they have just been able to incorporate two out of the four contexts initially outlined as part of Product Semantics (the context of use and the context of language). In this sense, it will be interesting to see how future proposals within this framework will incorporate the huge diversity of techno-economic and psychological theories in a coherent view for product design. Secondly, it is also hard to see how a theoretical approach that has been defined as the study of the 'symbolic' qualities of man-made forms (Butter, 1987; Krippendorff, 1989) can provide an account of those meaningful situations which are not socially determined; especially since symbols are generally defined either as signs of a conventional nature (Peirce, 1897) or as signs of an iconic nature (Guiraud, 1999), and provided that psychological theories such as that of **Direct Perception** (Gibson's theory of affordances) are focused on indexical 'readings' of things.[127]

For design authors such Peter Lloyd Jones (1991: 56), in Product Semantics "aesthetics is still treated as somewhat of a side issue", since the level of discrimination, critical judgement and appreciation are the least developed of such a theoretical programme. For other authors such as Seppo Vakëva (in Michl, 1990) the use of the term 'semantics' for this theoretical approach is paradoxical provided the fact that other meaningful dimensions for product design such as the syntactical and pragmatic one, seems to be excluded. As a paradigm of design practically

[127] In his writings Klaus Krippendorff acknowledges the relevance of Gibson's affordances to Product Semantics. Nevertheless he does not seem to envisage the place of affordances in his definition of Product Semantics as the study of symbolic qualities.

recent, it is clear that Product Semantics still has a long way to go to incorporate what is lacking and to solve some of its intrinsic contradictions.

2.2.8. Theories on the obliteration and re-semantization of references in utilitarian objects and products

The last type of theories of reference that will be reviewed as part of this research are those about either the obliteration or the transformation of the functional references (functional readings) of utilitarian objects by virtue of commercial, technological, cultural or historical circumstances.

Of all the authors working with the obliteration of functional references, Jean Baudrillard is perhaps the one who has devoted more time to this subject. His views about the obliteration of functional references have been presented in different ways along no less than 20 years. His approach is socio-economic, this being the reason why he constantly appeals to notions of classical economics and refers to utilitarian objects mostly in terms of consumption. He begins to develop his argument by conceiving the meaning of utilitarian objects as derived from four different logics (Baudrillard, 1969): the *functional logic of use-value* or that focused on the practical operations perform through objects, the *economic logic of exchange-value* or that centred in the theoretical equivalences characteristic of goods, the *logic of symbolic exchange* or that about the ambiguity derived from our subjective understanding of the exchangeability of objects, and *the logic of the value as a sign* or commercial logic of differentiation.

With these four logics in mind, Baudrillard realises that the decontextualization and subsequent distortion of our utilitarian objects for merchandising purposes was bringing along a progressive obliteration of our practical understanding of them (Baudrillard, 1969). This an idea that became stronger when the economic climate of the 1970s showed that the use-value of products could be definitely overtaken by their exchange-value, drawing him to forecast the coming of the death for all the functional references of our utilitarian objects (Baudrillard, 1993). During the 1980s Baudrillard takes this idea even further by pointing out that the commercial alienation in our consumer societies was instituting an 'age of simulation' in which our new ways of understanding things were transforming *the signs of the real into the real itself* (Baudrillard, 1983), and where our utilitarian objects were becoming fetishes (objects without a function) with an incredible regularity (Baudrillard, 1997).

This 'apocalyptic' view of the functional understanding of our utilitarian objects found relative confirmation in the 1980s consumerism. However, economy was not the only force helping to turn 'the signs of the real into the real itself' but a combination of it with the development of technology. In this sense, Gillo Dorfles is among the authors that since the 1970s have been relating the obliteration of the functional references in objects to the directions followed by technological development. In his view, the form of our utilitarian objects "...either no longer exist or else it is invented of whole cloth without the slightest relationship to whatever it 'covers' or hides" coming to be a 'simulacrum of container', i.e. a container "...devoid of content that correspond morphologically" (Dorfles in Barbacetto, 1987b: 97). Hereof for Dorfles, what we have been witnessing is the establishment of an **unmotivated technology**: a technology where the function of objects is being wiped out from their appearance without any conscious purpose (Dorfles, 1979). This is a view of no exclusive concern for Dorfles since authors such as Chaput (1988), Friedländer (1989), Krippendorff and Butter (1993), and Baudrillard (1994) have also focused on the implications of new technologies for designers and users.

Besides the socio-economic and socio-technological views above presented, there is also a socio-cultural view on how the obliteration of functional references has been taking place. One of the most representative works of this view is that of Michael Thompson in his 'Rubbish theory'. This is a theory that studies the social control of value building on the fact that "rubbish is socially defined" (Thompson, 1979: 11). According to Thompson, people in Western culture place objects either in a 'transient' category or in a 'durable' one. Objects in the *transient category* decrease in value over time and have finite life-spans, whereas those in the *durable category* increase in value over time and have infinite life-spans. Consequently, a used car falls into the transient category whereas an antique piece of furniture falls into the durable one. Objects that do not fit into any of these two categories, that is, those of zero value, comprise the *rubbish category*. Based on this conceptual framework, Thompson suggests that *transient objects* gradually decline in value and expected lifespan sliding across into the *rubbish category*, in which they remain in a timeless and valueless limbo until they are rediscovered by someone, who re-value them as *durable objects*.

Besides the theories aforementioned, there are also theories that, differently to the previous ones, support the idea of re-semantization (transformation) for the functional references of utilitarian objects. Since the standpoints working around this view can not be summarized through the study of few authors, they will be here presented chronologically, starting from the 1960s, since it was the decade in which these theories began to emerge or be related to design. The 1960s was also the decade in which the *semiotics of objects* began to be cohesively appraised (Krampen, 1979b).

The oldest approach to the re-semantization of functional references in utilitarian objects is perhaps that of 'objects as extensions of man'. The best known adaptation of this theory for design seems to be that of Marshall McLuhan whose writings on this subject were initially published in the 1960s. Under this approach functional references are generally understood as part of three generations (Morgantini, 1983): (1) **Prostheses of the limbs**, (2) **prostheses of the senses**, and (3) **prostheses of the mind**. This idea of generations gradually replaced by new and more effective ones (Dorfles, 1972; Virilio, 1991), outlines a process of re-semantization where the traditional materiality associated to certain functions is ignored a number of times in order to manipulate reality in more direct and flexible ways (Toffler, 1983; Mangieri, 1998a; Kerchove, 1999). The interesting side of this trend is that functions in themselves remain the same or are simply reinterpreted whereas the major changes take place in the means used to accomplish them.

Another interesting contribution, also from the 1960s, is that of Roland Barthes. His work corresponds to that stage of general semiotics focused on cultural systems (Gandelsonas, 1974). Consequently, Barthes owns up to the task of approximating the semantics of objects as cultural manifestations whose understanding follows a process comprising three phases (Barthes, 1964b). A first one, where the object presents itself as a functional one, that is, as "a mediator between humanity and the world" (Barthes, 1964b: 189). A second phase, where the object enters the semantic field of equivalences (or other meanings), struggling between "the activity of its function and the inactivity of its signification" (Barthes, 1964b: 189). And finally a third phase, where the object describes a sort of return movement from the world of secondary references to that of its functional reference – see figure 32.

In 1973, Juan Pablo Bonta presented a process of re-semantization for architecture which can also be applied to the re-semantization of functional references in utilitarian objects. Stemming from the semiotic writings of Eric Buyssens and Luis Prieto, he argues that the information conveyed by design objects can assume three distinctive roles: as **indicators** or pieces of information where the relationship between form and meaning is natural or factual, as **signals** or pieces of information where the relationship between form and meaning is conventional, and as **intentional indicators** or indicators purposely created and used to communicate as signals do. Thus, according to Bonta (1973), the production of meaning in design objects begins when an *indicator* is transformed into an *intentional indicator*, which in turn ends up as a *signal* after being repeatedly used. This primary semantization is subsequently followed by several re-semantizations due to the obsolescence achieved by signals throughout time. Then obsolete *signals* are taken as *intentional indicators* to restart the process all over - see figure 33.

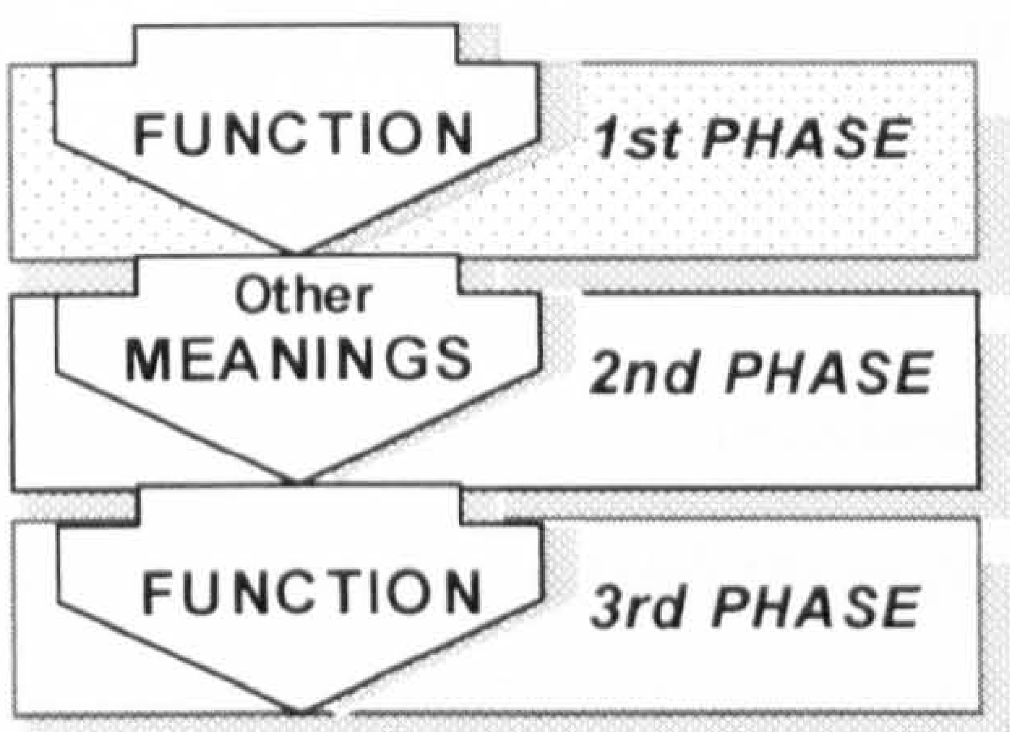

Fig. 32 – Barthes' model of re-semantization (1964)

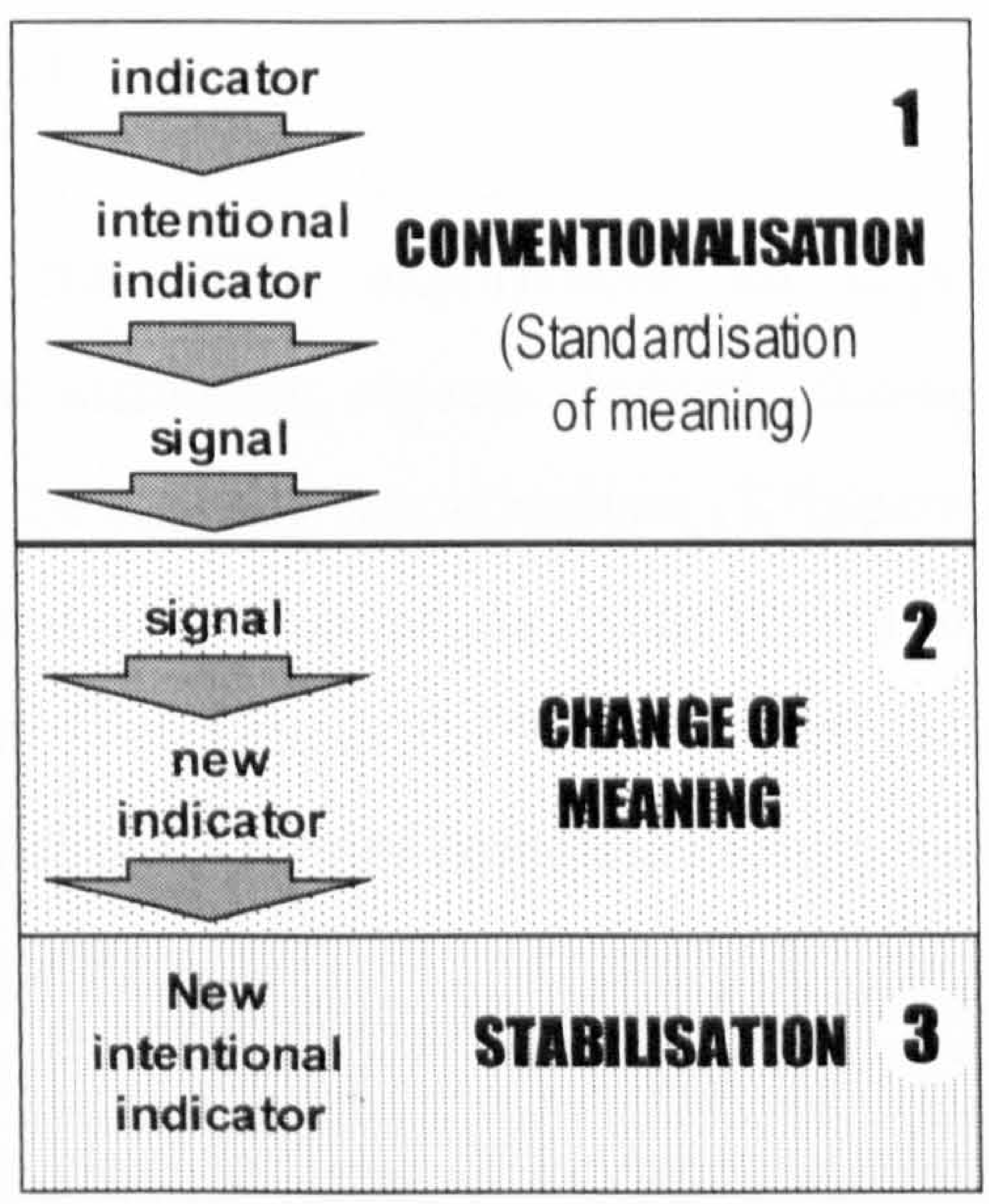

Fig. 33 – Bonta's model of re-semantization (1973)

In the late 1970s, the outbreak of critical controversies about mass media and popular culture provided new grounds for semantic theorizations. The most representative work of this period is perhaps that of Paul Levinson (1977) about mass media technology. Levinson, a professor of communication, focused his research on the changing usages and perceptions of film since its first appearance. From such a study he elaborated three principles that, according to him, can be extrapolated to define the development of any new technology as well as our perceptions about them. These principles take place chronologically, bearing some interesting resemblances with well-known models of human development such as that of Piaget for children's intellectual growth (Levinson, 1977).[128]

The first of Levinson's principles puts forward the idea that all new technologies are initially visualized by people as **toys**, because their potentialities are poorly understood. This is a principle that characterizes a stage in the life of technological objects based on the idea they project about their own identity, where the content of the object is the object itself. Once the new technology is socially accepted and its nature recognized, a second principle named by him **mirror** takes place. Such a principle corresponds to a stage where the object's content becomes a reflection of life, transforming the technological object into a surrogate of reality. Finally, when technology stops being a mature translator or reflector of reality, a third principle comes to light. Summarized under the name of **art**, this principle represents the moment when the passive copy of reality is replaced by a re-fashioning of it, and where the triumph of form over content closes the technological dialectic of pre-reality, reality and post-reality – see figure 34.

Differently from studies such as this, the 1980s experienced an important conceptual shift in the theorizations about utilitarian objects. Indeed, during this decade a *semantic paradigm* is opposed to the existing functionalism (Krippendorff, 1990) and the role of context is up-dated in terms of its contribution to the production of meaning (cf. Krampen, 1989; Krippendorff, 1989). Nevertheless no remarkable propositions are made in terms of processes of semantic change, besides the one already suggested by Morgantini (1983).

During the 1990s, on the contrary, similar ideas to those of Levinson are brought back in discussion but under a different methodology. As a matter of fact, historical accounts are replaced by theoretical proposals stemming from psychology and the

[128] This process of intellectual growth is divided by Piaget in three stages: sensorimotor, concrete and formal / abstract (Levinson, 1977).

sociology of knowledge. Thus, based on the writings about human needs of K.S. Young and Abraham Maslow, Ding-Bang Luh (1994) outlines a group of psychological indexes to typify the way in which users perceive design products along their life cycles. This is a work that ends up defining four different conceptual phases for our understanding of mass-produced utilitarian objects. According to this theory, we first perceive the object as a **new tool**, secondly as a piece of **standard equipment**, thirdly as a means for **status-reflection** and finally as a **source of entertainment** – see figure 35. In this respect, it is curious to see how this theory bears some conceptual proximity with that of Levinson, even though the phases or principles present in both are arranged differently.

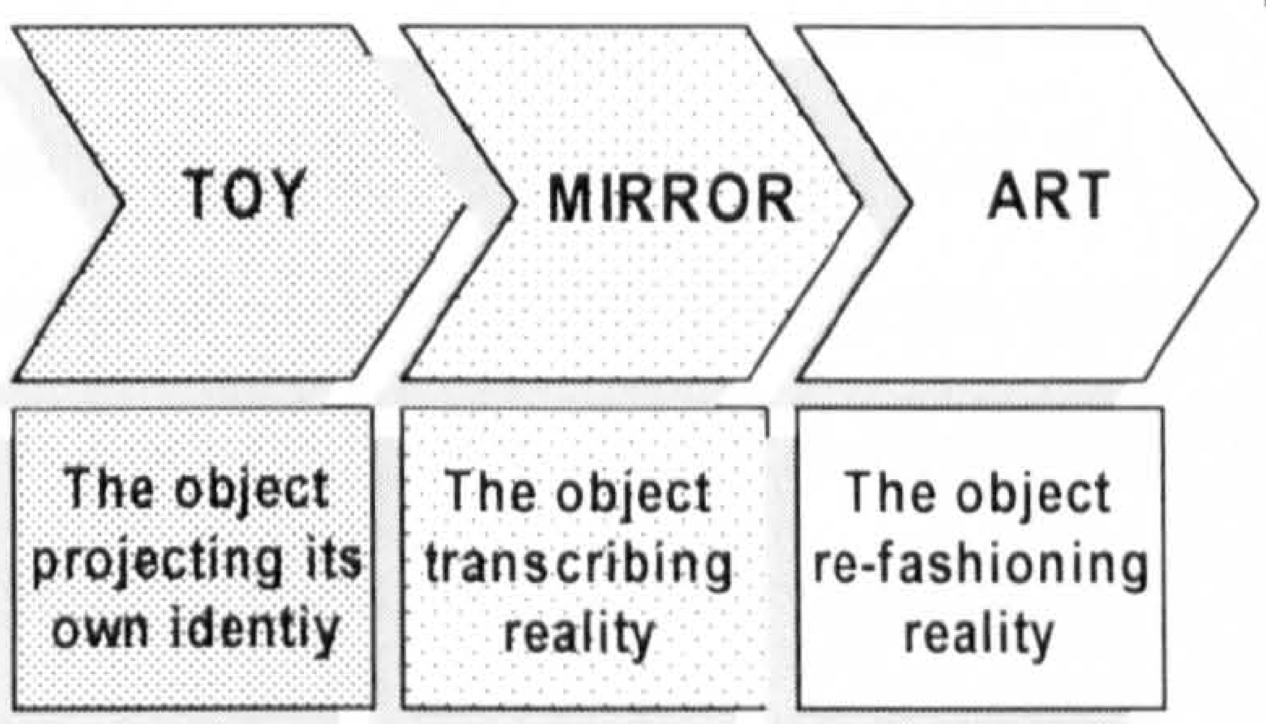

Fig. 34 – Levinson's model of re-semantization (1977).

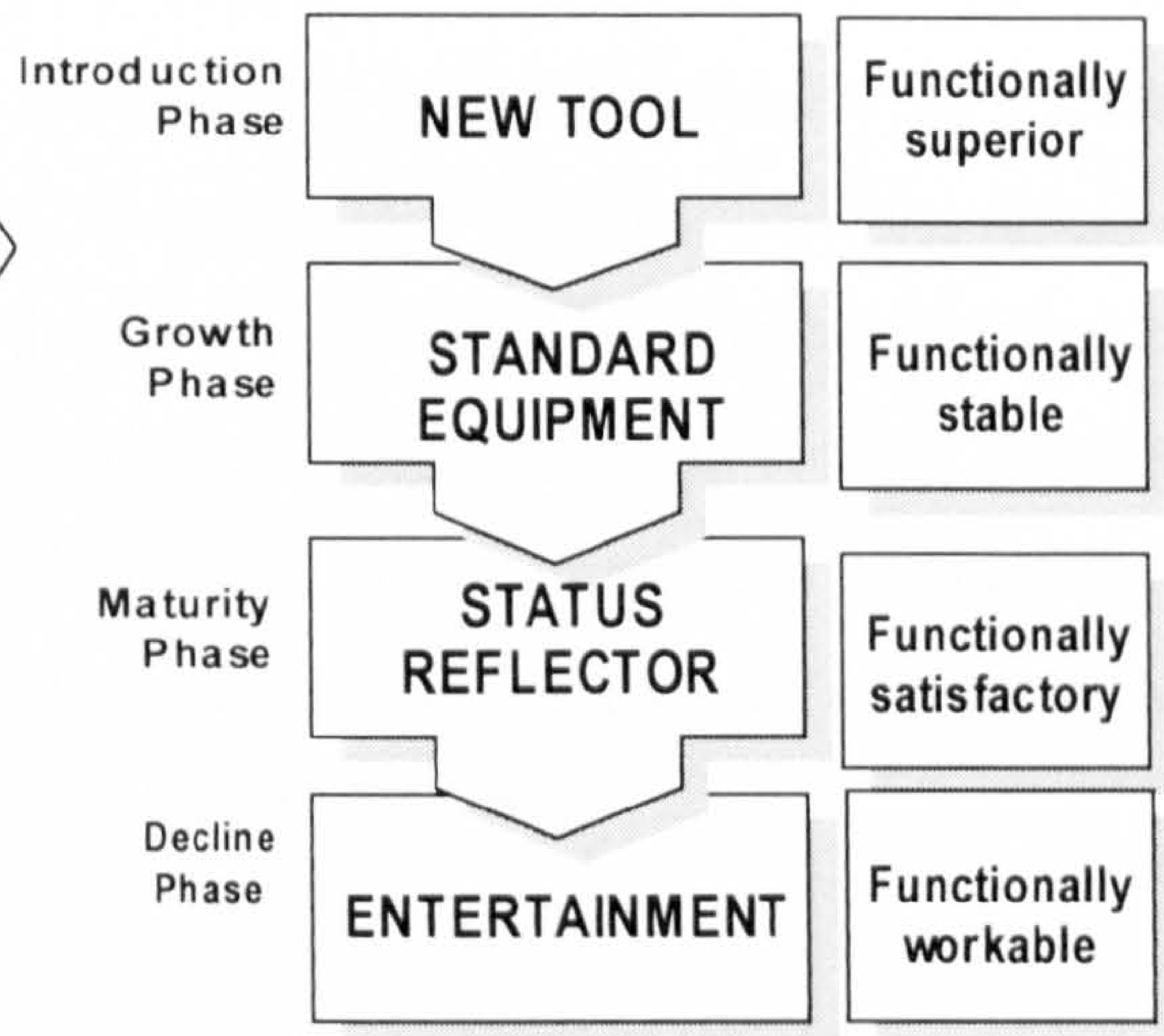

Fig. 35 – Luh's model of re-semantization (1994).

Likewise, in 1997, I proposed a model to explain the mechanisms underlying re-semantization in products along their life cycle (Lacruz-Rengel, 1997). In my approach, re-semantization is seen as the result of a social process comprising three stages. The first one is **Externalization** or the expression of the designer's ideas through the creation of objects. The second stage is **Objectivation** or that in which the designer's creations are submitted to social scrutiny in order to be accepted or rejected by its potential consumers. *Objectivation* is in turn subdivided into two phases: **Institutionalisation** or acceptance of a given form or functional principle as typical of certain kind of object, and **Legitimisation** or creation of habits to support the continuity and use of those objects already typified. Finally the third stage is **Internalization** or that in which the object and its configuration are apprehended by its potential users, provided that they did not participate in their objectivation.

Such a process of social 'negotiation' is repeated in each phase of the Product Life Cycle (PLC), bringing along a first order of Externalisation-Objectivation-Internalization (E-O-I) for the product's phase of *introduction and growth*, a second order of E-O-I for its *maturity*, and a third order of E-O-I for its *decline*. From the standpoint of the consumer as an individual, the model suggests the pre-eminence of a different perceptual dynamic for each phase of the PLC. They are: *Familiarisation* for the phase of introduction and growth, *Refinement* for the maturity phase, and *Exhaustion* for the decline phase. Such a perceptual sequence also help to outline the strategy designers need to follow in order to develop successful products. Thus, for the *introduction and growth phase* of the PLC designers are recommended to treat products as *symbols* or objects whose function is unknown by the consumer and whose features help to expressed how the product works. For the *maturity phase* of the PLC designers are recommended to conceive their products as *icons* or objects whose development focuses on the introduction of new features given that the functional identity of these objects is already granted. And for the *decline phase* of the PLC designers are recommended to treat their products as *indexes* or objects whose renovation resides in the use of sources of inspiration extraneous to the nature of these objects – see figure 36.

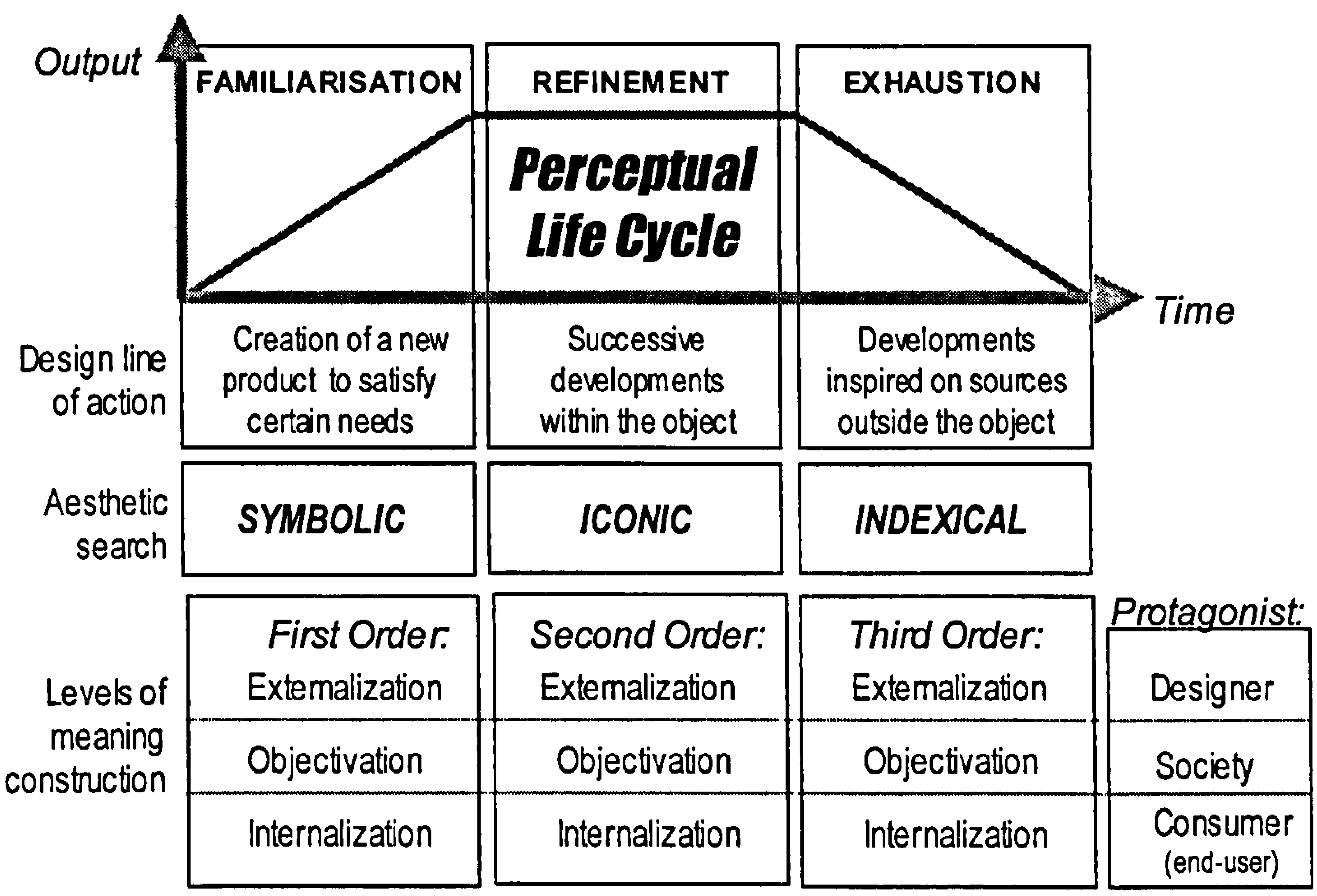

Fig. 36 – Lacruz-Rengel's model of re-semantization (1997).

Finally, we have the work of the Italian sociologist Fabrizio Carli, published in the year 2000. Based on a methodology that combines history, psychology and aesthetics, his study is particularly devoted to the re-semantizations of electrical appliances. According to Carli, throughout history this type of utilitarian objects has subsequently repeated a process comprised of five phases – see figure 37:

* **Indifference** or the allocation of these objects into existent aesthetic canons.
* **Gestation** or the visualization of the object physical configuration as being characteristic of certain aesthetic or technological period of time.
* **Semantic deviation**, where objects suggest ideas technologically too advanced for their time. Therefore, this phase is characterized by an intense formal experimentation that reflects people's future expectations.
* **Epistemic fracture** or the breaking of tradition to shake the beholder's perception. In this phase objects are deformed and regenerated by a slow sedimentation.
* **Revisionism** or phase where previous designs to the epistemic fracture are taken over again and re-interpreted.

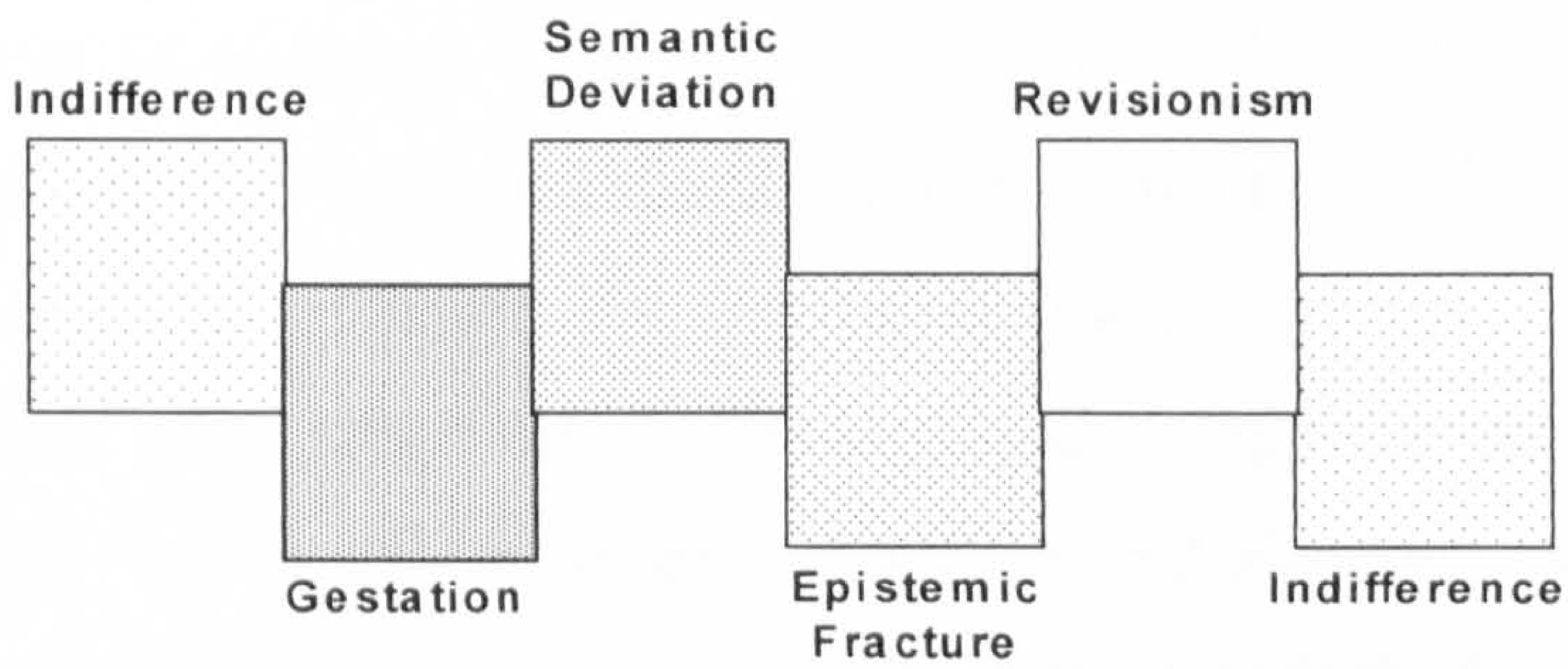

Fig. 37 – Carli's model of the re-semantization of electrical appliances (2000).

Having presented the theories that support or deny the obliteration of functional references in utilitarian objects, we can conclude that since the function of utilitarian objects cannot be permanently obliterated, re-semantization is what actually takes place during our transactions with these objects (Lacruz-Rengel, 2003c). Such a re-semantization, however, may not follow the same phases and sequences here mentioned given that the objects, circumstances and users involved are not always the same.

Chapter 3

Foundations for a theory on design concepts

The last chapter provided an overview of the way in which design concepts are understood and the theories that have been used to explain the production of meaning in utilitarian objects and products. The present chapter will set up the theoretical basis from which our theory of reference for product design will be built. Generally speaking, concepts are ideas conceived and formed according to our understanding of things (RAE, 1992). They help us to achieve different levels of abstraction and to develop the required abilities to think and act consciously (Sánchez, 1991a). Since product design works around the creation of concepts, this chapter offers a theoretical framework to appraisal them.

3.1. The act of conceptualising

The formulation of concepts is an activity directed to transform the reality we experience into abstract representations for our thinking (Morin, 1994). As such concepts are essential mediators for structuring our knowledge. They are for our intellectual work what genes are for biology and energy for physics (Moloney, 1981), since they do not only represent what exists but also help us to realise what could be possible. Indeed, concepts are part of the **Semiotic function** of human behaviour by which "…the representative evocation of objects and events not perceived at that particular moment..." make thinking possible (Piaget and Inhelder, 1969: 91). Concepts help us to combine our aptitude to form *mental images*[129] with our aptitude to produce *material images* – i.e. objects (Morin, 1994).

In design, the formulation of concepts has been equated to the ideation of design proposals (Asimow, 1962; Pile, 1979; Rodríguez, 1987; Baxter, 1995; Ulrich and Eppinger, 1995; Roozenburg and Eekels, 1995; Sánchez, 2001; Hansen and Andreasen, 2003), and hence as a sort of restructuring of those things designers

[129] Within the context of Humanities the term 'mental image' is used to encapsulate all kinds of mental representations.

think to be true and possible (Eekels, 1982; Buchanan, 1989; Irigoyen-Castillo, 1998). In this respect, design concepts reflect the very human need of organising the unorganised, of imposing a 'will to order'[130] upon reality (Boulding, 1964; Huxley, 1970; Papanek, 1984). As such they have more to do with individual ideas about things or **personal concepts**, than with definitions derived from agreements about particular ways of understanding things or **transpersonal concepts.**

The idea of *personal concepts* is not new at all. It is implicitly present in Charles Sanders Peirce's (1897) *Interpretant*, in Jakob von Uexkull's (1934) *Wirkmal* or functional significance, in George Kelly's (1955) psychology of mental constructs,[131] in Kenneth Boulding's (1956) 'organic theory of knowledge',[132] in Karl Popper's (1968) distinction between *universal* and *individual* concepts in science,[133] as well as in his distinction between the *worlds of subjective and objective knowledge* of his theory of the three worlds (Popper, 2005).[134] The idea of 'personal concepts' is also present in Emiko Ohnuki-Tierney's (1981) ethnologic phases for human perception, conception and symbolization; in Lev Vygotsky's (1995) *concepts in itself, concepts for oneself* and *concepts for the others*; in Algirdas Greimas' (1983) understanding of knowing and believing in the configuration of our *individual universes*;[135] in Edgar Morin's (1998) stratification

130 Aldous Huxley defines our *will to order* as a sort of intellectual instinct that, as a primary urge of our mind, turns our action toward "...the will to impose order in the confusion, to extract harmony from dissonance and unity from multiplicity" (1970: 154). Victor Papanek (1984: 4) has referred this same idea in design as "...the conscious and intuitive effort to impose meaningful order".

131 According to Kelly (1955), we come to understand the world by placing our *personal constructs* (interpretations) upon its events; creating in this way an abstractive structure to transform the substance of these events into something meaningful to us.

132 Indeed, for Boulding (1956) our personal concepts are 'images' that reflect what we know.

133 For Popper, "the distinction between universal and singular statements is closely connected with that between universal and individual concepts..." (1968: 64)

134 In Popper's view (2005) our reality is comprised of three different worlds: one of objects and physical states (which includes inorganic matter and energy, the biological structure of all living organisms, and our artefacts), one of subjective knowledge (individual perceptions, thoughts, emotions, intentions, dreams and memories), and one world of objective knowledge (scientific, technical, and artistic knowledge developed as part of our culture).

135 According to Greimas (1983: 173), *collective universes* are characterised by different types of mentalities, systems of thought and beliefs, whereas *individual universes* are those assumed by individuals and therefore those which have "...undergone a more or less coherent deformation...".

of the anthropo-social world into *psycho-sphere* and *socio-sphere*;[136] in Jerome Bruner's (1991) division of his 'Folk Psychology' into a *world of inner experience* and *an outer world*;[137] and in Umberto Eco's (1999) distinction between *Cognitive Types* (personal mental schemes) and *Nuclear Contents* (collective interpretations); just to mention a few. They show the variety of fields in which 'personal concepts' are considered as part of our explanations.

For biologists Humberto Maturana y Francisco Varela (1996), the presence in our acts of ideas such as our *personal concepts* is rooted in a condition proper to any living organism called **Autopoiesis** [from the Greek *"autós"* (self) + *"poieín"* (to create)], which stands for our capacity of self-determination or self-production.[138] In the specific case of human beings, this biological condition is driven by intentional acts or projects whose choice depends upon their needs (Uexküll, 1934; Scruton, 1999; Goldberg, 2002). Thus, we impose our *personal constructs* (interpretations) upon reality to anticipate events and define possible routes of action (Uexküll, 1934; Kelly, 1955; Desiato, 1996; Goldberg, 2002). In this sense, the presence of intention in **human autopoiesis** introduces a new level of mental life absent in other species: the capacity to react not only toward stimuli but also toward our ideas/representations of them (Boulding, 1956; Esté, 1997; Scruton, 1999). This happens in such a way that every human action ends up generating knowledge (and concepts as part of it) in the same manner as knowledge ends up defining action, within a cognitive cycle where "...all our actions, without exception, make a contribution to form the world we live in..." (Maturana and Varela, 1996: 164).

Such an approach to concept formation does not intend to suggest that our *'personal concepts'* lack of any moulding agents of social nature. As a matter of fact, a relatively small part of our knowledge of the world originates within our personal experience (Schütz, 1953). Indeed, there are levels of complexity in which sense

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136 In Edgar Morin's view, the *psycho-sphere* is that referred to individual spirits and brains, whereas the *socio-sphere* is the culture stemming from the interaction of individual spirits and brains.

137 Jerome Bruner's understanding of *Folk Psychology* suggests the existence of a world beyond each individual capable of modifying the way individual desires and beliefs are expressed.

138 The words *poem, poetry* and *poet* are all derivatives from the Greek 'poieín' (Ayto, 1991). The link between *poetry* and *creativity* finds its origins in the fact that, in ancient Greece, only poets were considered to be creative among all artists (Tatarkiewicz, 1977).

can only be provided by the sort of 'objectivation' derived from social interaction (Berger and Luckmann, 1997). In this respect, language is perhaps the most important social means to mould our concepts. Especially if we acknowledge the fact that it is as part of language that our consciousness normally manifests (Maturana and Varela, 1996).

It does not mean, however, that all human consciousness has a linguistic nature. There is also a pre-linguistic consciousness, mainly observable in new born babies, which stays with us throughout the rest of our lives, complementing and supplementing our linguistic consciousness once this appears (Mosterín, 1981; Deval 1982). This pre-linguistic consciousness is comprised of multiple non-verbal sign systems that allow babies to acquire and compose an active knowledge of their world (Sebeok, 1996). The mental products of this pre-linguistic stage are normally known as **perceptual pre-concepts** (Mosterín, 1981). These are pre-linguistic types of representation closely related to concepts which emerge in babies after their 18 months of age (Piaget and Inhelder, 1969; Deval, 1982). Among them are babies' *deferred imitation* and their *symbolic plays*. The former alludes to ways of imitation taking place in the absence of the thing that is being imitated (e.g. the sucking of a thumb as a surrogate of breast feeding). This sort of imitation constitutes the origin of representation since it marks the beginning of our ability to take something as standing for something else. *Symbolic plays*, on the other hand, are 'as if' games (e.g. when babies simulate to be sleeping), which provide a means to assimilate reality without coercions, that is, without feeling the need of accommodating their own models to external models (Piaget and Inhelder, 1969).

Beyond this, the role of language in concept formation is quite significant provided that words not only help us to enter realms of collective consciousness but also equip us with a fundamental 'tool' to interact with other human beings (Rorty, 1995). Indeed, we manipulate objects based on the names we use to designate them (Moles, 1971), that is, through generalisations (concepts) preserved as part of the ancestral experience of human communities (Marina, 1996). On the other hand, the value system we inherit through language ends up even mediating our simplest acts of perception (Boulding, 1956). Therefore, the role of language in conceptualisation is more than that of a simple tool. Through language, not only our experience but also our ways of behaving and the organisation of our mental activities are broadened out (Luria, 1982), given that language allows us to conceptualise, think and communicate our experiences by detaching them from the presence of time and from their dependence on sensation (Lannoch and Lannoch, 1989).

However, neither language is the only social mechanism involved in concept formation nor all our cognitive mechanisms related to concepts can be tagged as social. Indeed, our natural understanding of antecedent-consequence relations and our recognition of mediating forces to explain why antecedent-consequences occur are both instances of concept formation (Tomasello, 1999). There are cognitive mechanisms linked to concept formation which are based on social abilities previous to language, such as our capacity to direct our attention to some kind of referent during our communication with other people as well as during the assessment of our own ideas (Bruner, 1991; Goldberg, 2002). There are also cognitive mechanisms that without being derived from language work alongside with it. Such is the case of our ability to learn not just from other people but also through them by imagining ourselves 'in their shoes' (Tomasello, 1999). As a matter of fact, in the behavioural human horizon other people are always present somehow (Boulding, 1956; Desiato, 1996).

Thus, no matter how *'personal'* we think our concepts are they are always mediated by culture as culture is also mediated by them (Morin, 1998). To the extent that our dependency on culture works as a hidden dimension whose effects are beyond our will and many times even beyond our consciousness (Hall, 1973), providing us with a great number of 'pre-packaged' associations and conceptual schemata[139] (Shore, 1991). In this sense, concept formation is not only at the crossroad between biological and social processes but also in that between the individual and the social, confirming the kind of interdependencies alleged by social scientist like Norbert Elias (1999 and 2000). An interesting example of this double interdependence (biological-social and individual-social) during concept formation can be seen in phases proposed by the ethnologist Emiko Ohnuki-Tierney (1981) to

[139] *Scheme* (in singular) / *Schemata* (in plural): mediating representation of categorical nature that serves as a sort of guide or framework for our interpretation of phenomena.

explain the process of perception, conception and symbolization of certain cultures. Such a process can be summarised in the following four phases:[140]

PHASE	ASPECTS INVOLVED	OUTCOME
- 1 - **Initial perception and identification** of the object by the individuals of a society	* Natural discontinuities: **Pointing** = recognition of sensory stimuli (perception). * Cultural discontinuities: **Naming** = classification of the object (projection of this classification on the object).	* **Sense image** = mental image of how the object is. * **Sound image** = linguistic label for the object. * **Concept** = conceptual identification of the object as such.
- 2 - **Further identification** of the object based on the classification system of that culture	**Concepts** in relation to other concepts.	* **Memory codes** = cultural definitions at a minimum level.
- 3 - **Symbolic transformation** (A different role or meaning is assigned to the object)	**Natural and cultural continuities in time and space** (agreed linkage between the object at stake and certain phenomenon)	* **Analogy codes** = those resulting from cause and effect.
- 4 - **Symbolic substitution** (Externalisation of a symbolism through the creation of an icon)	An **iconic materialisation** of the agreed linkage.	* **An icon.**

Keeping in mind these ideas, it can be said that when we perceive an object, we relate the personal idea (*personal concept*) we have about it to the idea or concept shared by the society of which we are part (*transpersonal concept*) – see figure 38. When one designs an object, on the other hand, the thinking process taking place is quite the opposite (O'Doherty, 1963), since designers generally consider the *trans-*

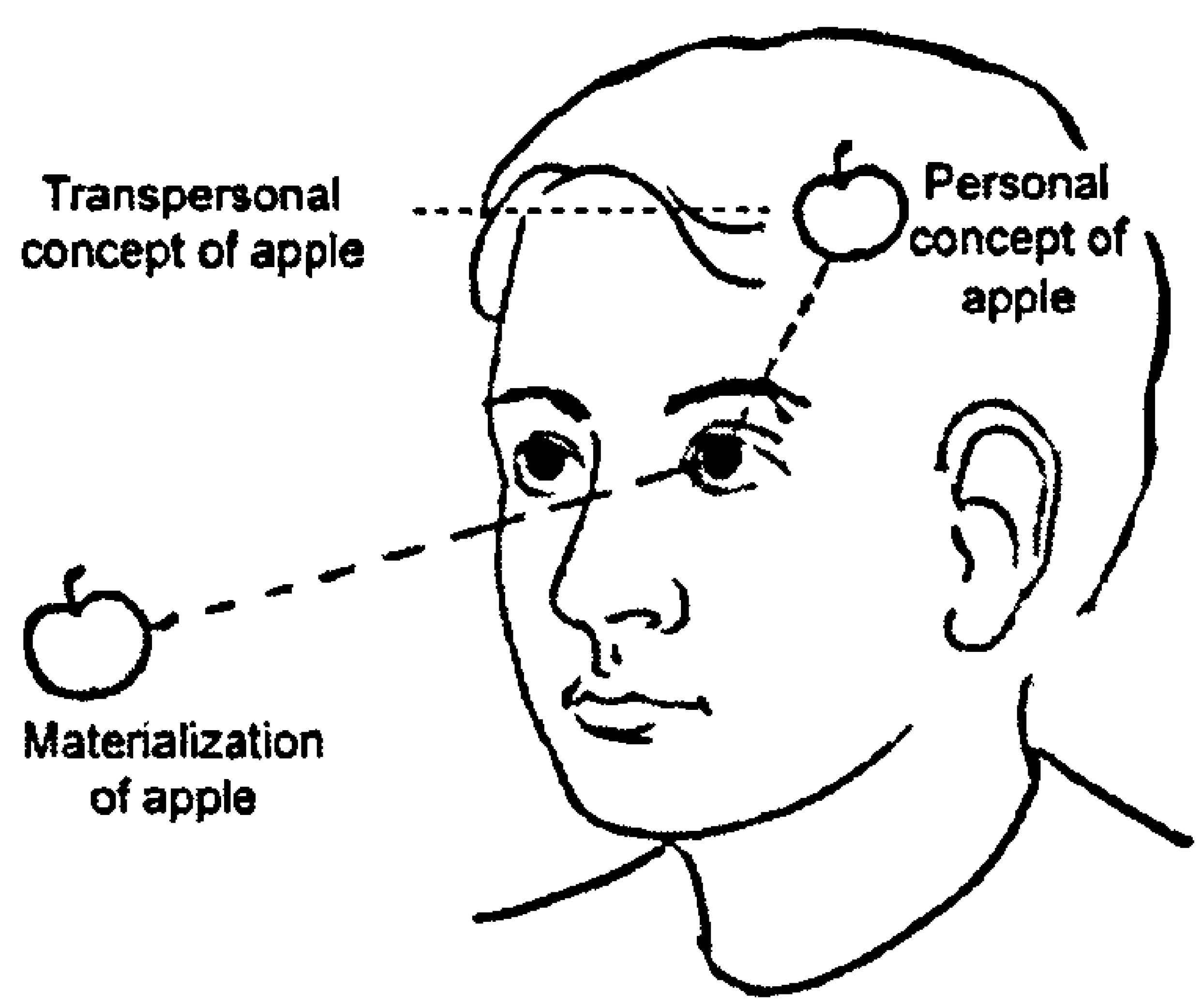

Fig. 38 – Interrelation between personal and transpersonal concepts during perception [Figure modified from: F.H. George (1974: 23)].

[140] This process originally comprises seven phases. For the sake of clarity they have been summarised and reduce to four.

personal concepts of the object they want to design in order to outline their design concepts (*personal concept*). Thus, **design concepts** are 'personal concepts' formulated by designers for the creation of objects, based on their experience and knowledge: an individual and creative act par excellence, even though some of its elements may have a social origin.

3.2. The function of concepts and their place in designing

There are two basic ways to studying the functional side of concepts. One is to look at them in terms of what they do. The other is to study them considering how they do what they do. The former corresponds to the field of philosophy whereas the latter to that of psychology. In philosophical terms, the function of concepts can be visualised through three operations of our thinking: defining, dividing and classifying (Serrano, 1978). Things are *defined* when they are circumscribed within certain limits that separate them from the rest of things. Things are *divided* when our understanding of them aims toward their partition into parts. And things are *classified* when our idea of them responds to certain logical order capable of placing them in relation to other similar things (i.e. to place things as part of species). Since defining and dividing do not exclusively relate to concepts, they are also quite useful to clarify what concepts stand for. Indeed, the act of defining draws our attention toward the synthesis of things whereas that of dividing toward their analysis. The act of classifying (categorising), on the other hand, provides significant clues about the identity of things within a range of meanings that moves between what is typical and what is ideal (Athavankar, 1990). Given that the act of classifying will be appraised in detail later, the following lines will only refer to those variations of *definitions* and *divisions* relevant for the present research.

Generally speaking, definitions can be divided into *real* and *nominal*, that is, into those referring to things with actual existence and those alluding to things existing only by name. In product design both types of definitions play a role: *real definitions* help to build the corpus from which designers innovate; whereas *nominal definitions* contribute to outline and present the innovative aspects of a product through the name assigned to it. Real definitions can be of three kinds (Serrano, 1978): essential, genetic, and descriptive. *Essential definitions* allude to the basic aspects that define what things are. *Genetic definitions*, on the other hand, designate the way in which things are produced, i.e. their genesis. Whereas *descriptive definitions* outline what things are according to their distinctive and contingent properties.

Nominal definitions generally allude to the essential, genetic and descriptive aspects present in *real definitions*. This is why nominal definitions are commonly understood as generic names given to things. Within design, however, the name of a product does more than just identifying it. It helps to define the product's 'personality' and to highlight its distinctive features (Dormer, 1990). Therefore, when naming a product it is advisable to (Pope, 1984): (1) favour the use of connotations as part of it, (2) create names compatible with the type of product it is about (e.g. childish names for children's products), (3) make sure that such names are easy to pronounce and remember, and (4) choose names neither too familiar nor too strange, in order to attract people's interest.

Finally, in relation to *divisions*, there are three basic types (Serrano, 1978): *real* or those based on the actual parts comprising an object, *logic* or divisions of the object into fictitious parts for the sake of study, and *logic with support in the real* or those which are intermediate versions of the two types already mentioned.

In the ideation of design concepts, operations such as defining, dividing and classifying normally take place via criticism.[141] To such a degree that criticism is an important part of the creative act in itself, and design a way to think how objects can be defined (Flusser, 2002). Therefore it is logic to think that our essential, descriptive, and genetic definitions can have parallel types in criticism. Wayne Attoe (1982) has identified the presence of three kinds of criticism in design which are definitely linked to our types of definitions. They are called by him: normative, descriptive, and interpretative criticism (Attoe, 1982). *Normative criticism* works around the discovery of the fundamental aspects that comprise each object in order to use such information as a measurement for their reformulation. *Descriptive criticism* presents a series of aspects about the object in order to facilitate or improve our understanding of it. And, *interpretative criticism* explores the ideas

141 It is worth noticing that 'to criticise' is to discern or judge something (from the Greek *Krinein*).

evoked by the object's configuration (sources of inspiration, memories, etc.). The parallelism so established might not be so straightforward for the case of concepts based on divisions, since it is hard to establish which of these three types of criticisms have more to do with real, logic or a blend of both types of divisions – see figure 39.

TYPE OF DIVISION	TYPE OF DEFINITION	TYPE OF CRITICISM
Real Logic Logic with support in the real	Essential	Normative
	Descriptive	Descriptive
	Genetic	Interpretative

Fig. 39 – Relation between types of concept (divisions and definitions) and types of criticism in design.

Differently to philosophy, psychology has been predominantly interested in studying our acts of categorisation (classifying) as a way to outline concepts. This becomes obvious in the functions psychology assigns to concepts (Medin and Smith, 1984):

a. Simple categorisation or determination of whether something belongs or not to a simple class of things. For example, when someone attempts to classify a cutting utensil as being a 'knife'.

b. Complex categorisation or our understanding of objects as part of complex classes of things. For instance, when one tries to determine if a knife, as the cutting utensil it is, can be defined as a 'knife for butter' or for some other specific task.

c. The structuring of linguistic meaning. The definition of other terms and things according to relations of similarity (synonymy), opposition (antonymy) and semantic implication – i.e. by hierarchical inclusion according to their roots (hyponymy) or similarity of form but not of meaning (homonymy). An example of this takes place when a 'spoon' is used as a means to define by comparison what a teaspoon, a dessertspoon and a tablespoon are within the realm of utensils used to stir and take up food.

d. The characterisation of the components of our cognitive states. That is, as a help to discriminate aspects of our beliefs, preferences and other cognitive states. For instance, the role played by concepts such as *gun*, *defence* and *security* in our comprehension of the use of weapons.

Of these four functions, simple categorisation is the function that more attention has received in the psychological literature about concepts (Medin and Smith, 1984). Nevertheless, within design, all four functions deserve close attention since:

1. Simple and complex categorisations play a remarkable role in the way products are recognised and differentiated from others (Athavankar, 1990).

2. The structuring character of linguistic meanings offers interesting ways to unveil the reality behind product specialisation. Indeed, there are clear generative correspondences between words and objects (Ricard, 1982), provided that the key to the history of ideas is that of the history of words (Read, 1967) - see figure 40.

3. As a way to characterise our cognitive states, concepts also help us to realise the variety of ways we have to contemplate and understand objects (Moles, 1975; Vihma, 1995), given that they respond to a mixture of knowledge, interests and preferences, among other things (Norberg-Schulz, 1965; Kotler and Armstrong, 1991).

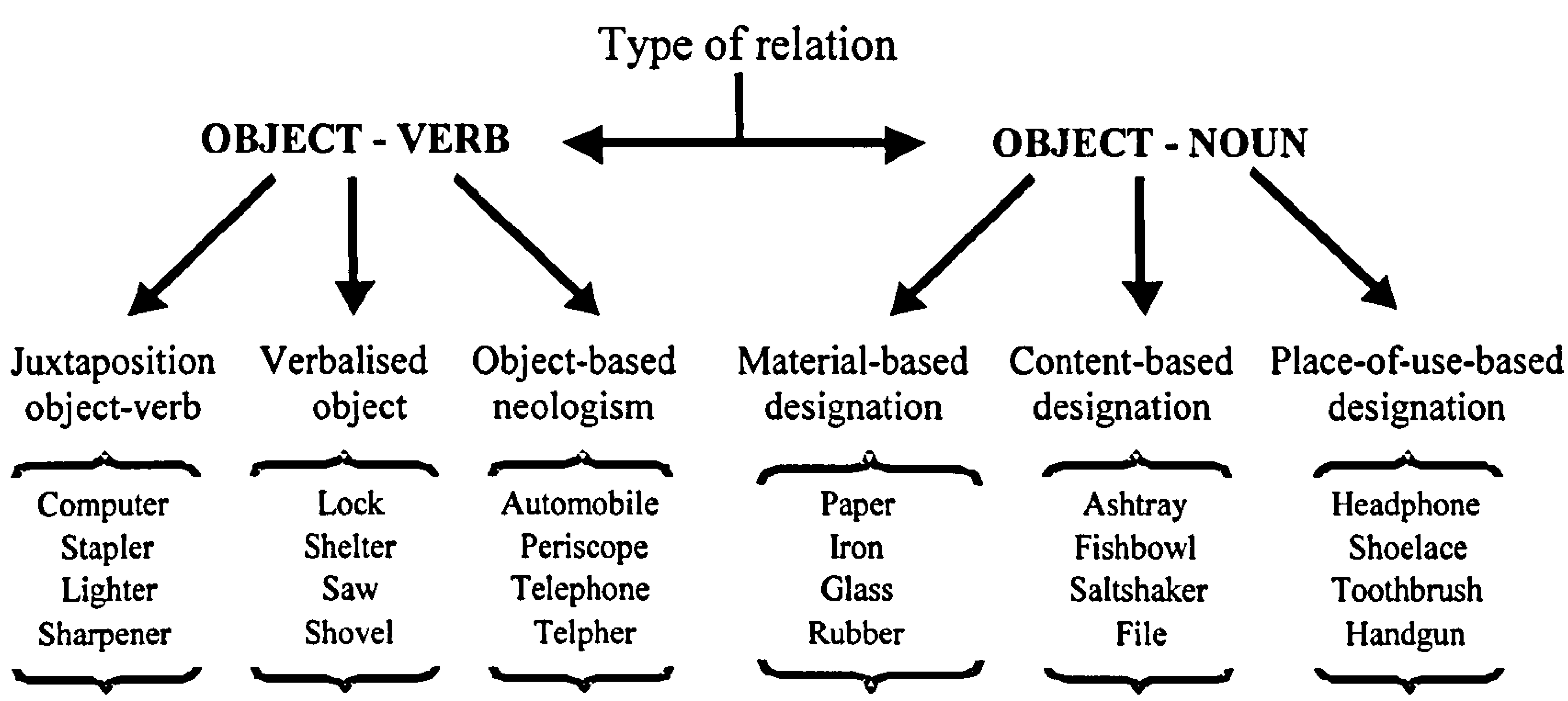

Fig. 40 – Relational categories between objects and words according to André Ricard (1982).

3.3. Creative thinking, mental images and concepts

From the standpoint of logicians, our thinking is linked to three mental operations (Serrano, 1978): apprehension, judgment and reasoning. The first of these operations in our interaction with reality is *apprehension.* Through it we discover what objects are, their essence, structure and nature. The products of apprehension are **concepts** (abstract representations of things). Once apprehension has taken place *judgement* comes into place. This is the process by which we accept or reject the ideas and things associated to concepts. The products of judgements are **enunciations** (assertions about concepts). Following judgement is *reasoning.* It is the operation by which we relate enunciations to discover new truths. Thus, the products of reasoning are **arguments** (rationales aiming to convince or proof enunciations). But, does design thinking follows the same chain of operations?

Some design authors insist on the idea that creative thinking should be mostly associated to ways of thinking different to the rational one (Broadbent, 1969; Ward, 1984), whereas others are more inclined to understand design in rational terms (Archer, 1965; Rittel, 1972). Authors from outside design, however, acknowledge that despite better results are sometimes achieved from multi-directional and non-sequential ways of thinking, linear or rational ways of thinking also play an important role in the creative process (Novaes, 1973; Beveridge, 1982; Sánchez, 1991b). Bearing this in mind, design authors have begun to conceive the design process as a combination of different thinking 'styles' (Martin, 1982; Cross, 1983; Tovey 1984; Rodríguez-Morales, 2004). The acknowledgement of such a blend of thinking styles shows that the rational and intuitive ways of thinking may not take place in any definitive order during designing. So that the contingent (i.e. mental images) may contribute to generate the abstract (i.e. concepts) as the abstract may impel the production of the contingent.

Since the imaginative and the conceptual are commonly seen as essentially different planes of mental activity (Serrano, 1978) and creative thinking strongly relies on our imagination (Malrieu, 1971), how do these two plains interact in the formulation of design concepts? As mental images and concepts are both mental entities, our best answer to this question may come from psychology. Indeed, for psychologists mental images are not concepts in themselves but as one of the behaviour patterns (together with drawing and the use of language, among others) that help us to formulate our concepts (Piaget and Inhelder, 1969). Such a distinction becomes more obvious when we look closer into the nature of both things.

The term *image* comes from the Latin *imâgô*, which means "likeness of something" (Ayto, 1991). Consequently, mental images have been defined as: quasi-sensory or quasi-perceptual experiences (Richardson, 1969),[142] "non-verbal memory representations of concrete objects and events" (Paivio, 1971: 12), psychic object-like representations produced by our memory or imagination (Braier, 1980), and as mental inventions or recreations of experiences (Finke, 1989), comprised of "...brain states like those that arise during perception but occurs in the absence of the appropriate immediate sensory input... usually accompanied by the conscious experience of 'seeing with the mind's eye', 'hearing with the mind's ear', and so on" (Kosslyn, 1988: 1621). In other words, **mental images** are a form of mental representation which resembles in some respect what it represents (Eysenck and Keane, 1990). But, the likeness of mental images is not a literal one provided that they are not necessarily visual, can be schematic and to a certain extent abstract (Arnheim, 1969; Paivio, 1971; Kosslyn and Shin, 1991).[143] Thus, the likeness of mental images is of an 'as if' type, since they are mental constructions rather than reproductions (Reber, 1995). This is precisely what helps them adjust to the requirements of our imagination.

The word **concept**, on the other hand, derives from the Latin *conceptus* which means "that which is conceived" (Gómez de Silva, 1988). That is to say, an intellectual creation of our thinking par excellence, and therefore not necessarily linked to the sensible (like in the case of abstract ideas such as *love* and *justice*).

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[142] Indeed, Allan Richardson (1969) designates one of his four types of mental images as *imagination images* (in contrast to what he calls *memory images*), and Piaget & Inhelder (1969) outline the existence of *anticipatory images* as the counter part of *reproductive images.* In this sense, Ronald Finke (1989) has asserted that mental images are very different from either *retinal* (the projection of visual sceneson the back of the retina) or what he calls '*iconic*' images (short-term retention of visual information in sensory mechanisms). And Philip Johnson-Laird (1980: 91) asserts that "it seems unlikely that they [mental images] are simple pictures in the head".

[143] Mental imagery can also be tactile, auditory, olfatory and even images of taste (Richardson, 1969; Paivio, 1971).

Concepts have been understood as general ideas of things derived from analytical and synthetic procedures, abstractions, comparisons and generalizations (Braier, 1980), as well as definitions of terms (words) or statements of the defining conditions for membership in the classes or domains designated by those terms (Cohen and Murphy, 1984). This latter definition is so deeply rooted in psychology that in some standard experiments concepts as understood as clear-cut verbal and logical operations (Luria, 1976). However, the analytical and synthetic procedures from which concepts emerge also involve types of mental representations different to the verbal ones, so that we can also have **visual concepts** (Arnheim, 1969).[144] In this respect, concepts and mental images should be understood as complementary, especially in creative activities such as design (Fish and Scrivener, 1990). Indeed, while mental images are quasi-sensible/concrete,[145] contingent, and generally used to designate things; concepts are abstract, non-contingent and commonly used to interpret and understand things (Piaget and Inhelder, 1971; Serrano, 1978).

The link between mental images and concepts can also be studied through distinctions such as that between the **intension** (aspects comprising concepts' content) and **extension** (examples embodying concepts) of concepts.[146] These two views on concepts are clearly correlative since intension has to do with identifying particulars and extension deals with the grouping of identified particulars (Dewey, 2005). Following this direction, concepts have been classified in terms of their intension as (Serrano, 1978): *positive* (about an entity) or *negative* (about a privation), *simple* (about a single element or characteristic) or *compound* (about several elements), *concrete* (if its content refers to the being that embodies it) or *abstract* (if its content refers to an idea or essence in itself). Whereas, in terms of their extension, concepts have been defined as (Serrano, 1978): *transcendentals* (if they are applicable to all sorts of things), *universals* (if they applicable to all the members of a certain species), *particulars* (if they are applicable only to some

[144] For Arnheim (1969), *visual concepts* are those which grasp the generic structural features of stimulus material. According to Vygostsky (1995), at one stage of children's mental development they use undifferentiated images of things (i.e. stemming from casual situations) as if they were concepts.

[145] Indeed, since the classical approaches to imagery in psychology, distinctions have been drawn in terms of their sensory modalities (Paivio, 1971). In this sense, images have been defined as visual, olfactory, auditory, kinaesthetic and so on (Norman & Rumelhart, 1975b).

[146] This approach is not a new one. We inherited it from empiricist philosophers such as John Locke (Mervis & Rosch, 1981).

members of a certain species), and *singulars* (if they are applicable only to a single member of a certain species).

Bearing these categories in mind, **design concepts** could even be characterised with certain precision. We can, for instance, assert that design concepts are negative, compound, concrete, and singular. *Negative*, because they help us to realise what is lacking. *Compound*, for the number of variables and elements normally considered as part of them. *Concrete*, because they are mental creations aiming to be embodied in material terms. And *Singular*, given that they respond to the particular circumstances of the problem they attempt to solve, and their realisation changes according to the views, experiences and professional background of those who envisage them.

3.4. The nature of concepts

In the philosophical tradition from which psychology originates, concepts are formed when a person "shows the ability to respond to a series of different events with the same label or action" (Bourne in Posner, 1973: 46). In this sense, concepts can be appropriately characterised as mental representations stored in our memory (cf. Eysenck and Keane, 1990; Roth, 1995). The nature of such re-presentations has been approached from two different perspectives in psychological research: the **defining-attribute view** and the **prototype view**. The former states that concepts are built up of atomic units or primitives, each of them singly necessary and jointly sufficient for something to be identified as an instance of a concept (Eysenck and Keane, 1990). These units are commonly enunciated as the attributes[147] of a list which is associated to a concept (Roth, 1995).

The origins of the *defining-attribute view* of concepts can be found in Aristotle, who understood conceptual categories as being "...logical, clearly bounded entities, whose membership is defined by an item's possession of a simple set of criteria features..." (Rosch, 1975: 193). This approach, also known as the classical view of

[147] Mervis and Rosch (1981) explain that in modern cognitive psychology parts, relations and functions of things are normally taken as attributes. Nevertheless, attributes are generally seen as being either *features* or *dimensions*. The former designate qualitative properties (e.g. legs, wooden, you sit on it), whereas the latter are used to describe quantitative properties (e.g. size).

concepts, seems to be also based on the work of the German logician Gottlob Frege (Eysenck and Keane, 1990), for whom, actual objects and concepts were radically different (Frege, c.1892-1895). Indeed, for Frege (1892b), the main distinction between objects and concepts stems from the idea that objects have a substantive (actual/real) nature whereas concepts have a predicative (attributive/descriptive) one.[148] To the extent that the matters asserted about concepts cannot be the same as those asserted about objects, even though objects can be part of predicative expressions (i.e. concepts).

The *Prototype view* of concepts, on the other hand, states that there is no delimiting set of necessary and sufficient attributes for determining whether something is definable or not as an instance of a concept (Eysenck and Keane, 1990). This is an idea that according to its advocates is supported by the fact that the world as we perceive it does not contain things standing on their own but in constant relation to one another (Rosch et.al. 1976).[149] In this respect, what concepts are supposed to have is a *prototype structure*, that is, either a sort of composite abstraction based on the most typical members of a category (concept) or a collection of characteristic attributes seen as an indication of what is most typical and distinctive of that category (Roth, 1995).[150] Thus, differently from the traditional *defining-attribute view*, the attributes comprising a prototype structure are not jointly necessary neither sufficient to describe a concept (Eysenck and Keane, 1990), since concepts are in this view mere 'indications' of categories. The realisation of this approach stems from the research carried out in cross-cultural studies about colour categorisation during the late 1960s and 1970s (cf. Rosch, 1975); having in Eleanor Rosch and her associates its best known advocates.

The defining-attribute view and the prototype view have been both subjected to strong criticism. The defining-attribute view has been accused of failing to capture significant aspects of conceptual behaviour (i.e. small variations in object

148 Frege's original assertion uses the term 'predicative' to speak about the nature of concepts. Therefore, terms such as 'attributive' or 'descriptive' should only be taken as paraphrases to explain it.

149 The exact terms used by Rosch et.al (1976: 428) to express this idea was: "...the perceived world is not an unstructured total set of equiprobable co-occurring attributes".

150 This dual definition came into existence as a later evolution of the original prototype model suggested by Rosch and her colleagues, due to the difficulties experienced to describe prototypes in terms different to those of defining features (Roth, 1995).

recognition) as well as of having a major flaw in its dependence on the conjunction of necessary features (Eysenck and Keane, 1990). The prototype view, on the other hand, has been seen as faulty because not all concepts have prototype characteristics (i.e. characteristics based on physical features), for assuming that people know more about the relation between the attributes of a concept than about those attributes alone, and for failing to explain why categories cohere (Eysenck and Keane, 1990). To some scholars the main flaw of both views has to do with the little attention they pay to the way in which people's knowledge affects conceptual categories (Roth, 1995). This is quite relevant since people's knowledge can affect things like: the type of representation employed to define concepts (whether a prototype or a feature list), the features considered as characteristic attributes, and the way in which the relationship between concepts is represented (as an intuitive hierarchy or as a taxonomic hierarchy).[151] For other scholars the ambiguity of the prototype-view is the real problem given that it is neither totally based on examples of things nor on their mental representations (Cohen and Murphy, 1984). With the above criticisms in mind, researchers argue that a new model is needed: a non-extensional and knowledge-dependant one.

The criticisms to both views seem to· claim for explanations based on the way human thinking has been historically studied. That is to say, through the consideration of the material out of which thoughts are made, and the way in which new information comes to be part of our memory. From this perspective, the nature of concepts can be studied in terms of the sort of units that are stored in our memory, even though some researchers may contend that this approach does not have any relation with the existent views. As we shall see in this section, this is not totally true. This sort of approach has been already developed by Michael Posner at the University of Oregon. According to Posner (1973), concepts can be classified either as *iconic* or *symbolic* based on the type of memory code that prevails in each of them. **Iconic concepts** are built around **imagery codes**, that is, sets of mental representations that bear a close correspondence to the sensory experience from which they emerged. Since the mental representations comprising imagery codes work with different sensitive modalities (e.g. visual, auditory and olfactory) and

[151] The term 'intuitive hierarchy' refers here to those hierarchies based on everyday experience (i.e. layman's experience), whereas a "taxonomic hierarchy" alludes to those categorisations of reality based on expert knowledge (i.e. scientific or professional knowledge).

resemble in some respect what they represent, they are also known as **analogical representations** (Eysenck and Keane, 1990).

Symbolic concepts, on the other hand, are built around **symbolic codes** or sets of mental representations which stand for something by reason of an arbitrary relationship rather than resemblance. Since the mental representations comprising these codes are language-like (arbitrary/abstract), Posner describe them as **'words'**. However, some authors have argued that these representations are more abstract that words and even sentences, suggesting instead the use of the term **propositional representations** (Anderson, 1978). These latter are abstract assertions about the relation between informational entities of any kind - see figure 41 for an example.

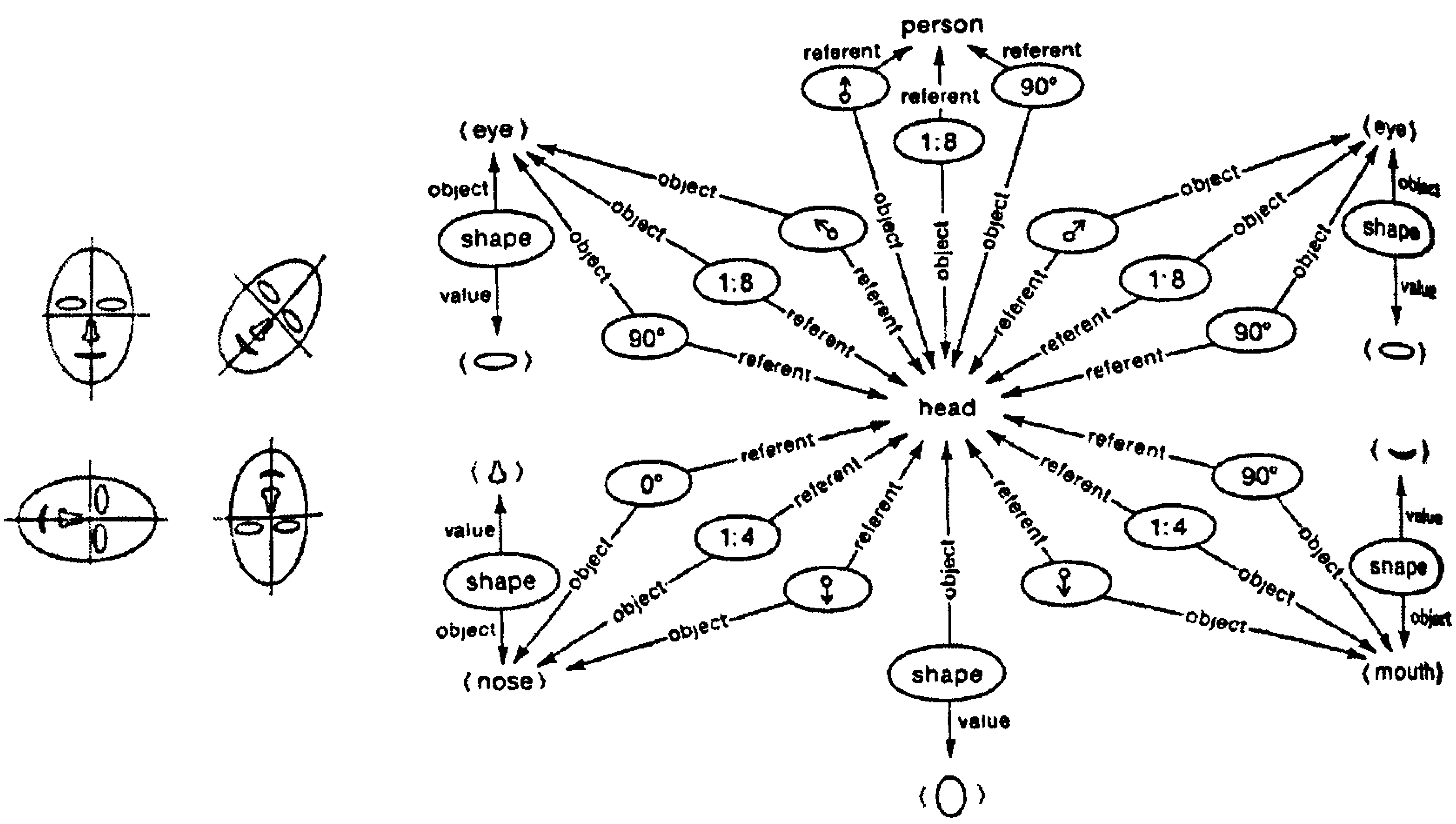

Fig. 41 – Example of a propositional representation for the rotation of a face.
[From: Palmer (1975a: p. 290)].

Posner's approach to concepts may not satisfy in all respects the two requests made by critics to the defining-attribute and prototypical views of concepts (i.e. the need to be non-extensional and knowledge-dependent). But it is at least a clear attempt in that direction. Indeed, what makes this approach so different is precisely that on which it stands: people's knowledge instead of elaborated ideals or examples of things. The problem with taking people's knowledge as the point of departure is that it can only be objectively generalised in terms like those used by Posner. In this respect, his view on concepts is a midpoint between the defining-attribute and prototypical views, since through its mental representations the ideal/abstract (propositional representations) and the example/concrete (analogical representations) are both addressed. Unfortunately, Posner's view does not provide an explanation for the way in which his two types of concepts combine: a situation particularly relevant for the understanding of design concepts.

3.5. Coding modalities of the information contained in design concepts

For no one is a secret that most design schools teach their students to communicate their design concepts using graphic and visual images, treating their verbal communication as something accessory. Nevertheless, there are reasons to believe that visual and verbal means have both important roles to fulfil in the communication of design concepts (Tsow and Beamer, 1987). In this sense, a key aspect to bear in mind is that concepts do not say anything about the visual/iconic or verbal/symbolic means referred as part of them but about the meaning these two types of representations allude to. Therefore, further clarification is needed about the way words/propositions and images interact to build the meaning of design concepts and their contribution to the process of concept ideation. In the present scientific scenario three theories seem to be particularly relevant to elucidate these queries: the theory of the two hemispheres of the brain, the theory of dual-coding in human cognition proposed by Allan Paivio in the 1970s, and the theory of mental models proposed by Philip Johnson-Laird in the 1980s. All of them have the peculiarity of providing explanations directly related to the role of words/propositions and images either in concept or meaning construction.

The theory of the two hemispheres of the brain states that although each half of the brain performs as many tasks as the other, their contribution to information processing is quite distinct. This theory was formulated during the 1960s as part of the work of Roger Sperry and a team of surgeons at the California Institute of Technology. He and his team practiced operations in epileptic patients cutting the *corpus callosum* or thick network of nerves that joins the two halves of the brain as a way to alleviate the effects of this disease (Williams, 1986). The observation of side effects in split-brain patients and a wide range of experiments carried out not just with patients but also with normal people[152] has indicated that the left hemisphere is mainly specialized in processing verbal, analytic, symbolic, abstract and time-oriented information; whereas the right hemisphere is superior in handling non-verbal, synthetic, concrete, analogical, holistic, spatial, diffuse and timeless information (Tovey, 1984).

Thus, within this theory, the left hemisphere of the brain is commonly associated with **language thinking** and the right hemisphere with **visuo-spatial thinking** (Tovey, 1984; Ward, 1984).[153] But, despite both hemispheres process the perceived world in a different way, they usually exchange the information of each other (Smets, 1987; Goldberg, 2002) and even complement each other in functional terms (Williams, 1986; Eysenck and Keane, 1990; Goldberg, 2002). It may happen in terms of the representational capabilities of their units (e.g. words, images, etc.) as well as in relation to the sort of procedures of inference[154] each hemisphere supports. Indeed, there is neurological evidence suggesting that the representation of objects through words in our brain is inextricably linked to other types of mental representations for those same objects, such as images of them and mental representations of the actions carried out through them (Goldberg, 2002).[155] On the other hand, the procedures we use in our inferences can also be considered as complementary. Indeed, *words/propositions* allude to a calculus-plus-proof procedure whereas *images* stand for a non-proof (non-deductive) procedure (Lindsay, 1988). Therefore, beyond the idea that - within concepts - *words* designate objects based on elaborate relations, and *images* designate the same objects through their particular perceptual details (Piaget and Inhelder, 1966), it is clear that contributions from both hemispheres of the brain are requested to achieve certain tasks in a satisfactory way (Williams, 1986).

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152 Experiments with normal people were developed using two techniques: one in which an instrument call *Tachistoscope* presents visual material for less than one millisecond of duration to each eye separately, and another where both ears are simultaneously stimulated with distinctly different sounds – also known as *Dichotic Listening* (cf. Williams, 1986; Reber, 1995).

153 The differences in the lateralization of functions seem to be less marked in women and left-handers. Indeed, there are cases of left-handers whose speech function is dispersed more less evenly in both hemispheres (Ward, 1984).

154 *Inference* is here defined as the action of making explicit information that was implicit before.

155 As a matter of fact, the meaning of words and cognition in general have been proved to be distributed along different regions of the brain (Goldberg, 2002).

The complementarity of the two hemispheres is so remarkable that some studies have shown that the understanding of verbal information is not totally absent from the right hemisphere (Williams, 1986),[156] and that abilities such as that of recognising and imagining shapes defined by arrangements of parts - which might seem to be located in the right hemisphere - are actually located in the left one (Pinker, 1999). Indeed, there are studies that have come to the conclusion that none of the two hemispheres can really be considered as the seat of mental images, since images take place through multiple processes which are not implemented equally effectively in the same part of the brain (Kosslyn, 1988). Such a functional complementarity has also been proved by other studies like the one carried out by Leventhal and Tomarken in the 1980s. They found that the right hemisphere contributes to the negative affective states (e.g. depression) of our emotional experiences whereas the left hemisphere contributes to the positive ones (Smets, 1987). Beyond this, there is no doubt that our dreams and speculations would be mere fantasies if we could not count on reason to guide them toward useful purposes (Beveridge, 1982). Therefore, one should accept that both halves of the brain simultaneously contribute to design solutions instead of asserting that the creativity of designers primarily belongs to one or another hemisphere - as some authors do (cf. Ward, 1984; Ramírez, 1987). Such a cooperative work maybe is part of a dual process similar to that suggested by Michael Tovey (1984), in which actions such as forming, fitting and filtering are carried out with the help of both hemispheres - see figure 42.

Following a similar path of reasoning to the above suggested, the psychologist Allan Paivio (1971), from the University of Western Ontario (Canada), has proposed a theory to explain how memory formats such as words/propositions and images interact in human cognition. Paivio (1971) reviews the way meaning has been historically studied in psychology; coming to the conclusion that linguistic meaning is for long identified with mental images. Following this idea, he suggests a sequence of confluent levels for the mental processing of information where the linguistic and imagery formats, called by him **logogens** and **imagens** respectively, work together toward the creation of more and more complex meanings (see figure

[156] In this respect studies have proved that the left hemisphere uses an internal acoustic method to recognise words whereas the right hemisphere identifies them through their form (Williams, 1986).

43). Thus, for him, our ways of processing information are part of four discrete levels of meaning construction directly related to our short and long-term types of memory. The first of these levels is considered as practically unrelated to any meaning and located within our short-term memory. Its presence is confirmed when one needs to retain untransformed information for a brief period of time following a stimulus presentation. That is to say, for instance, when one quickly memorises a telephone number - one did not know before - just to execute the action of dialling it. In terms of meaning, there is no doubt that such a telephone number has been at least momentarily associated with the person to be contacted, but it is an association so weak that once the dialling is finished the person calling normally forgets it. Differently from this level of information processing, Paivio's upper levels take place within our long-term memory and involve processes that different research traditions have theoretically and operationally linked to meaning.

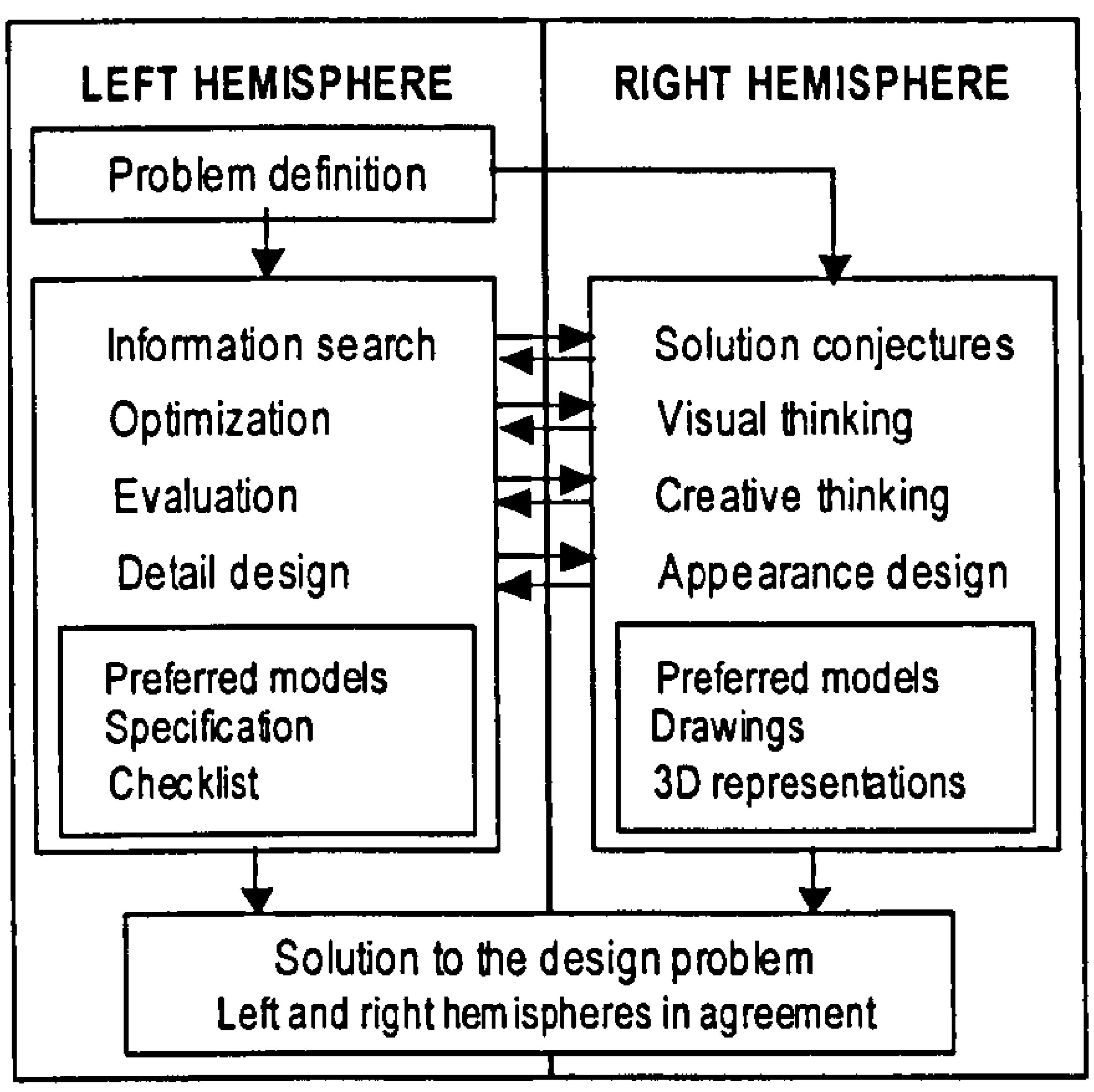

Fig. 42 – Michael Tovey's dual processing model for design.

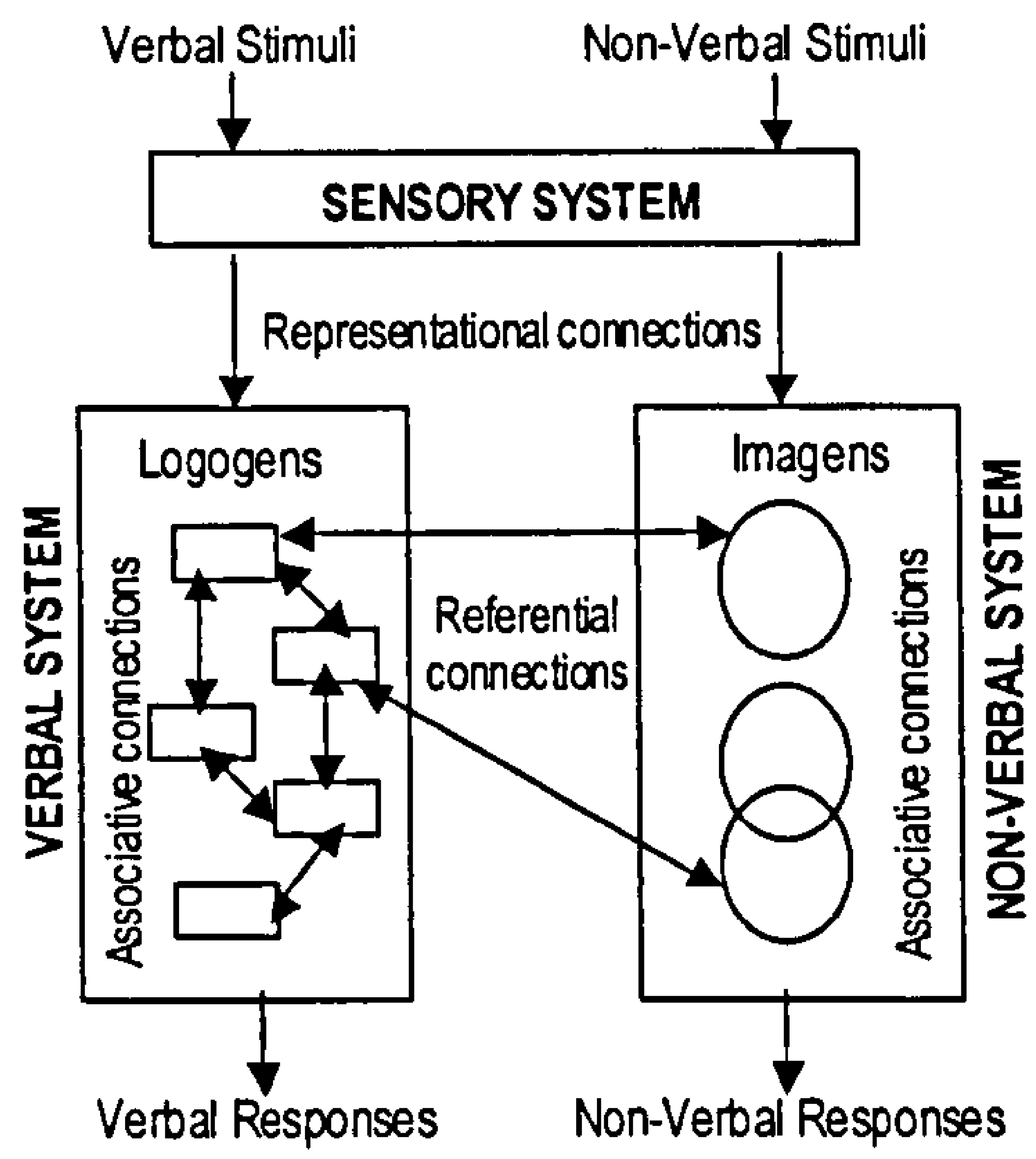

Fig. 43 – Allan Paivio's dual coding theory for human cognition.

Thus, the *second level* of Paivio's model is referred as **representational meaning.** It is the level where representations of iconic and symbolic nature are stored as concrete memory images (in the case of objects)[157] or auditory-motor representations (i.e. verbal or propositional representations) in our long-term

[157] The word 'object' is used here following its etymology, that is, the Latin *Ob* + *jacere* = something placed in front of us. Therefore, at this point no distinction is suggested between natural and artificial objects.

memory.[158] Therefore, this is the level in which people become familiar with stimuli in the most elementary sense, that is, creating in their minds basic repertoires of representations for later use in more complex operations of meaning construction. Paivio called the following level of information processing **referential meaning.** It comprises reactions of denotative[159] nature between the images and sounds used to re-present a particular concept in our mind. This comprises the evoking of actual objects or mental images through their implicit or explicit verbal label or vice versa. All this is part of a dynamics where interconnections between imaginal and verbal representations enable us to name actual objects as well as our non-verbal representations of them (e.g. drawings, pictures, etc.).

Beyond this level, there is a fourth one known by Paivio as **associative meaning.** This is a level where associative sequences or patterns take place not just among verbal and imaginal representations, but also intraverbal or intraimaginal as part of chains of assumptions (mental structures) and chains of transformations. In this sense, the main difference between this level and the referential one stems from the fact that its associative reactions do not stay close to their referents (those things to which they allude) as happens in the previous level; bringing along the development of mental connections between different referents (i.e. things represented through mental images and words) and conceptual categories (i.e. ideas represented through words or propositional representations).[160]

Paivio's levels cast some lights on the way the different types of information stored in our memory interact to build references - i.e. ways of standing for – during concept design. If we take into account that Paivio's *representational meaning* alludes to a sort of personal apprehension of those means needed to think or even express ideas about something, what is understood as 'concept design' may begin to

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[158] In Paivio's proposal it is worth noticing that his use of the term 'symbolic representations' encompasses Posner's iconic and symbolic memory codes. This is the reason why in order to avoid disruptions throughout the argument of this research, the corresponding equation of terminology has been already set in place in the text.

[159] Those related to the identification or basic nature of objects, i.e. expressing what objects are.

[160] It is important to acknowledge that whereas things can be represented by both imagery and linguistic units, conceptual categories are hardly representable through images. Even in the cases suggested by the prototype view on this subject (see section 3.4.), concepts need to be translated into abstract patterns (i.e. set of attributes) at last.

take place at Paivio's *referential meaning*. Therefore, the interaction between information coding modalities commonly referred as part of concept design ought to be studied as part of our capacity to *evoke* iconic codes (images) through symbolic ones (words/propositions) or vice versa (i.e. Paivio's *referential meaning*), as well as part our unlimited capacity to connect those iconic and symbolic codes during the formalization of new types of references (new ways of standing for) and combine our basic concepts of things to concepts of things totally different or even unrelated to them (i.e. Paivio's *associative meaning*). This way of understanding the construction of references openly assigns a complementary importance to both iconic and symbolic codes in the process of concept design. As such this situation has been acknowledged by authors like Donald Schön (1998) for whom drawing and speech are parallel and closely connected modes of designing. Indeed, they both comprise what he has called the **'language of design'**.

This interactive view can be complemented by some of the theoretical insights developed to define the role of mental representations during the realization of specific tasks, i.e. as part of the notion of **mental models**. In cognitive sciences the term 'mental model' is used in two basic ways (Payne, 1991): to allude to a theory of language comprehension and inference, and to name the theories people built to explain and reason about aspects of the physical world (e.g. how something comes to happen or the way in which something functions). Design concepts comprise both versions of them. On one hand, because it is practically impossible for a literate person or anyone who speaks a language to avoid using words and propositional representations as part of his/her processes of thinking (Cassirer, 1945). On the other hand, because it would be totally absurd to design utilitarian objects such as those of product design without considering the way in which such objects function and are used (Tjalve, 1979; Norman, 1988; Baxter, 1995; Cross, 1999). Indeed, within design theory, the presence of two types of mental models has been already identified (Lidwell, Holden and Butler, 2003): those about how systems/artefacts work or **system models**, and those about how people interact with those systems/artefacts or **interaction models**. They are so important to design practice that authors like Lidwell, Holden and Butler (2003) have asserted that an optimal design solution can only result from an efficient merge of accurate and complete models of both systems and interactions.

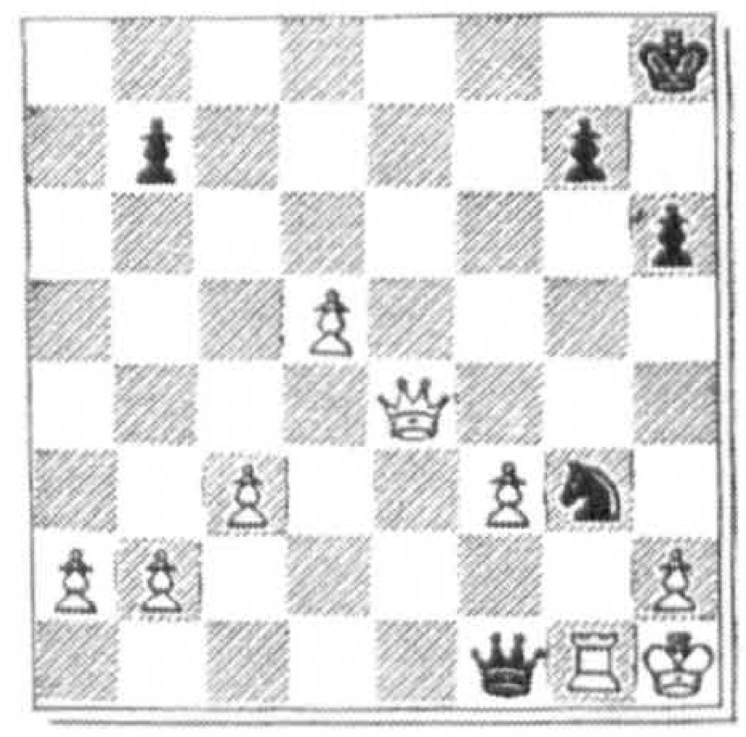
The inception of *mental models* in psychological studies stems from the argument developed by Kenneth J. W. Craik during the 1940s in his book *'The nature of explanation'* (Rogers, 1992). According to him, we create mental models to ease the manipulation of things and events in our search for explanations and predictions of possible outcomes (Craik, 1943). Thus, mental models are "...internal constructions of some aspect of the external world" (Rogers, 1992: 2). Such constructions are possible thanks to three essential processes (Craik, 1943): A *translation* of the external world into certain codes of mental representation (e.g. words and numbers); the *arrival at other mental representations* by processes of reasoning, deduction, inference, etc.; and the *re-translation* of those representations into external responses (or at least the recognition of correspondences between such representations and external things or events). It is, indeed, in these same terms how mental models were introduced to the design world by authors like Donald Norman (1988).

The sequence of three processes described by Kenneth Craik for the formulation of mental models is despite of some differences not very distant from that suggested by Paivio (1971) for meaning construction. As a matter of fact, in the chapter six of his book, Craik (1943) acknowledges the role of *meaning* and *implication* in his theory, defining the former as the power to symbolise or refer things and events through the neural means that give rise to words and images, and the latter as the power of neural mechanisms to operate on each other as happens with real events. Nevertheless, Craik's approach is more preoccupied with the processes taking place between the units involved (e.g. words and images) than with the nature of such units (whether they are blended or pure, for instance).

This view on mental models changed with Philip Johnson-Laird's approach to the subject. To such an extent that his most controversial claim about mental models stems from the need of explaining the interaction of the units involved in such processes but in terms of their nature (Rogers, 1992). Since the theory of mental models assumes that they can be constructed on the basis of either verbal (symbolic) or perceptual (iconic) information, Johnson-Laird (1980) asserts that images correspond to those components of models directly perceptible in the equivalent real-world objects (i.e. the analogical ones), whereas propositional/verbal representations correspond to those linear strings of symbols in which the initial stage of our comprehension rests. In this sense, images contribute with those aspects of mental models that cannot be provided by their propositional (symbolic) components due to their lack of flexibility. Indeed, propositional representations are not analogical, do not use arbitrary assumptions as images do, and differently from images, they are always mediated by an evaluation.

This latter idea is also encapsulated in a model for humans' mental representation of external events developed few years before the publishing of Johnson-Laird's main paper on mental models. Such a model was proposed by John R. Anderson (1978) at Harvard University. This model, however, is based on Paivio's **Dual Code theory** but differently from this, it equates visual representations (imagery) with pictures and verbal information with strings of words. Thus, considering our limited capacity to hold information on a single mental image, Anderson suggests that a single external situation such as a chess end-game can be represented as a number of overlapping images (not necessarily complete nor veridical) connected and tagged by verbal associations (see figures 44 and 45).

Fig. 44 - An end-game chess position [Source: Anderson, 1978: 252]



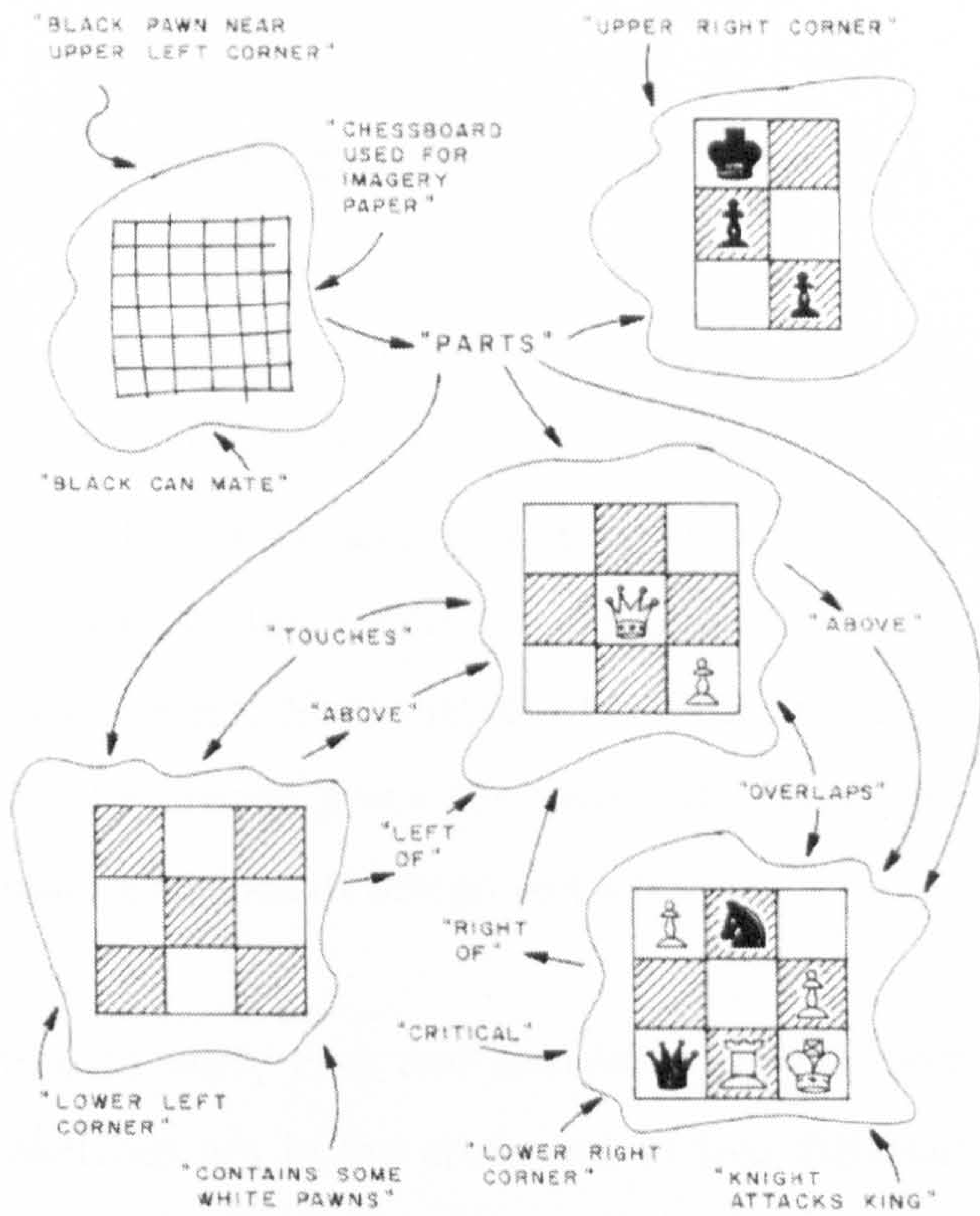


Fig. 45 – Anderson's representation of that chess position [Source: Anderson, 1978: 253]

This idea of a part-at-a-time construction of our mental visual images finds scientific support in the fact that there are two classes of processes taking part in our memory during mental representations (Kosslyn 1988): one in charge of storing the parts of visual shapes, and another in charge of storing the spatial relations of those parts. This is the reason why in order to re-construct the organisational pattern of each part of an image one needs to have some parts already activated as a spatial reference for the location of the others.[161] Thus, when people are asked to imagine an object, the more complex its form is the more time is required by people to imagine it. Indeed, this fact has been used since many decades ago to explain some aspects of designing (cf. Negroponte, 1975; Glegg, 1981).[162] Such scientific models and facts also help to refute the argument substantiating that design - as a whole - is a non-discursive activity (cf. Susanne Langer, 1957 in section 2.2.2.) provided that the formulation of design concepts may also involve verbal information (which is discursive by definition) and the images comprising them actually appear progressively in the designer's mind.

3.6. Design concepts as descriptive-depictic representations

Given the considerations outlined as part of the three theories previously reviewed (i.e. the theory of the two hemispheres of the brain, the dual coding theory, and the theory of mental models), Anderson's model can be said to be quite an appropriate description of the way in which the two basic coding modalities (images and words) used as part of design concepts normally interact. Nevertheless, it is clear that up to this point we have mainly focused on the mental processes involved. Hereof we need now to concentrate in the overt manifestations of design concepts.

Following a route of reasoning similar to ours, Fish and Scrivener (1990) have come to the conclusion that design sketches are in the crossroad of two different representational systems: a **descriptive** one derived from language, and a **depictic**

[161] This fact has been specifically tested when people are asked to generate images of block letters.

[162] For Nicolas Negroponte (1975: 27) in the 1970s there was already "...evidence that basic graphic memorizations are stored in our minds as contruction processes, not developed figures". For Glegg (1981: 10), on the other hand, when intuitive design ideas are complex they can only be imagined "...in a series of successive pictures; like slides... [where] it is very difficult to be certain that the slides touch; there may be a gap; our total picture may not be complete, or else the edges may not fit".

one based on analogue representations (similar to our live experiences with objects). The former helps us to realise the abstract and categorical nature of objects; this being the reason why it is a system amodal (no specific to a sense organ) and extrinsic by definition (given that the interpretations derived from it go beyond the actual materiality of objects). The depictic representational system, on the other hand, is concrete and spatially specific. Hence, it is a modal (derived from specific modes of perception) and intrinsic (extracted from an imaginary inspection of things) system.

With this in mind, Fish and Scrivener (1990) have outlined what they consider to be the three most familiar attributes of design sketches.[163] They are:

1° Design sketches use abbreviated two-dimensional sign systems to represent three-dimensional experiences, supplemented in most cases by written notes, to provoke an experience that tends to resemble those aspects they attempt to represent. In this sense, the graphic conventions they contain can be seen as a means for either externalising ideas for public inspection and for recalling remembered images (Herbert, 1988).

2° Design sketches contain selective and fragmentary information (i.e. information based on those particular aspects in which the designer focuses his/her attention). Thus sketching becomes a way to progressively add information to the solution of the design problem (Herbert, 1988).

3° Design sketches commonly have deliberate indeterminacies (e.g. areas where the drawing fades away, multiple contour lines, and energetic cross-hatching) that can be seen as ways of keeping design decisions open for further exploration.

To these three attributes we should add a four one suggested by Daniel Herbert (1988): Design sketches/drawings[164] represent a set of hidden structural relations about the design problem the designer is intending to solve.

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[163] According to Fish and Scrivener (1990: 120), these attributes area valid for either sketches from nature (i.e. form a model) and sketches from imagination, given that their difference "...is not as great as might be supposed".

Beyond these four attributes, let us not forget that people are capable of retrieving and transforming the information stored in their memory into whatever format is most appropriate for answering the questions or problems put to them (Norman and Rumelhart, 1975b). Therefore, in a conscious level, verbal associations presented as part of design sketches may either help to direct and even broaden some of our creative efforts (Daru, 1973; Baudrillard, 2002) or become a 'screen' (an obstacle) which stands between the creative thinker and its reality (Koestler in Ward, 1984). Similar considerations should also be made about the representational ambiguity of images. Indeed, such an ambiguity is said to promote inferences and new ideas (Tversky et.al. 2003). Nevertheless, "for concepts strictly identical from one individual to the next... there are countless corresponding personal images..." (Piaget and Inhelder, 1971: 380). Thus, the way in which concepts are expressed through sketches (using more graphic or more written information) may vary from one designer to another based on their background and preferred cognitive styles. Hereby, it is hard to generalise on this matter.

On the other hand, it is known that our global recognition/perception of things rests on both descriptive and depictic representations. In this respect, there is neurological and neuropsychological evidence suggesting that there are moments where image-based processes prevail over the verbal-based ones and vice versa. Indeed, the presence of two different post-sensory categorical stages in our recognition of objects has been scientifically established: one *perceptual* or pre-semantic - located in the right hemisphere of our brain and therefore related to images – and one *semantic* - located in the left hemisphere and therefore linked to words (Warrington and Taylor, 1978). These two stages are seen as complementary since the full recognition of an object implies the capacity to detect similarities and differences, where **perceptual categorization** works based on similarities (generalization) and **semantic categorization** works according to differences (Warrington and Taylor, 1978). As the retrieval of information for the generation of concepts works basically under these same procedures of categorisation (see section 3.4.), this also applies for the formation of design concepts.

[164] Herbert (1988) uses the term "study drawings" instead of sketches, but the meaning he assigns to the former is the same of the latter.

Having clarified this, it is also important to highlight other aspects related to the role of descriptive (verbal) and depictic (imagery) representations in the ideation of design concepts. As a matter of fact, our judgements (interpretations) only take place as part of language and most of our states of consciousness too (Roger Sperry in Eccles, 1970). Hereof the role of our mental images (and even that of our graphic images too) is basically reserved to illustrate or designate things (Piaget and Inhelder, 1969 and 1971; Enaudeau, 1999). In this respect, there are reasons to belief that the role of language in concept ideation is even greater given that through language (Piaget and Inhelder, 1969): (a) long chains of action can be represented very rapidly, (b) our thoughts are freed from the immediate – that is, time and space - and (c) the elements of an organised structure can be simultaneous represented. Thus, the role of language can be defined as metaphorical since it is perceptually detached from reality (given its conventional nature) but at the same time capable of eliciting images via verbal means (Pross, 1980).

Beyond this, we should not forget that verbal communication is part of the conceptual system we use in thinking and acting. Therefore, there is no doubt that language is an important means to understand what such a system is like (Lakoff and Johnson, 1980). Indeed, our objects are "...constituted in language, participate in interpersonal relationships through language, [and] become built into social realities by language" (Krippendorff, 1990: a-15). Hereof, if design can be articulated metaphorically or directly through verbal means, it is because language is the most universal system of meaning and cognition that people can count on (Zimmermann, 1981). This, beyond the opinion of those who support the idea that verbalization plays a relatively small part in designing (Daley, 1982).

Finally, in relation to the role of depictic (images) representations in the ideation of design concepts, we are obliged to say that the precise connection between imagery and creativity is quite complex (Finke, 1989). Indeed, it is known that there are mental operations that could hardly take place without the intervention of images (e.g. the transformation of objects). It is also known that the common ambiguity of mental images is by no means negative for the creative process, since it elicits the exploration of ideas without committing the design solution to any image in particular until the final shape is achieved (Arnheim, 1969 and 1995; Tversky et.al.

2003). This is the reason why there have been some strikingly creative discoveries thanks to mental images (Finke, 1989), as well as through their graphic counterparts – i.e. drawings/sketches (Suwa, Gero and Purcell, 1999). These latter, however, cannot be taken as faithful replicas of mental images since they only share some of their properties - especially those considered as structural in nature (Arnheim, 1969; Tversky, 2002b).

3.7. A design method for concept ideation

Keeping in mind the above considerations as well as the fact that a significant part of recent design research seems to overestimate the role of "images" in concept ideation, a design method will be now suggested to explore the contribution of verbal information in design concepts. To this aim a verbally-centred method for concept ideation will be purposely designed. This will be used in the experimental phase of this research (see chapter 5) to explore the extent to which verbal information can help to separate the act of conceptualising into distinctive theoretical dimensions (those suggested as part of the model that will be presented in the next chapter).

Thus, standing on the discussion carried out in section 1.2.3 of chapter 1 ("Design methods and the ideation of design concepts"), our method for concept ideation will aim to:

1. *Enable* the generation of a brain-storming where mental associations normally held as irrelevant and even absurd for a design solution will be also taken into account (as suggested by Synectics).

2. *Externalise* in some respect the mental mechanisms that take place during the formulation of a design concept in order to trigger self-reflection on how the solution is being achieved.

3. *Promote* a fruitful assessment of the requirements posed by the design brief.

4. *Ease* the translation of the designer's intentions to material properties in the product.

These four aims are fulfilled in the intended method through the realisation of four consecutive steps:

A. Generation of free mental associations. Verbal recollection of free association about objects, events, functions, fantasies and potential users directly or indirectly linked to the product to be designed.

B. Selection of mental associations in terms of design intentions. The designer assesses the conceptual potential of the mental associations already expressed in words, selecting only those that can contribute to the formulation of his/her design concept. As part of this process, new and more specific mental associations can be suggested in order to complement those aspects considered as necessary to achieve the design concept in mind.

C. Physical characterisation of the associations outlined as part of the design intention. Using strings of words, the designer defines the physical properties (forms, colours, materials, finishes, etc.) that will be used to materialise each of the mental associations selected in the previous stage.

D. Sketching of concepts. Following the physical characterisation above defined, the designer proceeds to express graphically his/her concept. To this aim, preliminary and exploratory sketches are generated in order to outline the most convenient pattern of arrangement (proportions, location of parts, etc.) for the product, bearing in mind the way it functions.

Based on these steps, the method above described will be named **ASCHASKET** (an acronym for ASsociation, CHAracterisation and SKETching) throughout the remaining chapters of this dissertation (see example in figure 46).

- **Free associations**: mix, movement, kitchen, woman, handy, cleanliness, practical, breakfast, speed, home, timesaver.
- **Associations linked to the design intention**: housewife (between 20 to 35 years old), anatomical, practical, feminine, clean.
- **Physical characterisation**:

Housewife = dynamic, warm colours, handle softly texturized.
Anatomical = curved surface, easy to hold, non slippery.
Practical = wide beating area, holes for airing the mix, separation between handle and beating area.
Feminine = slender style, light colours, care for details.
Clean = stainless steel mixing wire, plastic handle, detachable parts.

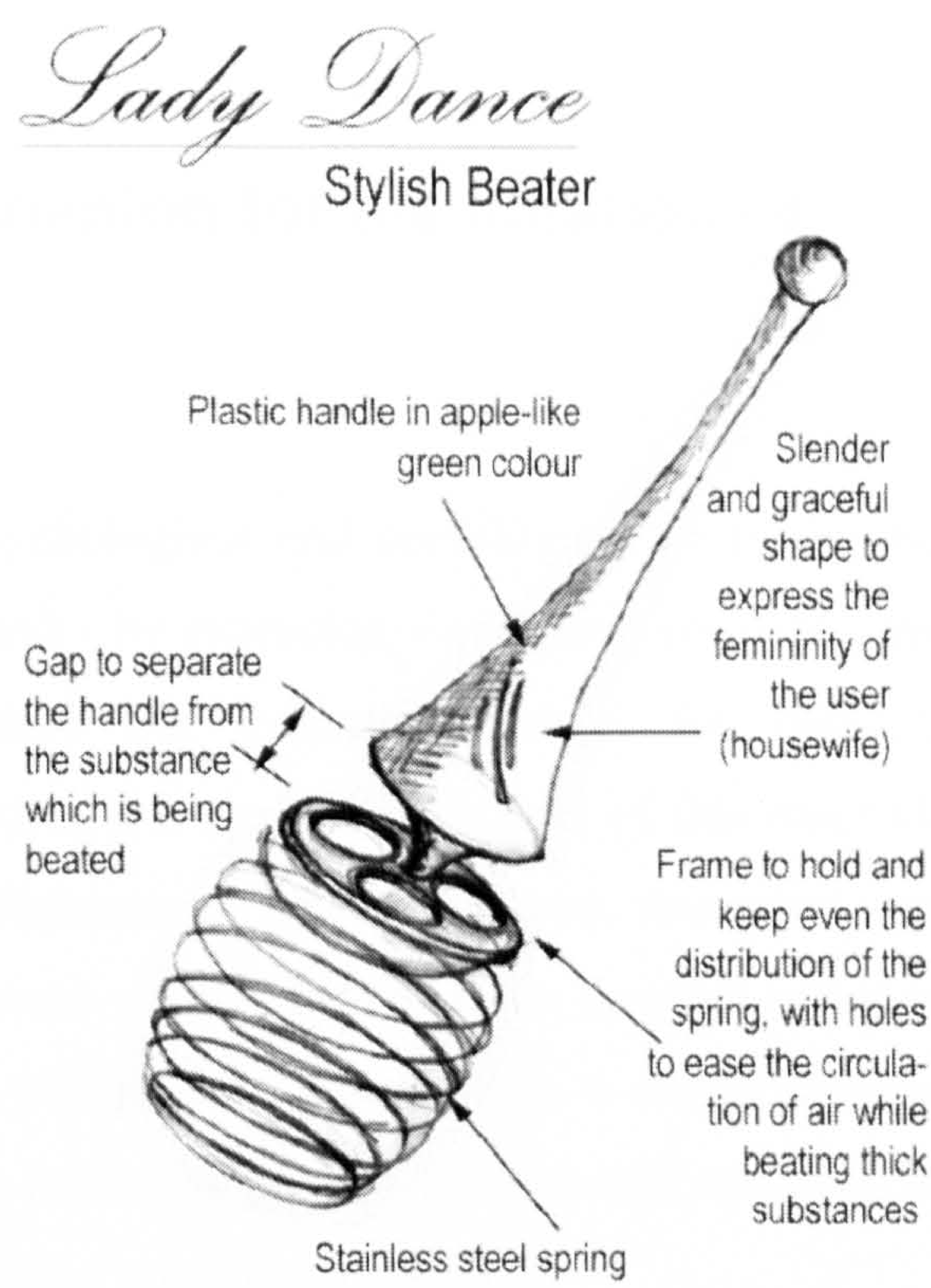

Fig. 46 – Example of the use of ASCHASKET for the design of a beater.
[Source: 2001 Edition of the Product Conceptualization Seminar at the School of Industrial Design, University of Los Andes, Venezuela].

Chapter 4

A theory of meaning construction for the ideation of design concepts

Having oultined the philosophical, psychological and sociological premises that define our understanding of concepts and - by extension - of design concepts, this chapter will introduce the reader into the theoretical model for meaning construction in the ideation of design concepts developed as part of this research. To this end, a set of six theoretical dimensions will be defined, described, and characterised in semiotic and communicative terms based on the theories reviewed in chapter 2. Then, such dimensions will be incorporated into a comprehensive model for product design. With this in mind, the present chapter will stand on the following three ideas already outlined in the previous chapters:

1. **Design concepts** are *"holistic and mostly graphic descriptions of the physical configuration that will prevail in a design product, the mental associations from which it has emerged and the innovative intentions of its designer"*. Therefore, our understanding of meaning construction and the theoretical model derived from it will not attempt to describe the steps by which a particular designer formulates his/her design concepts, but the type of associations and general lines of concern that can intervene during such formulations. In this sense, the model to be developed will be of a *descriptive* nature. That is to say, a model whose principal intention is to reduce the apparent complexity of the observed world to "a coherent and rigorous framework..." (Rowe, 1987: 166).

2. Graphic descriptions, like those of design concepts, will be understood as channels of communication between either the designer and his/her clients, his/her colleages or between the designer and him/herself, with the purpose of presenting, exploring or assessing proposals for design solutions/products (Herbert, 1984; Ashwin, 1984; Fish and Scrivener, 1990; Arnheim, 1995; Schön, 1998). Thus, we will be looking at concept ideation as a way of communication (Tsow and Beamer,1987; Tversky, 2002b; Olver, 2003).

3. Given that our research subject is the construction of meaning in design concepts, our theoretical modeling will be expressed in semiotic terms. The idea is to incorporate the modelling experience and theoretical richness of semiotics to the advantage of this investigation.

4.1. An approach to the theoretical dimensions of design and concept ideation

Since the times of the Roman architect Marco Lucius Vitruvius (25 BC) what we call design has been outlined as comprised by different dimensions or aspects. In the early treatises and handbooks of design these key aspects or dimensions assumed the form of principles. Later on, they were associated to the functions that design objects ought to fulfil, to the different tasks involved in the creation of these objects, and even to the sort of pleasures such objects are supposed to evoke.

According to Vitruvius (1991), design (particularly the architectural one)[165] emerges from the understanding of three fundamental principles: *Firmitas* or the adequate selection of the materials and means to build a design object, *Utilitas* or the appropriate conception of its use, and *Venustas* or the search for harmonious and pleasant configurations.[166] This idea of principles persisted throughout the Middle Ages, becoming a theoretical common place during the Renaissance. Indeed, the medieval calligraphy of books (especially bibles), for instance, was based on three design principles (Rotte, 1993): *Ordo* (order based on hierarchy to structure complexity), *Claritas* (legibility or clarity of meaning and purpose), and *Consonantia* (consonance or harmony for the beholder's eye). Similarly, in 1452, Leon Battista Alberti highlighted *unity*, *proportion* and *suitability* as the essential principles of architectural design (Lambert, 1993).

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[165] Vitruvius' definition of these three principles may seem at first as exclusively referring to what we know today as architecture. However, Gasparski (1984:20) has clarified that "...the acient concept of architecture embraced civil engineering, clock construction, and mechanical engineering". Therefore, the Vitruvian principles are seen nowadays as applicable to any design object (cf. Gasparski, 1984; Lamber, 1993; Rodríguez-Morales, 2004).

[166] The names of these three principles has been translated into English as *Strenght*, *Utility* and *Grace*.

Within the particular field of product design, the first examples of design principles seem to be those of the 19^{th} century. Among them, some of the best known are those of Owen Jones and Christopher Dresser. For the former, all works of the Decorative Arts (as well as those of Architecture) should possess *fitness* or be adapted to its purpose, *proportion* or display a clear arrangement of its parts, and *harmony* or present an appropriate balance and contrast among its forms (Jones, 1856). For Dresser, on the other hand, *truth* (to be truthful in the use of materials and what objects express), *beauty* (to be graceful, delicate and refined), and *power* (to be energetically composed) are the three 'art-principles' which, in conjunction with the basic principle of utility (i.e. to be suitable for its purpose), define the primary nature of any ornamental device – i.e. design object (Dresser, 1973).[167] The design principles outlined by these authors, however, are not different from those of the Vitruvian triad. Indeed, they encapsulate more or less the same ideas. This might be one of the reasons why the teaching of design "through principles" prevailed until the beginnings of the 20^{th} century, especially through the understanding of the beauty of design objects as stemming from the idea of "fitness for its purpose, together with a due recognition of what is sane and suitable for tools and materials" (Glass, 1927: xix).

Such a state of the art began to change with the incorporation of new aspects as fundamental elements of design. Among the promoters of this new approach are the Bauhaus School of Design and the pioneer product designers of USA. Indeed, in his *Principles of the Bauhaus production* (1925), Walter Gropius pointed out the need of designing objects that clearly serve their purpose, long lasting, of a low cost, and beautiful. As such this was an attempt to embrace the formal, technical and economic aspects of the changing design scenario of that time. Following a similar vision of the new realities of design, the American product designer Henry Dreyfuss wrote in 1955 that every design problem involves five points that should be tackled by the designer:[168] utility and safety,[169] maintenance, cost, sales appeal, and appearance. In the same direction but less explicit than Dreyfuss, the designer Harold van Doren (1954) also divided the design concerns into: *practical*

167 In Christopher Dresser's (1973: 17) view, "...the first aim of the designer of any article must be to render the objects which he produces useful..."

168 Henry Dreyfuss' five points are derived from his 25 years of experience doing product design (Dreyfuss, 1955: 178).

169 According to Dreyfuss (1955: 179), "Safety is a natural corollary to utility".

requirements (study of material and processes, of the client's manufacturing facilities as well as a preliminary investigation of costs), and *merchandising requirements* (maintain a competitive position by seeking new features for old products and add new products to certain lines).

Besides this, the first half of the 20th century also witnessed how some theoretical proposals from the field of linguistics began to mould new ways of understanding product design. Such is the case of Jan Mukarôvskỳ's typology of functions. Indeed, in his view man-made objects ought to fulfil four types of functions (Mukarôvskỳ, 1942): *practical functions* or those having to do with the direct physical transformation of reality as part of a purpose, *theoretical functions* or those in which reality is transformed in a direct but imaginary way, *symbolic functions* or capacity to change reality through the representation of cultural conventions and values, and *aesthetic functions* or capacity to trigger people's self-realisation through supraindividual ways of looking at our reality. This theoretical contribution - together with those of other theorists from fields such as semiotics and art history - helped to change the concept of function in design as something beyond the strictly practical. Indeed, Mukarôvskỳ's typology is an inevitably reference for the understanding of functional typologies such as that formulated by the Offenbach School of Design (Germany) during the 1970s and 1980s (within the *theory of product language*, see section 2.2.7. of Chapter 2); the six functions of design presented by F. van der Put at the ICSID Conference of 1979, i.e. a division of design into economical, technical, physical, psychological, aesthetic and social functions (Put, 1980);[170] as well as those simplified versions of these typologies where design is - once again - defined in triadic terms, that is, as comprised by practical/technical, aesthetic and symbolic functions (Hauffe, 1998).

Differently from this, the second half of the 20th century brought along principles or dimensions of product design in the form of either levels of work within design or as basic requirements. Examples of this kind can be seen in Gillo Dorfles' (1968) idea of tackling mass-produced objects in terms of their technological, innovative, commercial, stylistic, symbolic and communicative sides; in Max Bense's hyletic,

[170] According to F. van der Put (1980), these functions are carried out by a design team comprised by marketing specialists, engineers and product designers. So that product designers are mainly responsible for the physical, psychological and aesthetic functions.

morphetic, synthetic and pragmatic dimensions for the product's form (Bense and Walther, 1975); in David Pye's (1983) six basic requirements of design (correct arrangement, correspondence of parts, strength, ease of use, suitable cost, and acceptable appearance); in Oscar Olea and Carlos Gonzalez's (1988) five levels of work in design (functional, contextual, structural, productive and expressive); in Richard Buchanan's (1989) three elements of the design argument (technological reasoning, character and emotion); in Angela Dumas and Henry Mintzberg's (1991) three dimensions of design (function, fit and form);[171] in Ray Crozier's (1994) three factors that influence response to design (i.e. form, meaning and function); and in Luis Rodríguez-Morales' (2004) four vectors of design (functional, expressive, technological and commercial vectors), to mention just a few authors.

At the end of the 20th century, another way to approach the aspects or dimensions of product design was that focused on the sort of pleasures and benefits that can be associated to design objects and to the understanding of creativity in product design. Examples of them are John Walker's (1989) four pleasures derived from design objects (pleasures of use, possession, purchase, and social accomplishment); Patrick Jordan's (2000) three main benefits obtained from design objects (practical, emotional and hedonic benefits),[172] and Susan Besemer's (2000) aspects of creative product design (novelty, resolution and style).[173]

The different ways to define the constitutive aspects of product design here reviewed, lead us realise that any theoretical model for the concept ideation of design products should consider:

1. UTILITY as its most basic dimension, given that no design object is created without a practical function or purpose in mind.

[171] In Dumas and Mintzberg's view (1991): *function* has to do with the practical and technological aspects of design, *fit* with the relation between user and product (i.e. ergonomics), and *form* refers to the aesthetic and stylistic side of design.

[172] According to Jordan (2000), *emotional benefits* are those pertaining to how the product affects the person's mood, whereas *hedonic benefits* are those related to the sensory and aesthetic pleasures that people associate to objects.

[173] In Besemer's view (2000), *novelty* has to do with the elements of newness in the product (what make it to be original and surprise us), *resolution* refers to how well the product does in terms of logic and usefulness, and *style* (also called by her "elaboration and synthesis") relates to the manner in which the product concept is worked out and how well the parts of the product are integrated into a coherent whole.

2. COMPETITIVENESS as a natural dimension of product design, provided that products need to be commercially successful.

3. ORIGINALITY as the dimension by which the innovative contribution of any design object is defined, since - as part of their nature - these objects need to bring along something new or different to what already exists (Bonsiepe, 1992a).

4. PERTINENCE or dimension dealing with the context in which the object / product will be used, either in terms of their ambience (i.e. the ecology of objects in offices, kitchens, etc.) or in terms of the characteristic features of certain lifestyles.

5. REPRESENTATIVENESS as the dimension in which the emotional responses that products can elicit in their users are tackled.

6. EXPRESSIVENESS or dimension of product design dealing with the social, cultural and therefore symbolic nature of products.

Having outlined these six dimensions, it is curious to see how the theoretical proposals reviewed in order to develop these dimensions are not comprised by more than six aspects. This may have to do with our mental capacity to differentiate categories. Indeed, there is scientific evidence suggesting that either by learning or by design of our nervous system, we cannot discriminate more than 6.5 categories with an absolute clarity (Miller, 1956). The more categories we add to our understanding of things the blurrer the boundaries of such categories become. Besides this, it is also curious to see how despite of the complexities and levels of especialization achieved by product design nowadays, there are design theorists and researchers who still insist on modeling concept ideation based on no more than two aspects or dimensions. Clear examples of these are the models of Dahl, Chattopadhyay and Gorn (1999) - who focus on *originality* and *usefulness* - and that of Hansen and Adreasen (2003) - who consider the *product's marketing* and the *product's functionality* as the two dimensions of concept ideation.

In order to understand the real implications of each of the six dimensions for the ideation of design concepts suggested as part of the present research, let us now explore the theoretical distinctions among them as well as their particular contributions to the meaning of products.

4.1.1. UTILITY

Differently from art, product design essentially creates utilitarian objects (Dorfles, 1968; Löbach, 1981; Acha, 1990; Pastor and Echegaray, 1997).[174] That is to say, objects with an intrinsic capacity to serve for some practical purpose. This, of course, does not mean that the whole of product design has only to do with practical matters. Indeed, design products unite *use value* with *cultural value* (Argan, 1961; Staufenbiel in Bürdek, 1994), so that their practical side is normally complemented by aesthetic, symbolic, communicative and even economic considerations. In this sense, our idea of utility is - in one way or another - always related to what we consider to be useful as well as useless (Ferrater-Mora, 1999).

Within product design, utility has been traditionally associated to the concept of function, even though, there is a lot more to say about utility in design than that encapsulated by the notion of function. Hereof, in order to provide a clear picture of the meaningful implications of UTILITY as a dimension of concept ideation we will stand on the following premises:

1.- The perception of objects'/products' utility will be understood as a continuous constructive process directed by anticipations of certain kinds of information which make us see "...what we know how to look for" together with new information available in the environment (Neisser, 1976: 20). Under this view our original ideas about the utility of things are progressively modified by every new information we receive. This is, indeed, an idea that complies with the cognitive view on concept ideation that we have developed as part of this research (see section 3.5 of chapter 3).

[174] Gillo Dorfles (1968) is among the very few authors considering a category of useless objects as part of product design (those described by him as 'programmed art'). Nevertheless, it is only one of his five categories to understand the objects derived from product design (the other four categories allude to utilitarian objects).

2.- The meaningful side of utility will be envisaged as taking place in between two meaningful poles (Greimas, 1973): an **immanent semantic universe**, focused – for our case - on the object's potential usefulness beyond the function assigned to it, and a **manifested semantic universe**, centred on how the product's usefulness is visualised as part of its function.[175] The presence of these poles complies with the idea that our world is made up of "...several superimposed, or even sometimes yuxtaposed, layers of signification [layers of meaningful relations]" (Greimas, 1970: 20).

3.- The practical meaning of design products will be conceived as resulting from the progressive awakening of the three different levels of semiotic conciousness described by Roland Barthes in his "Imagination of the sign" (1962). The first one of these is a **profound conciousness**[176] or that where the object as a sign is "...much less a (codified) form of communication than an (affective) instrument of participation" (Barthes, 1962: 214). Therefore, what is most relevant for this level of consciousness are the physical indications provided by the object regardless of its actual function. The second one is a **paradigmatic consciousness**. It comes to life when the forms of two or more objects are compared and their physical variations realised in order to define/locate the nature of the objects at stake (e.g. a tea spoon in relation to a soup spoon). Finally we have a level of **syntagmatic conciousness** or that conciousness based on the constraints, tolerances and liberties which define the possible arrangements and combinations of the object's elements in order to express its function.

With these three premises in mind, our understanding of the utility of design products will be here characterised as a continous mental construction whose starting point is the realisation of their **practicality** or their suitability for certain

175 The aesthetician Louis Arnaud Reid (1969) some years before suggested a similar idea to describe the way in which meaning arises during the making of art. In his view, before being part of any composition, the materials of the arts (colours, textures, shapes, sounds, etc.) posses various meanings in advance. But once these materials are incorporated into a composition, their original meanings are either overshadowed, affirmed or highlighted as part of a new whole where those original meanings normally change.

176 Barthes (1962) uses the terms "symbolic conciousness" and "profound imagination" to allude to this semiotic level. Nevertheless for the sake of clarity we have preferred to use here "profound consciousness".

practical ends (from the Greek *praktikós* = concern with action), followed by the apprehension of their **functionality** or their usefulness defined within certain practical limits and contexts of use (from the Latin *functiō* = that referring to a particular performance), which leads us in turn to the assessment of their **usability** or level of efectiveness, efficiency and satisfaction derived from their use (from the English *usable* = that which is fit to be used). This way of looking at design products is not new at all. However, the existing attempts to place these notions as part of a coherent whole have unfortunately ended up: disregarding the presence of one of these three ways of understanding the utility of products (cf. Jordan, 2000),[177] referring them in combination with non utilitarian considerations (cf. Norman, 2004), or presenting them in such a dispersed manner that their real implications and interconnections can be hardly realised (cf. Lannoch, 1990; Feijs and Kyffin, 2005)[178].

Having said this, it is important to clarify that *practicality* is placed in the conceptual pole previously defined as that of immanent semantics, where the profound (semiotic) consciousness suggested by Barthes (1962) is what prevails. The apprehension of the product's *functionality*, on the other hand, is located in the pole of manifested semantics and therefore linked to our paradigmatic and our syntagmatic consciousness. Differently from practicality and functionality, the realisation of the *usability* of a design product incorporates aspects from both the immanent as well as the manifested semantic universes. Hereof, from the standpoint of meaning construction, usability stands on the three types of semiotic consciousness described by Barthes (profound, paradigmatic and syntagmatic) – see figure 47.

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[177] Patrick Jordan (2000) only acknowledges three levels in which human factors can contribute to product design: *functionality*, *usability* and *pleasurability*. It is clear that in his view nothing previous to the realisation of the product's functionality seems to be relevant for the design job.

[178] For Hans-Jürgen Lannoch (1990) the meaningful side of design products comprises six dimensions in which *experiential qualities of objects* (sensory experiences) and the *object's orientation* (directionality) are artificially separated from other dimensions which also encapsulate this sort of aspects such as his "dimension of affordances". Loe Feijs and Steven Kyffin (2005), on the other hand, standing on a distinction of nine levels of design work (called by them "configurations"), artificially separate aspects which are part of the same thing. In this way, for instance, they place anatomy, physiology and human information processing as part of a "configuration" different to that of ergonomics.

<table>
<tr><th>Level of Utility</th><th>Meaningful pole</th><th>Levels of semiotic consciousness</th><th>Modeling system</th></tr>
<tr><td>PRACTICALITY</td><td>Immanent semantic universe</td><td>Profound</td><td>Primary</td></tr>
<tr><td rowspan="2">FUNCTIONALITY</td><td rowspan="2">Manifested semantic universe</td><td>Paradigmatic</td><td rowspan="5">Secondary and Tertiary</td></tr>
<tr><td>Syntagmatic</td></tr>
<tr><td rowspan="3">USABILITY</td><td>Immanent semantic universe</td><td>Profound</td></tr>
<tr><td rowspan="2">Manifested semantic universe</td><td>Paradigmatic</td></tr>
<tr><td>Syntagmatic</td></tr>
</table>

Fig. 47 – Levels of meaning construction in the Utility dimension of concept design.

Furthermore, these three levels of meaning construction (practicality, functionality and usability) entail different ways in which people model the utility of objects/products in their minds. Indeed, the practicality of design products is normally envisaged through interpretations of the kind referred by the semiotician Marcel Danesi (2004) as **primary models**. That is to say, mental constructions derived from the instinctive ability of people to model sensory or perceptual properties into referents (e.g. the understanding of the narrower part of an object as standing for graspable). Whereas functionality and usability encapsulate what Danesi has described as *secondary* and *tertiary models*. That is to say, models stemming from people's capacity to "...refer to objects with extended primary forms and with indexical (indicational) forms" or **secondary models**, and models derived from people's capacity to "...acquire and utilize the symbolic resources of culture-specific abstract systems of representation" or **tertiary models** (Danesi, 2004: 6). In these two latter cases, the main difference from *primary models* lies in the fact that the interpreter already has in his/her mind a definition of the object at stake. In practical terms, however, *secondary models* normally come forward when the interpreter of an object does not know how to name it but can describe the way it looks or functions using words or any other iconic means (cf. Greimas, 1970;

Ekman and Friesen, 1976; Guiraud, 1986).[179] Whereas *tertiary models* commonly appear in the way in which the function of certain objects is culturally conceived, involving in some cases levels of categorical and functional specialization quite rare in other cultures or sub-cultures (e.g. the different types of knives used in gourmet restaurants). Thus, "...the *form* that *knowledge* takes [in the interpreter's mind] depends on the type of *modelling* used" (Danesi, 2004: 5) – see figure 47. Let us now explore how these three levels of utility have been theoretically outlined within product design.

Our theoretical understanding of PRACTICALITY has its roots in philosophical proposals such as Aristotle's three laws of association for our conception of things (4th century BC) and Peter Abelard's doctrine of the abstract universal qualities of things (11th century AD). Indeed, for the former, our first understanding of what things are about is the result of our capacity to outline them in terms of contiguity (sequence in time), similarity and contrast with other things. For Peter Abelard, on the other hand, things such as "...a ball and an apple, though different, are identical in that both are round" (Posner, 1973: 5). Thus, in his view, general qualities such as roundeness can be taken as intuitive sources to identify objects as such. Nevertheless, the way in which we understand the practicality in design nowadays is mostly based on the findings of Gestalt psychology and James Jerome Gibson's Theory of Affordances (Krampen, 1989).

The basis of Gestalt theory are in the ideas of the 19th century philosopher Christian von Ehrenfels. According to him, we perceive objects in terms of qualities derived from global patterns distinct from their parts seen in isolation (Gordon, 1997). Von Eherenfels called these qualities **Gestaltqualitäten**. By this he refers to qualities of objects' such as their squareness, redness, smallness, heaviness, symmetry, verticality, etc. That is to say, qualities evoked by the structure of objects instead of being imposed on objects by the beholder. This is the reason why *Gestaltqualitäten* (Gestalt qualities) were seen by their 20th-century advocates (the Gestalt

[179] Such communicative acts are, according to Ekman and Friesen (1976), derived from an iconic codification (a codification based on degrees of resemblance between the means of representation and the thing represented). Thus, in their view, communication using iconic means generally stands on *pictoric codifications* (gestures and sounds resembling the look and sound of things), *kinetic codifications* (gestures reproducing actions performed with objects), and *spatial codifications* (gestural indications about the distance or location of things in relation to other things).

psychologists) as qualities that can be perceived without the need of any previous knowledge about the nature of the objects containig them (Köhler, 1967). Consequently, some Gestalt psychologists have taken them as the basis of our pre-concepts or **perceptual concepts** of objects (Arnheim, 1947). In other words, of those perceptual apprehensions that provide first hand information about the objects' nature (e.g. the object's weight as the kinestesic experience of heaviness). In this sense, perceptual concepts can be seen as the counterpart of our **intellectual concepts** or those developed based on our knowledge of things (e.g. 'weight' defined as the force exercised by the earth to attract objects toward it), and also the counterpart of our **representational concepts** or those created as tangible / sensorial surrogates of perceptual and intellectual concepts (e.g. 'weight' as having to do with bulky objects).

Together with the realisation of Gestaltqualitäten and perceptual concepts, Gestalt Psychologists have also envisaged what they agree to call the **physiognomic character** of objects. Based on the works of M. Scheler and Heinz Werner during the 1920s (Kofka, 1935), the physiognomic character of objects is said to be derived from similar experiences to that of 'reading' people's facial expressions (physiognomies) to judge their mental abilities, character, emotional attitudes, etc. but this time applied to objects (natural or artificial). Thus, it actually alludes to a sort of intuitive perception where, for instance, trees are seen as 'sad' and weapons as 'dangerous', under the idea that those 'impressions' are not projections of our own emotions on things but properties inherent to their 'natural' configuration. Herefrom that the 'impressions' (percepts) derived from this kind of perception are described as unstable acts of categorisation - i.e. starting points for subsequent probes in our understanding of things - which are used by people to react in an almost instant way to the properties of things under vital questions such as whether those things are friendly or hostile, good or bad for us (Gombrich, 1960). As such, the physiognomic character of objects is - together with their Gestalt qualities and perceptual concepts - part of their inmanent semantics since its apprehension does not depend on our knowledge about objects but on the general subjective impression triggered by the object's features (Kofka, 1935).

Besides Gestalqualitäten, perceptual concepts and the physiognomic character of objects, our understanding of the immanent semantics of utilitarian objects has also been nourished by James Jerome Gibson's notion of **affordance**. Such a term was coined by Gibson to describe a kind of perceptual or spontaneous meaning (Smets, 1989), neither objective nor subjective, partially physical and partially psychical, that naturally emerges during the organism's interaction with the environment and its objects (Gibson, 1979). Hereof, affordances can only be measured in relation to the organism that perceives them since they are what the environment and its objects provide or furnish in that organism for good (positive affordances) or ill (negative affordances). In this sense, affordances have to do with what objects can be use for, which is not necessarily what objects are by definition (e.g. a hammer can be used as a weapon or as a means for personal protection under certain circumstances, even though it is a tool to strike nails by definition).

On the other hand, affordances should not be equated to functions provided that only the latter need to rely on the former and not necessarily the other way around (e.g. the use of a stone to strike nails does not mean that it is the function of the stone).[180] Therefore, affordances can be said to be derived from what Jakob von Uexküll (1934), the precursor of ethology, once described as *Merkmal* or **perceptual cues** defining the attributes of objects and serving as the basis for our actions in relation to them. But only those cues, whose 'reading' is invariant, i.e. derived from the object's physical features (Krampen, 1989) and therefore perceived without recourse to memory or rational processes (Smets, 1989). Thus, from this perspective, the edges of an object can afford[181] cutting and scraping, pointing and elongated shapes afford piercing, handle-like shapes afford grasping, broad and stable surfaces afford support, hollow surfaces afford containing, medium-high horizontal surfaces afford sitting, etc. (Gibson, 1979). Indeed, it is said that artefacts whose affordances correspond with their intended function are more efficient and easier to use (Gaver, 1991; Lidwell, Holden and Butler, 2003).

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[180] As a matter of fact, design authors such as Lidwell, Holden and Butler (2003: 20) define an affordance as "a property in which the physical characteristics of an object or environment influence its function".

[181] Following Gibson's view, the verb 'afford' is here used as an equivalent to the verbs furnishing and inciting.

The four notions above described (Gestalqualitäten, perceptual concepts, physiognomic characters and affordances) may not be the only ones comprising the inmanent semantics of utilitiarian objects. However, they are already incorporated to the theory of design. To the extent that Gestalt theory was taught at the Bauhaus of Dessau and that of Chicago, and applied to design by personalities such as Josef Albers, Paul Klee,Wassily Kandinsky and György Kepes (Behrens, 1998). Whereas the gestaltists' *physiognomic character* of objects, commonly let aside by the alleged objectivism of modern design, has been given a special place in the emotional side of product design during the 1990s and the beginnings of the 21st century (cf. McDonagh-Philp and Lebbon, 2000; Desmet, Overbeeke and Tax, 2001; Govers, Hekkert and Schoormans, 2004). Some theorists have even began to see it as part of what they call **visceral design,** i.e. design focused on eliciting reflex-like emotions in their users (Norman, 2004). On the other hand, Gibson's theory of affordances has also become part of design theory thanks to the writings of authors such as Donald Norman (1988), Klaus Krippendorff (1989, 1990 and 1992) and Gerda Smets (1987, 1989 and 1994); even though, the basic idea underlying affordances was part of the theory of art many years before (cf. Gombrich, 1951).[182]

Nevertheless, it is only nowadays that the design community has begun to realise that all these theoretical contributions are part of a level of work in design of instinctive nature, originating new studies and theoretical proposals aiming to understand and get the most of such a level of theorisation for designing (Lannoch and Lannoch, 1989; Oehlke, 1990; Maurer, Overbeeke and Smets, 1992; Campen, 1996; Lacruz-Rengel, 2003c; Norman, 2004; You and Chen, 2004; Feijs and Kyffin, 2005). Indeed, such an **instinctive level of meaning construction** has been already characterised in product design as a semantic dimension (Lannoch and Lannoch, 1989), as a level of elementary meanings (Oehlke, 1990), as a sub-notational order of reference (Lacruz-Rengel, 2003c), as a visceral level of object-subject interaction (Norman, 2004), and as part of the product's first level of configuration (Feijs and Kyffin, 2005).

[182] In his *Meditations on a hobbie horse or the roots of artistic form* (1951), Gombrich asserts that any 'ridable' object could serve as a horse such as a thumb is suckable by a baby as if it were the breast given that, in both cases, the object and the thumb fulfill a minimum practical requirement.

Having outlined the nature of the immanent semantics of utilitarian objects, one can see how the signs of utility (i.e. features standing for something else) are not strictly formed by social interaction but also by action, reaction and interaction (Gfesser, 2004). Indeed, once the profound level of semiotic consciousness has been awaken, the information stored in people's mind as part of action and experience get generalised as a system of rules or patterns that helps people to "...identify the specific and to make cognitive and emotional evaluations" (Gfesser, 2004: 2).[183] These patterns are the constitutive elements of what Susanne Langer (1957) once described as our **practical vision**. That is to say, the spontaneous abstraction derived from elementary sense-knowledge, which allows us to understand the forms of objects as typical of something or of such-and-such events. In this sense, practical vision represents "...the meeting-point of thought, which is symbolic, with animal behaviour, which rest on sign-perception..." (Langer, 1957: 267). It is also the point where objects begin to become cultural, provided that it is here where a particular purpose and a particular name is normally assigned to them by someone and recognised as such by many others (Eco, 1995).

Thus, despite the idea of function stands on our practical vision, it only takes shape in artefacts when some physical features - seen as suitable to accomplish certain task - are purposely use to create or re-create an object. In this sense, the notion of function we are dealing here with is that outlined as the 'intended function' of things (Michl, 1995).[184] That is to say, the purpose for which things are created: their intended performance.[185] Hereof a function can be defined as the capacity of things to serve for a particular purpose in certain way (Lacruz-Rengel, 2003a). It is here precisely where the real beginning of FUNCTIONALITY is. As a matter of fact, we have now enough scientific evidence to differentiate what some design authors mistakenly saw in the past as *acquired functions* (affordances, nowadays) from

183 According toJoseph LeDoux (1994), a professor of neural science and psychology, emotional information (such as that defining the phsiognomic character of things) is stored in our memory in a relative permanent way (changes can be brought about by controlling rather than eliminating an emotional memory), even though we do not have conscious access to it but to its consequences.

184 Jan Michl (1995) has proposed the term 'intended function' in contrast with that of 'actual function' (i.e. what something does no matter if it is part of an original intention or has no intention at all).

185 By 'intended function' it is neither meant the notion of function as understood in the sciences (i.e. what something does or how it behaves) nor that of the functionalist theory (i.e. an objective and therefore abstract principle of supra-human nature).

what they described as *innate functions* (the object's functions in their own right) (cf. Löbach, 1981 and Fornari, 1989). In this sense it is clear that the functionality of objects can only be interpreted as derived from our **noetic consciousness** (i.e. that mediated by knowledge) of things (Lacruz-Rengel, 2003a).

From a psychological standpoint, the FUNCTIONALITY of utilitarian objects has been studied through notions such as Jakob von Uexküll's (1934) *functional tone*, and what the Gestalt Psychologists have called the *demand* and the *functional characters* of things (Kofka, 1935). The **functional tone** of things refers to our understanding of objects based on the way we have learned to use them, so that we see the function we perform with each object "...as surely as we see their shape and color" (Uexküll, 1934: 48). Thus, a chair has for us a 'sitting tone', the table of our dinning room a 'meal tone', the plates and glasses on top of it have an eating and 'drinking tone', a desk has a 'writing tone' and a lamp has a 'light tone'.

The demand and functional characters of things, on the other hand, have been described as stemming from the interplay of forces between people and objects. From this perspective, the objects of our environment are not 'dead' or 'indifferent' to us since they can trigger certain behaviours on people. Hereof that the **demand character** of things has to do with our interaction with them in terms of the need they evoke - e.g. a hammer is evoked when we need to strike nails (Kofka, 1935). In this respect, demand characters rely on our knowledge of what things are or are made for as well as our need of them. In this respect, a thing once important and attractive can suddenly become repulsive and unimportant, based on our needs at that moment. Differently from this, the **functional character** of things has to do with the relation objects bear to our own activities. However, it is a character that only emerges when "...a particular object has functioned in a behaviour act" (Koffka, 1935: 392). Thus, based on our experience we know that the functional character of a brush is to paint as that of a pen is to write/draw. In this sense, the demand character of things generally stand on their functional character, with the remarkable difference that the functional character always stays with the object whereas its demand character dissapear with the satisfaction of the need that evoked it (e.g. the functional character of a mail box is "to post letters" but its demand character only appears when we need to post one).

Differently from psychology, within product design the functionality of objects has been approached as part of typologies of functions (see figure 48). Some of them divide functions into 'physical' and 'psychological' (Fornari, 1989) or into 'hard' and 'soft' (McDonagh-Philp and Lebbon, 2000), as if the concept of function could be unilaterally centered in either the object or its user. However, much of the typologies recognise the interaction between subject (user) and object as a necessary condition to define functions (cf. Mukarôvský, 1942; Löbach, 1981; Bürdek, 1994). Another important aspect of these typologies is that the idea of functionality is presented as a **system** where, for instance, practical functions are complemented by symbolic and aesthetic functions, in such a way that the symbolic side of a product may also affect its practical side (Boesch, 1990). All this beyond the opinion of those who describe such an outline of functions as an act of "creeping inclusiveness", given that they understand functions as merely related to the satisfaction of material needs (Benton, 1990).

	Mukarovsky (1942)	**Löbach (1981)**	**Fornari (1989)**	**Bürdek (1991)**	**McDonagh (2000)**
Material	Practical Functions	Practical Functions	Physical Functions	Indicative Functions	Hard Functions
	Symbolic Functions	Symbolic Functions	Psycho-physical Functions	Symbolic Functions	Soft Functions
	Aesthetic Functions	Aesthetic Functions	Psychological Functions	Formal-aesthetic Functions	
Abstract	Theoretical Functions				

Fig. 48 – Comparison of five typologies of function in design
[Source: Lacruz-Rengel 2003a].

In this respect, one should bear in mind that these theoretical subdivisions only aim to ease the apprehension of the functionality of design objects as a whole. This view of function, however, has also opened up a Pandora's Box in terms of interpretation. Indeed, there are cases where the concept of function has been applied with more freedom than its basic definition allows (Lacruz-Rengel, 2003a). Thus, some authors have mistakenly used the term *function* to allude – among other things - to the subjective/personal associations made by people about the purpose of things which have nothing to do with their nature or with their actual function (cf. Löbach, 1981). Beyond this, the visualisation of the product's function as part of a comprehensive system of built-in purposes has also helped to shape the idea of utility as something beyond the merely instrumental or physical. Indeed, it is not by chance that human factors in design are now concerned with aspects beyond the traditional ones (see figure 49), encapsulating as part of this new approach the social and cultural aspects of our cognition and perception of artefacts (Stanton, 1998; Jordan, 1998 and 2000; Macdonald, 1998 and 2002). Hereof human factors in design are now divided into four major categories (Heskett, 1998): *physical* (human dimensions and capabilities), *cognitive* (human processes of cognition and perception), *social* (how people work in groups and social contexts) and *cultural* (how habits and values are differentiated between groups and societies).

ANATOMY	Anthropometry	The dimensions of the body
	Biomechanics	The application of forces
PHYSIOLOGY	Work physiology	The expenditure of energy
	Environmental physiology	The effects of the physical environment
PSYCHOLOGY	Skill psychology	Information processing and decision making
	Occupational psychology	Training, effort and individual differences

Fig. 49 – Traditional aspects of human factors in design.
[Source: Based on Singleton, 1972].

These changes have brought along the need of rethinking the utility of design products in order to make them more pertinent and easy to use. To this aim design products are assessed in terms of their potential use by specific people to achieve specific goals with effectiveness, efficiency and satisfaction in specific contexts of use (ISO 9241 in Stanton, 1998). The introduction of these sort of considerations in product design adds to the idea of functionality that of USABILITY. That is to say, it takes the product's utility to a point where its configuration does not only respond to certain action (practicability) defined in terms of a particular purpose (functionality) but also to a conscious attempt to generate greater comfort and satisfaction (usability) for the users (Jordan, 1998; Stanton, 1998). This implies a work with aspects such as the user's previous experience with the object / product; the user's cultural and racial background (e.g. functional stereotypes and anthropometrics differences); his/her abilities and disabilities, age and gender (Jordan, 1998; Macdonald, 2002).

Thus the idea of USABILITY in product design aims to achieve ten basic properties in the configuration of products (Jordan, 1998 and 2000):

1. Consistency with the way similar tasks are done in other products.
2. Compatibility between the product's operation and the user's expectations about his/her knowledge of other types of products and of the outside world.
3. The consideration of all of the user's resources (body parts) and channels (senses) in the operation of the product.
4. The provision of clear feedback signs to guide the user.
5. The prevention and minimization of errors of use, and the creation of means to amend them.
6. The maximization of the user's control of the product.
7. Visual clarity (fast and easy reading of the information on displays).
8. The prioritisation of the most important information and functions.
9. The appropriate use of technologies developed in other contexts.
10. The provision of clues to make the product's functionality as explicit as possible.

With the increase of products with little overt indications of their operation, designers are requested today to develop what some authors have described as their **aesthetic intelligence** (Read, 1967; Macdonald, 1993).[186] That is to say, the designer's capacity to evaluate the perceptual, cognitive and cultural processes involved in a product in order to understand and even predict the users' reactions to the sensorial stimuli envisaged as part of products. In this direction, Jochen Gross (1997) has warned us from the effects of designing **techno-baroque products, i.e.**

[186] Aesthetic intelligence is defined by Herbert Read (1967) as reasoning set in a direct contact with the sensible world and in opposition to the Cartesian intelligence (that which is only based on reason).

products with an overwhelming burden of additional and false functions. And Donald Norman (1999) has insisted on the need of making more humane the interfaces designed for the new technologies by focusing on three axioms:

1. Simplicity: design products to make users feel that they are in control.
2. Versatility: design products to allow and encourage novel and creative interaction.
3. Pleasurability: design products enjoyable in terms of use and ownership.

4.1.2. COMPETITIVENESS

Since product design has to do with mass production and mass consumption (Conway, 1978), designers should respond to the demands of both consumers and manufacturers in order to create satisfactory products and avoid the generation of significant commercial failures. Indeed, "...the most credible estimates stipulate a new product failure rate at around 35%" (Heskett, 1998: 84), even though new product failure can go from as little as 10% to as much as 90% (Besemer, 2000). Therefore, design products should be among other things competitive to be successful (Zec, 1999). Such a COMPETITIVENESS can be defined as the capacity of design products to offer something appealing to the consumer and at the same time different from those of the competition (i.e. provide some kind of *product differentiation*).[187] To this aim, design objects are envisaged as products in marketing rather than manufacturing terms. That is to say, as "anything that can be offered to a market for attention, acquisition, use, or consumption that might satisfy a want or a need" (Kotler and Armstrong, 1990: 226). However, in our particular case, we will mostly refer to products as *durable goods* (i.e. tangible products that normally survive many uses) even though product design has also worked in the creation of non-durable products – such as packaging - and with the idea of products-as-services since some years ago (see section 1.2.1. of Chapter 1).

In marketing terms, a product is conceived as involving three different ideas at once (Kotler and Armstrong, 1990): that of a *core product* or the collection of services

[187] *Product differentiation* has been defined as the differentiation which arises predominantly from appearance to rate the product's uniqueness and consistency with corporate identity (Ulrich & Eppinger, 1995).

and benefits it offers to the consumers, that of a *tangible product* or group of attributes which are combined to deliver the core product (i.e. design features, styling, quality, packaging and brand name), and that of an *augmented product* or additional services and benefits built around the core and tangible products (i.e. delivery, installation, warranty and after-sale service) - see figure 50. Of these three ideas comprising a product, the product designer can really intervene in the core and tangible products. In the former, the designer's intervention takes place during the refinement and interpretation of the design brief. As a matter of fact, some of the most successful new products come from design briefs initially too broad but later refined by a design team (DTI, 1992). But, it is in the tangible product where the contribution of the product designer is mostly placed. To the extent that it is generally a designer who defines how the physical configuration of the product will efficiently fulfil its purpose and comply with its manufacturing and commercial requirements (Conway, 1978; Rams in Burkhardt and Franksen, 1980).

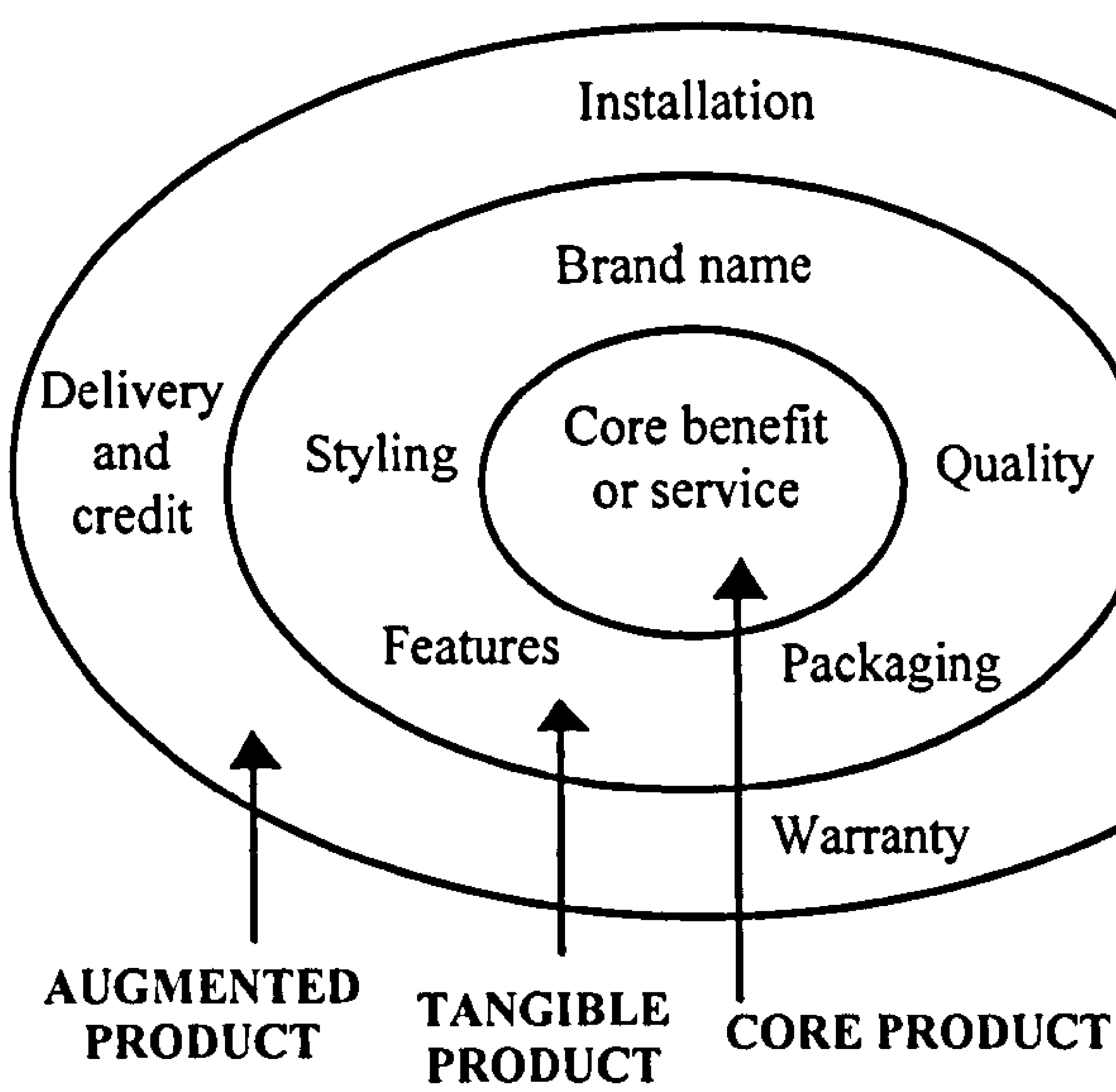


Fig. 50 – Marketing view of a product [Source: Kotler and Armstrong, 1990].

The nature of such an intervention, however, varies with the nature of the product to be developed. Thus, for *consumer/market-driven products* the designer has to take the role of both coordinator and judge in the formulation and selection of design concepts as well as in the detailed design of the product; whereas in *technology-driven products* his/her job is generally focused on the correct application of human factors and the configuration of the interfaces between the users and the technology at stake (Ulrich and Eppinger, 1995). Hereof the strongest contribution of product design generally takes place in market-driven products, given that in technology-driven products most of the decisions are in the hands of engineers and technicians. This is a situation that should not be taken as a discouraging statement for product designers since four out of five products are said to be market-driven (Kennedy and Baker, 1982). Furthermore, the field of product design has been progressively widening its horizons by increasing its levels of intervention in technology-driven products. This is particularly certain in relation to 'platform products' or those developed around a particular kind of technology with a variety of usages (Ulrich and Eppinger, 1995). This is indeed the case of new professional specialisations such as that of **interaction design** (Lango, 1999).

Having briefly outlined the degree of intervention of designers in products, our main concern should now focus on what makes a product appealing to consumers. In theoretical terms it is said to be derived from "...an elusive, psychological value [which encapsulates]...how a product feels to the touch, how it operates, and the association of pleasant ideas it conjures up in the purchaser's mind" (Dreyfuss 1955: 182). Indeed, it is no secret that consumers tend to associate products with their past or present lives, with their interest, goals, and social roles, among other things (Moles, 1975; Csikszentmihalyi and Rochberg-Halton, 1981; Savas, 2004). Therefore, to find out what makes a product appealing we need to look at people's emotional responses toward it and the reasons that make them feel attached to it (Gotzsch, 2005). In this direction, the design critic Stephen Bayley (1983) has asserted that the objects most admired by successive generations are those sharing the following four qualities:

a. Intelligibility in their form, so that people can understand their purpose.
b. Coherence and harmony between their form and their details.
c. An appropriate choice of materials for its purpose.
d. And an intelligent equation between their construction and their purpose, exploiting as much as possible the technology available.

Similarly, Stuart Walker (2006) has said that, in order to stand the test of time and held their place in society, objects have to avoid being: *culturally neutral*; *pristine, polished and fragile* (engendering consumer dissatisfaction by being easily damaged), *concealing and disguising* (with an external form bearing little or no relation with the product's inner workings), *cold or remote* (unfamiliar and hard to be understood by the user), *fashionable or showy* (designed to pander and spur short-life trends through unnecessary updates), and *complete and inviolable* (with an overall presentation with little or no room for additions or changes by the user). In this respect, it can be said that the appeal of a design product resides in its contribution to the satisfaction of consumers' interests and goals. Hereof that their appeal or attractiveness could also be defined as resulting from the product's capacity to (Baxter, 1995): grab people's attention, be desirable, or be both of these things.

With this in mind, Mike Baxter (1995) has outlined four basic ways in which a product can be attractive. They are: (1) *prior knowledge attractiveness* or designing products bearing some similarity with previous models of its type to ease their users acceptance, (2) *functional attractiveness* or making products look like they perform their function well, (3) *symbolic attractiveness* or designing products to reflect the values, styles or ideas which with people feel identified, and (4) *attractiveness inherent to the form* or that defined as part of the form of products in their own right. Such kinds of attractiveness correspond to what the design theorist Wolfgang Haug described many years before as the *aesthetic promise of use-value* in products. Indeed, in Haug's view (1989), the aesthetics of products poses particular promises of use-value (i.e. of different kinds of utility) to consumers. These promises can be of two kinds: objective promises of use-value or those derived from what the physical features of a product tell people about what it does (e.g. if it is resistant to impacts, easy to clean, portable, etc.), and subjective promises of use-value or those built around what consumers believe the product can do for them individually (e.g. help one to: feel more secure, get more friends, achieve certain social status, etc.).

Haug's ideas encapsulate what some marketing researchers have described as the 'economic and the emotive bases of value and purchasing behaviour' (Wolter et.al. 1989). The economic bases of value allude to issues such as efficiency, functionality and cost; whereas the emotive ones encapsulate the way in which sensory cues found within the product itself are linked to a range of psychological responses on issues such as self-esteem, ego, and status (Bacon and Buthler in

Wolter et.al., 1989). This twofold definition of the basis of value outlines the tangible and intangible aspects of what is known as the *perceived value of products*. That is to say, "the customer's impression of a product's benefits" (Nilson, 1992: 30).

The perceived value of products, however, may vary according to factors such as the consumer's education, social status, commercial orientation (the sort of things each consumer buys), empathies, motivations, attitudes, aspirations, exposure to mass media, and son on (Engel, Blackwell and Miniard, 1999). Another way to look at the perceived value of products is through the sort of needs they satisfy. In this respect, Lidwell, Holden and Butler (2003) has equated the five levels of needs suggested by the psychologist Abraham Maslow to the following five levels of perceived value in design products (see figure 51): (1) *functionality* or that where the most basic practical requirements are met, (2) *reliability* or level in which the degree of stability and consistency (quality) of the product's performance is established, (3) *usability* or that having to do with how easy to use a product is and how its design deals with human errors and the possibility of amending them during the use of products, (4) *proficiency* or level dealing with the extent to which a product can empowered people to do things better than they could previously, and (5) *creativity* or level having to do with the capacity of products to endorse new and different ways of using them. This theoretical proposal may not correspond to a totally licit interpretation of Maslow's theory but it has the merit of providing a way to adapt it to design matters straight away.

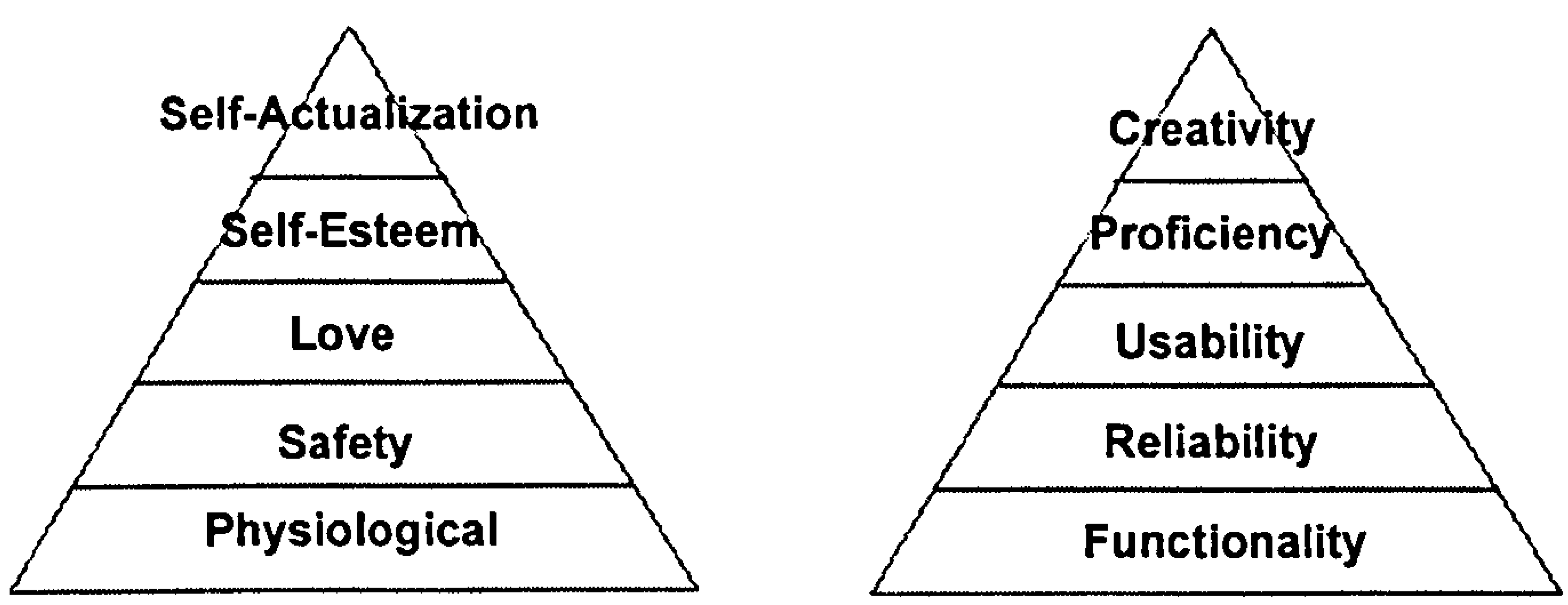


Fig. 51 – Maslow's hierarchy of needs (left) and Lidwell, Holder and Butler's adaptation of it (right) to assess the perceived value of products
[Source: Lidwell, Holden and Butler, 2003]

However, the most common way to link the *perceived value* of a product to its degree competitiveness is through the establishment of its acceptance by the consumer and the characterisation of the type of satisfaction and benefit products provide. In the first direction, Gillo Dorfles (1972) has described the acceptance and acquisition of products as resulting from two possible types of relations: one *integrative* – when products are acquired because they are seen as part of ourselves, as our 'natural' extensions - and one *counterpositive* – when products are seen as extraneous to us and therefore acquired as the result of external impositions. In this respect, our acceptance of a product is the result of impositions either personal (self-imposed) or social (Moles, 1975), which depend on how well the product accommodates the visual and conceptual prejudices already 'printed' in the consumer's mind (Vickers, 1991). To the extent that many of our ways of thinking, perceiving, appreciating and acting can be said to be imposed on us as part of different social processes (Lippmann, 1922; La Barre, 1964; Boulding, 1964; Bourdieu and Passeron, 1971). This happens to such an extent that some of our preconcepts of things (those derived from experience or social learning) are even capable of conditioning some of our most basic processes of perception (Maslow, 1987),[188] affecting in consequence our acceptance of products. Among these we ought to mention our natural tendency to perceive (Maslow, 1987): the familiar rather than the unfamiliar, the organised rather than the chaotic, the nameable rather than the unnameable, the meaningful rather than the meaningless, the conventional rather than the unconventional, and the expected rather than the unexpected.

In relation to the type of satisfaction and benefit products provide to consumers, marketing researchers have agreed to classify products into four main groups (Kotler and Armstrong, 1990): *desirable products* or those with high immediate satisfaction and high long-run benefits (e.g. a tool); *pleasing products* or those that give high immediate satisfaction but may bring some negative consequences to its user in the long term (e.g. videogames); *salutary products* or those with low appeal but giving benefits to consumers in the long run (e.g. seat belts), and *deficient products* or those with neither immediate appeal nor long-run benefits (see figure 52).

[188] Maslows (1987) actually uses the term "stereotype" but to allude to any preconcept people use to perceive reality. In his view, *stereotypes* do not only refer to the social psychology of prejudice as usual.

Immediate satisfaction

Long-term benefit		LOW	HIGH
	LOW	Salutary Product	Desirable Product
	HIGH	Deficient Product	Pleasing Product

Fig. 52 – Classification of products according to their perceived value
[Source: Kotler & Armstrong, 1990]

Nevertheless, for a new idea (a new product, by extension) to be popular it may have to suffer many different transformations until it turns into a quite simple form, and therefore easy to grasp by the mass of people (Le Bon, 1983). As a matter of fact, the reduction of original and successful designs to the symplest stylistic formulas has been seen as one of the processes leading to design classics (Bayley, 1990; Vickers, 1991). Hereof that classics are not necessarily expensive, rare or loud (Bayley, 1990). It does not mean, however, that all products need to become design classics to be accepted neither that the definition of the benefit and satisfaction they provide is just a matter of formal simplicity. Indeed, there are many issues involved. They have been appraised differently by design authors. For some authors like Abraham Moles' (1975) what we have defined as the correlation benefit – satisfaction could be outlined in terms of the relations between people and products.[189] He summarises these relations in the following seven types: (1) *ascetic* or that based on the rejection of most of what is offered to consumers, (2) *hedonistic* or relation based on the search of pleasure, (2) *aggressive* or that driven by the need of hunting or destroying, (3) *acquisitive* or relation focused on the sole idea of gathering possesions, (4) *aesthetic* or that derived from the satisfaction resulting from contemplating the form of certain products, (5) *surrealistic* or relation based on the appeal derived from rare yuxtapositions of elements in a single object (such as happens with the gadgets), (6) *functional* or that focused on the practical side of products, and (7) *kitsch* or relation involving a mix of hedonistic, seudo-rational and seudo-functional aspects of products.

[189] Moles (1975) uses the term 'object' to allude to design products, among other things. For the sake of clarity the term *product* is used in the text instead of *object*.

For authors such as Mihaly Csikszentmihalyi and Eugene Rochberg-Halton (1981), on the other hand, the correlation between benefit and satisfaction has to do with a double dialectic: one that runs from action to contemplation, and another that goes from the self to the others. From their point of view, the first poles of this double dialectic typify the relation of young people with objects, whereas the second poles of this dialectic typify the relation of adult and elder people with objects. Hereof that the young defines his / her own boundaries from an active involvement with products such as stereo sets, television sets, furniture (especially their own bed) and musical instruments; whereas adults expand their boundaries to include other people following a more passive involvement with products than the young (Csikszentmihalyi, 1995). Thus, they tend to prefer (in ranking order): furniture, works of the visual arts, books and musical instruments. Elders, on the other hand, tend to envisage their personal boundaries based on contemplation activities and relationships with others. Therefore, they organise their world around products such as photographs, furniture, books, television sets and works of visual arts (Csikszentmihalyi, 1995).

Differently from the views above, there are also authors working with the notion of the product life cycle. Such is the case of Mika Pantzar (2000), who following a line of thought similar to that of Jean Baudrillard (1969), Paul Levinson (1977), Ding-Bang Luh (1994) and Fabrizio Carli (2000), sees the benefit-satisfaction correlation as taking place in subsequent phases. In his view, consumers relate to new commodities following a three-stage process: (1) *The stage of self-purpose consumption* or that focused on the excitement of experiencing a new product, (2) *the stage of instrumental consumption* or that centred on more rational aspects such as the product's performance and quality, and (3) *the stage of critical and creative consumption* or that where "consumers may begin to question the lifestyle which is based on the product, and start to analyse their own commodity-dependency" (Pantzar, 2000: 4).[190] Thus, in terms of the benefit-satisfaction correlation consumers go from sensation, pleasure and status in the first stage to the satisfaction of needs and routines in the second stage, and from this latter to a search for stylization and self-expression in the third stage (Pantzar, 2000).

[190] Mika Pantzar (2000) also names each of his three stages as: *Consumption as play*, *consumption as work*, and *consumption as art*.

The three views above revised bring to our attention the fact that design products are endowed - as no others - by a fast caducity, which has been commonly explained as derived from the search of differentiation or individuality characteristic of human beings (Dorfles, 1968; Bourdieu, 1979; Conran, 1994; Baudrillard, 1998). However, as we have seen before, this is just one part of the whole story. What is actually certain about it is that humans are 'wanting animals' provided that "...as one desire is satisfied, another pops up to take its place" (Maslow, 1987: 7). Therefore, in the search of appropriate design concepts to satisfy human needs and wants, product designers are inevitably involved in a dynamics defined by the marketing notions of style, fashion and fad.

In this respect, we must clarify that the understanding of these concepts in marketing studies do not strictly correspond to the ideas associated to these notions in other fields of study. Hereof, in marketing studies the notion of *style* is used to allude to the consumer's basic and distinctive mode of expression, the notion of *fashion* to refer to a style which is currently accepted or popular, and the notion of *fad* to define the popular styles (fashions) which are adopted with great zeal but decline very fast in popularity (Kotler and Armstrong, 1990). Thus, these three concepts come to characterise three basic ways in which products are adopted: for self expression, because of their popularity (trend followers) or as a fad (see figure 53). This implies that designers (as perceptive marketers do) should not assume that people always know what they want neither that they always behave in rational ways (Packard, 1992). These three notions also remind designers that consumers' life is conditioned by the products they buy. Hereof that depending on the circumstances and needs, people's perception of products may change - see figure 54. Let us not forget that a significant part of the value assigned to products has its roots in social processes where objects may gradually slice from having a quite specific value to value decreasing, from value decreasing to having no value at all, and from this latter to a value increasing category (Thompson, 1979). In this sense, the influence of what has been described here as fashion is definitely omnipresent in product design since it helps to secure, increase and decrease the value of products in the eyes of their potential consumers (Dorfles, 1968; Gilles, 1991).

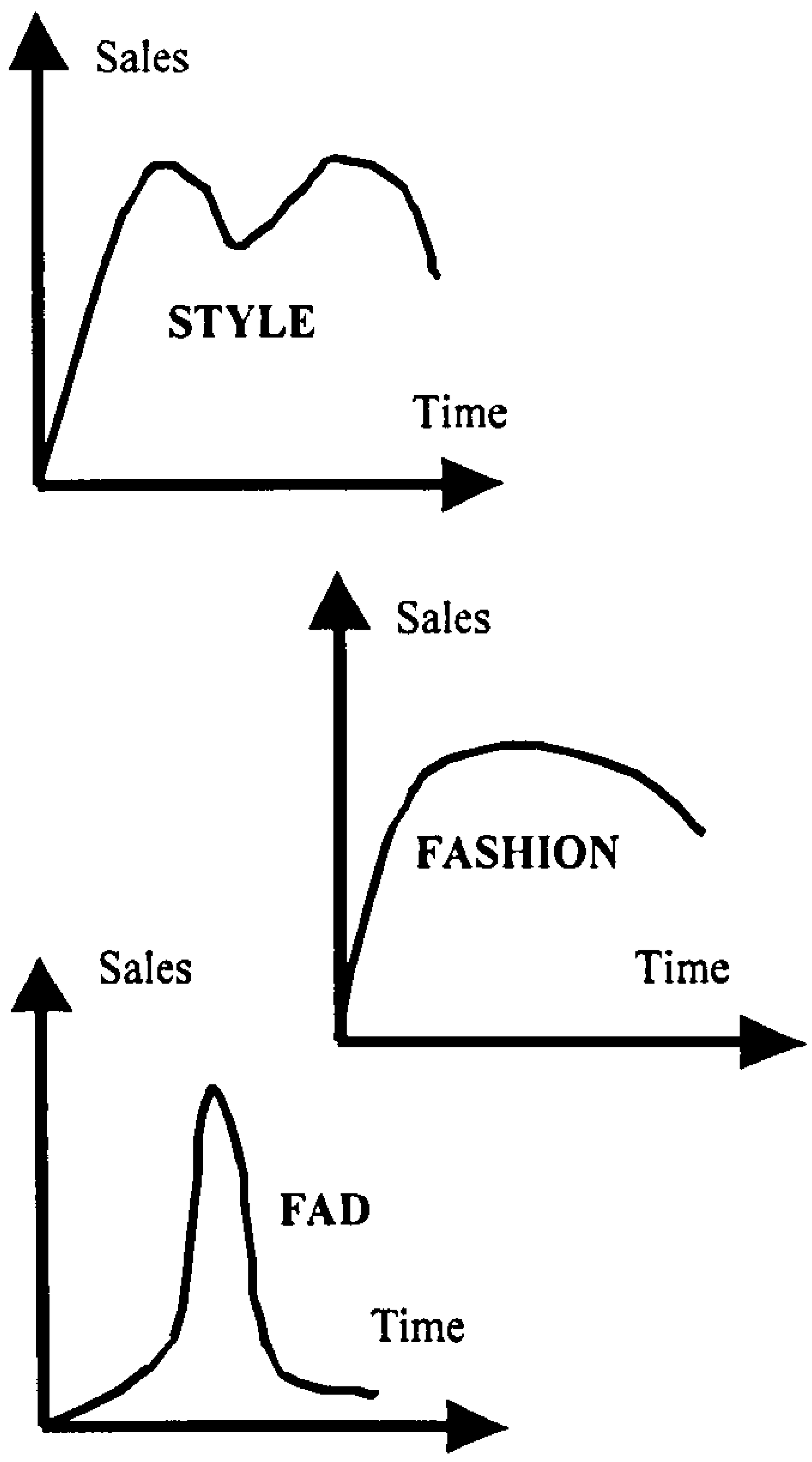


Fig. 53 – Life cycles of style, fashion and fad.
[Source: Kotler & Armstrong, 1990].

10 years before its time	INDECENT
5 years before its time	SHAMELESS
1 year before its time	OUTRÉ
At its time	SMART
1 year after its time	DOWDY
10 years after its time	HIDEOUS
20 years after its time	RIDICULOUS
30 years after its time	AMUSING
50 years after its time	QUAINT
70 years after its time	CHARMING
100 years after its time	ROMANTIC
150 years after its time	BEAUTIFUL

Fig. 54 – Perceived value in the cycle of fashion
[Source: Laver in Bayley, 1991].

Finally there is a key aspect helping to define the competitiveness of products: its advertising nature. It is commonly thought that advertising is a complementary activity carried out after the product has been developed. Nevertheless, authors such as Loewy (1951), Dreyfuss (1955), Dorfles (1968), Baxter (1995) and Zec (1999) have clearly substantiated that design products have – among other things - to be conceived with an advertising value in mind. Of particular interest is Gillo Dorfles's (1968) two-fold view of such a value for product design. Indeed, for him there is an *advertising value* as well as a *self-advertising value* in products. The former alludes to the search of a maximum visibility and a particular sort of visual enjoyment for consumers to help products stand out from their competition; whereas the latter (self-advertising value) has to do with the way in which the design of a product helps to highlight its most appealing features for the consumer. Hereof, the aim of working out the advertising value of products is to help them achieve notoriety in the market, whereas the aim of working out the self-advertising value is to position[191] the product in the minds of its potential consumers.

One traditional way of tackling the advertising side of products has been through the application of the AIDCA (i.e. Attention, Interest, Decision, Credibility and Action) formula, even though it is more a formula for the design of advertisements. That is to say, the consideration of the following five aspects in the material configuration of design products: (1) Get the consumers' attention, (2) provide elements to increase their interest based on the benefits and novel aspects of the product, (3) make visible the way in which the product will fulfil its promises to consumers, (4) make sure that additional benefits are clearly stated (e.g. guarantee, service support, etc.), and (5) make sure that all the previous aspects are covered to induce the acceptance and acquisition of the product. Beyond its usefulness, we should not forget that the AIDCA formula is rooted in a quite old advertising strategy focused on generating visual impact to make consumers remember the product. Since then, advertising strategies have gone through two more significant stages: one focused on the extent to which the advertising messages reflect people's needs and wants, and another centred on the search of images and ideas capable of involving users with products (Péninou, 1976). Thus, advertising strategies has gone from concentrating in the consumer's sensitivity to focusing on his/her sensibility, and from this latter to work with rhetoric. This advertising scenario has had its parallels in product design. Examples of these are: the search of visual impact propounded by the Borax style and the furniture designed by Memphis, the satisfaction of essential needs supported by the socially-responsible design and the lifestyle propounded by Pop design, and the involvement with the consumers' ways of understanding things and their emotional side characteristic of Products Semantics and the so-called Transitive Design of the 1990s respectively.[192]

Having said this, designers should be conscious that a bad manipulation of the advertising side of products can contribute to their economic failure. In this respect

[191] In marketing terms, what is known as *positioning* refers to the development of strategies to help products gain a space in the mind of consumers, a place in their thoughts, not necessarily as the best product (Pope, 1984).

[192] Transitive Design propounds a rescue of our memories through a blend of archetypal forms of objects with emotional tones of the present (Castelli, 1999).

it is advisable to avoid (Furones, 1980):

a) Making too explicit the motivation behind the advertising message or strategy.
b) Sacrifying the inteligibility of the product in search of creative solutions.
c) Generating expectations on the consumer that the product cannot satisfy.
d) Addressing the advertising message / strategy to the wrong public.
e) Building up advertising messages / strategies based on arguments easy to refute.

4.1.3. ORIGINALITY

Originality is generally defined as the state or quality of being newly created or formed (Cowie, 1989). In this sense, it has to do with the degree of novelty or unpredictability present in things; this being an essential aspect of product design given the fact that consumption and communicative wear are characteristic of its products (Dorfles, 1968). As such, originality has to do with the understanding of products as innovations, since innovation is also about novelty and foreseeability (Bense and Walther, 1975). Thus, to speak about originality is to refer to the special human gift by which people discover new ways to codify the information they already have (Miller, 1973). Hereof to be innovative things do not have to be objectively new. What they have to be is perceived as new depending on: the knowledge it encapsulates, its power to persuade others about its newness, or its capacity to awake in people the need of adopting it for the first time (Rogers, 1983).

Bearing this in mind, any innovation may have five main characteristics (Rogers, 1983): (1) *Relative advantage* or the provision of a relative degree of improvement in relation to what exists, (2) *compatibility* or being consistent with the existing values, past experiences and potential needs of those who will adopt it, (3) *complexity* or the presence of certain degree of difficulty in relation to its understanding and use, (4) *triability* or the need to be used on a limited basis or be at least seen in use in order to be known, and (5) *observability* or the introduction of its innovative nature in clear visible terms to people. These five characteristics help indeed to widen the traditional view by which innovations were defined either as radical or progressive (Johne, 1985). To the extent that alternative strategies of innovation have emerged. Among them we ought to mention (Freeman, 1982):

* *Offensive innovation* or that where design is used to achieve "...technical and market leadership by being ahead of competitors in the introduction of new products" (p. 99).
* *Defensive innovation* or that in which design is placed behind the times of the early innovators to keep a share of the market avoiding the heavy risks of the first to innovate.
* *Imitative innovation* or that based on the production of 'carbon' copy imitations of the products introduced by early innovators.
* *Traditional innovation* or that where products change little due to fashion rather than technique.
* *Opportunist innovation* or that based on identifying an opportunity or market niche in a rapidly changing market, which may not require any in-house research and development, or complex design.

Innovation has been also characterised according to the type of innovative activity present in each of the four classical phases of the product life cycle (Duijn, 1981). Thus, for the *introduction phase* of the cycle it is said that a large number of product innovations are developed due to the existence of different technological options and little knowledge about the nature of demand. For the *growth phase*, on the other hand, there are a decreasing number of product innovations given that sales growth leads to a standardisation of technology. Differently from this, during the *maturity phase*, product differentiation increases and innovations are focused on improvements. Finally, during the *decline phase* of the cycle "attempts are made to escape saturation through changes in technology, and the use of labour saving process innovation..." (Duijn, 1981: 265). However, when dealing with the decline phase of a product one should bear in mind that "...very few of the late-19^{th} and early-20^{th} century major innovations have been completely replaced by substitutes", and that the life cycle of products tends to be half a century or longer (Duijn, 1981: 266 - 267).

Within this scenario in mind, few things are more important than realising that, differently from innovation in science and technology, innovation in design is about giving form to the material aspects that support the socio-cultural practices and life styles of people (Bonsiepe, 1995a). Therefore, we ought to look at the caducity of design products as having more to do with obsolescence than wear (Moles, 1975; Dorfles, 1984). In this respect, there are four types of obsolescence that ought to be considered (Papanek and Hennessey, 1977): (1) *Psychological obsolescence* or that derived from the mental dissatisfaction toward old products that still work, (2) *'easy' obsolescence* or loose of attractiveness of a product through the emergence of new products which require less physical and mental effort to be operated, (3) *technological obsolescence* or diminution of the attractiveness of a product thanks to the presence of products technologically more advanced, and (4) *aesthetic obsolescence* or that derived from the trade of yesterday's aesthetic clichés for tomorrow's. This idea of caducity via obsolescence brings to our attention the notion of originality as stated by the information theory, where the more unpredictable the message is, the more original it is (Moles, 1966). Even though novelty is a fundamental aspect of product design, it is recommended to be against the excess of originality by keeping some features of those functional forms appropriately achieved (Dorfles, 1968), since otherwise design products may not be accepted or, what is worse, not even recognised for what they are by the public (e.g. a telephone that looks like a radio may hardly be recognised as such).

In this latter respect, psychologists have the last word. Indeed, in the view of Leon Festinger (in Lidwell, Holden and Butler, 2006) if the design of a product is not consistent with the consumer's attitudes, thoughts and beliefs it may cause *Cognitive Dissonance*. That is to say, a state of mental discomfort derived from the confrontation posed by different ideas to those of the individual.[193] For Daniel Berlyne (1974), on the other hand, complex forms have the capacity of catching our attention even though they are not pleasing to us, whereas simple forms are pleasing but do not catch our attention. Thus, designers are in the difficult crossroad between creating inteligible and simple objects which may be seen by the public as boring, and designing curious objects whose forms may catch people's interest at the risk of not being identified. In this particular direction Karl Teigen (1987) has asserted that when an object is too familiar for us we prefer to learn something new about it, whereas when it is new we prefer to learn something familiar about it. Herefrom, some psychologists have come to the realisation that "...judgements of interest and

[193] When *Cognitive Dissonance* takes place the individual may attempt to reduce it by assigning less importance to the aspects causing it, adding consonant cognitions, or removing or changing the dissonant cognitions or contradictory ideas (Lidwell, Holden and Butler, 2006).

pleasiness are positively correlated" and that "...people loose interest in objects that are too complicated for them, or too familiar" (Crozier, 1994: 73). In any case, designers should not forget that no matter how original they want to be, familiar things will always be the most probable point of departure for the expression of the no-familiar (Gombrich, 1998). Since research on the act of designing has shown that concept ideation has more to do with bridging ideas than creative leaps (Cross, 1997), the hardest work for designers is to achieve an appropriate balance between novelty and familiarity.[194]

4.1.4. PERTINENCE

From an etymological standpoint, the adjective 'pertinent' shares with the verb to 'pertain' the fact of being both related to the Latin word *pertinere* which means "to refer to something, to be about something and to be part of something" (Gómez de Silva, 1988). Therefore, the term 'pertinence' is here used to allude to the quality or condition of being part of something. In the product design field, this term can be translated as that capacity products have to reflect their user and the context where they are used. Let us not forget that "recognition and acceptance of an object is determined by the context in which it is perceived and used" (Macdonald, 1993: 5/1). Thus, a design is said to be pertinent when it appropriately fit into the scenario for which is has been created. Indeed, product design shapes the identity of our everyday objects and through them the identity of their users. They help people to "...construct a sense of who they are, to express their sense of identity... to create a particular meaning or image intended to shape" (Heskett, 2002: 125). In this sense the best way to design pertinent products is working with stereotypes, either by leaning on the existing ones or by breaking apart from them to create new ones. Whatever the case, it will always be easier to understand new situations if we partially stand on the things we already know (Miller, 1973).

In terms of design, some of the best strategies to approach 'pertinence' in products may be derived from the application of psychological findings. Firstly, because stereotypes are generalizations that lead us to categorise things, and the role of

[194] In the writings of some design authors from the beginning of the 20th century there was the belief that "...the things we love best are those with which we are most familiar" (Glass, 1927: 271). Nevertheless, this is an idea hard to support nowadays.

categories in human performance is primarily studied by psychology. Secondly, because a significant part of our categories are related to context and they are also study by psychologists. And thirdly, because treating design products as members of categories help to understand the sources of the existing semantic clues as well as to generate new ones (Athavankar, 1990). Categories are so important that, in our cognitive processes, objects (e.g. a chair), entities (e.g. a shopping list) and events (e.g. someone's birthday) are all treated as part of them (Roth and Bruce, 1995). In this respect, Ilona Roth reminds us that without categories (Roth and Bruce, 1995): (1) we could not recognise objects, (2) we could not interact appropriately with things (e.g. with a painting), (3) we would have to file in our memories trivial information about the details of objects, and (4) we would have difficulties to communicate about objects (since without categories we would have to fully describe them each time we refer to them). The reason behind it is that, even though each situation is unique, we do not respond to them uniquely but based on our past learning and categorization (Mervis and Rosch, 1981).

According to Eleonor Rosch (1975) not all the objects of a category are equally typical of it and people categorise better the typical ones. Consequently, to make people understand an object as part of a category such object must have the typical features of that category. However, from the standpoint of William Labov (1973), it is the context in which objects are placed what ends up determining to which category they belong, since there are no clear limits between categories.[195] In this respect, experimentation about the ideas elicited in people by words used to express concepts has led Lawrence Barsalou (1982) to assert that there are two kind of possible properties involved in our concepts of things: those directly activated every time a word is used to refer to a concept or *context-independent properties* (e.g. 'unpleasant smell' for 'skunk'), and properties which are only activated when words are placed in certain context to allude to concepts or *context-dependent properties* (e.g. 'floats' for 'basketball').

These ideas highlight two ways in which pertinence can be approached by designers. One where it is achieved by defining the configuration of products based

[195] In order to prove this Labov (1973) developed experiments asking people to categorise cups with variations in their proportions and form placed as part of different situations or contexts of use (e.g. for coffee, for food, for flowers, etc.).

on features considered as typical of the objects used or acquired by the potential users. And another where pertinence is achieved incorporating to the configuration of products features seen as characteristic of the environs where those products are supposed to be used. These two strategies, however, can be taken even farther in the light other psychological findings.

Indeed, the strategy based on the role that psychologists like Rosch assigns to typical features have been extended by the work of others psychologists like Irving Biederman (1987) and his *recognition-by-component theory.* In Biederman's view, there is a procedural parallelism between speech and object perception since both may rely on the identification of a small set of primitive elements (those from which other elements are perceptually built). As a matter of fact, it is estimated that all the words of the English language can be built out of just 44 phonemes (sounds). Similarly Biederman estimates that our object recognition may rely on 36 primitive elements (a number that he later reduces to 24 primitive elements). These primitive elements are called by him 'geons' (for 'geometrical ions') and described as geometric forms – generally convex and volumetric - such as cylinders, blocks, wedges, and cones. Each of these 'geons' "...comes in fifteen sizes and builds (a bit fatter, a bit skinnier) and there are eighty-one ways to join them" (Pinker, 1999: 271). But what is most interesting is that only two or three *geons* are normally sufficient for the rapid identification of objects; these being almost always the largest components of a complete object. This implies that "...10,497,600 objects can be built out of two geons, and 306 billion objects made of three geons" (Pinker, 1999: 271). This is, indeed, a measurement of the capacity of this theory to explain our identification of objects through their components. It is also a way to highlight that our recognition of objects is inevitably linked to a number of familiar forms and configurations derived from the joining of these latter.

With this theory in mind to create new products, designers could begin by establishing what 'geons' in what sort of arrangement are more significant in order to describe the typical configuration of the objects they are asked to design, either in terms of a particular context or according to the objects normally bought by potential users. As a matter of fact, similarly to the case of people who like to wear clothing with or without patterns on it, people also tend to associate the things they use with certain formal patterns, such as rounded and straight edges, bulky or slim volumes, simple or complex forms, etc. This is precisely what makes possible to speak, for instance, of a sportish or a professional look. The idea of a typical configuration for objects has, indeed, tacitly inspired design methods such as SCAMPER (Baxter, 1995) and Eskild Tjalve's *structure variation* (Tjalve, 1979) whose aim is to break away from what is typical (i.e. to create original rather than pertinent concepts).

In relation to the role of context in categorical concepts, Biederman, Glass and Stacy (1973) discovered via experimentation that the speed at which a single object can be spot out (detected) in a real-world scene is slower in jumbled than in coherent scenes. In this same direction, Stephen Palmer (1975) found that a good deal of what people know about objects relies on the sort of context in which those objects are normally placed. Thus, for instance, we tend to associate watches with wrists and television sets with living rooms. This, of course, independently of the intrinsic properties of these objects, since these latter properties together with context are what determines people's response to objects. The implications of these findings for product design can be of different kinds. At first, it is the idea that working with a context in mind may definitely help to design those objects whose definition is of necessity linked to a certain context (e.g. 'kitchen' utensils). Indirectly, it also implies that the design effort to create objects appropriate to certain contexts will be greater if the object is to be placed in a thematically mixed or jumbled context; in which case the freer the definition of the object is from contextual clues, the easier might be to formulate a design concept for it. Nevertheless, it can hardly be said in advance to a particular design problem what would be more difficult: if designing with contextual clues in mind or without them. Whatever the case, what is actually clear is that designers can not see the success of an object strictly in terms of how it fits in a context, provided the fact that such a single-focus view may be leaving out of consideration other aspects intrinsic to the object itself but not less important.

Finally, there is a third consideration to be made in relation to Lawrence Barsalou's context-dependent and context-independent properties in our concepts about objects. It is that similarly to the existence of these properties, cross-cultural psychological studies such as that H. A. Witkin (1967) have found the presence of two cognitive styles in people derived from socialization processes. In this respect, he found that there are *field-dependent* and *field-independent* modes of perception. The former is conceived as *global* since "...the organisation of the field [i.e. ground of the things we perceive] as a whole dominates perceptions of its parts" –where items are experienced as fused with their ground (Witkin, 1967: 103). The latter or field-independent, on the other hand, is defined as *articulated* given that "...the person is able to perceive items as discrete from the organised field of which they are part" (Witkin, 1967: 103), that is, items are perceived with disregard of their context. However, the interesting side of these findings is that, with the corresponding variations from one country to another, these styles have been found to be associated with the gender (sex) of people. To the extent that in some countries boys and men tend to be more field-independent than girls and women. Nevertheless, Witkin explains, that these differences in cognitive styles "...may not exist in children below the age of 8 or in geriatric groups" (Witkin, 1967: 111), since these styles are end-products of socialization processes. Relying on findings like these in each particular country, designers can have at their hand the possibility of creating products more appropriate to men or women, depending either more or less on the incorporation of features characteristic of the product's context of use.

Design researchers have already acknowledged the role of context in typifying design products (Moles, 1975; Krampen, 1989; Krippendorff, 1990; Athavankar, 1990). And even in some design schools, practical experiences have been developed on this subject. An example of this is the 1994-1995 Project 'CODE' at the University of Industrial Arts of Helsinki. It was a studio project in which students were asked to design electrical appliances for 12 different artefactual environments (Ahonen, 1996). In professional terms, consumer-led design has worked as a framework to develop products with people's life styles in mind (Whiteley, 1993), and case studies such as the Sony Walkman have become icons of this sort of approach (cf. Whiteley, 1993; Gay et.al.,1997).

4.1.5. REPRESENTATIVENESS

Since design is an aesthetic activity, designers should keep in mind that, besides functioning, their products are also capable of eliciting other experiences and readings/interpretations in their users. This is possible because objects 'represent' things to people; from the Latin *repraesentare* which means to show, reproduce, imitate or present things (Gómez de Silva, 1988). In this sense, products as any other representations are representations of something (Wollheim, 1993; Vihma, 1995), where that 'something' can be actual things, abstract concepts or things (like love and friendship), and even products of our imagination (things that do not exist yet), since resemblance is not necessary for representation (Goodman, 1976; Wollheim, 1993). This happens to such an extent that products can play the role of *poetic links* between the imagination of the designer and that of the user by the use of "...appropriate metaphors to bridge from one human's experience to another's." (Dormer, 1990: 112).

From a psychological standpoint, the act of representing things can be understood in two ways (Reber, 1995): as the act of using something to stand for something else, or as the act of presenting something to us once again (also spelled as *re-presenting*). This situation inevitably leads us to define design products as having to do with two faces of a single coin: one face about what products are made to stand for, and the other about what we - as individuals - make out of the meaning of products. Within product design, the former view is identified with the sort of meaning assigned to each product by society as a whole: what it simbolises or expresses for groups of people. The latter view, on the other hand, has to do with what products mean to us besides their socially agreed meanings: what products mean or represent to us as individuals (to the self). In this sense, the subject of this section will be 'representativeness' or the capacity of products to stand for things according to each person's knowledge and experience, i.e. the second of the two views above described.

In theoretical terms, the representativeness of a product can be outlined through what Harold Osborne (1970) has described as *emotional qualities*, what Jacques Maquet (1999) names *experiential references*, and what Irvin Child (1969) calls *expectational meanings*. These three aspects together can be said to provide the foundations for a comprehensive understanding of the representativeness of products from the standpoint of meaning construction, even though they may be called in different ways by different authors. As a matter of fact, emotional qualities, experiential reference and expectational meanings resemble the 'three universes of being' described as part of Charles Sanders Peirce's (1908) semiotic system, as well as they also encapsulate more recent theoretical categorisations for the understanding of this facet of artefacts such as that of Csikszentmihalyi and Rochberg-Halton (1981), for whom the representativeness of objects is visualised in terms of *aesthetic qualities*, *attention* and *goals*.

From the three concepts here proposed to define the representativeness of design products, *emotional qualities*[196] are the closest to the materiality of things. This is so, even though, emotional qualities are aesthetic by nature and therefore commonly described as 'tertiary properties': properties "...which are dependent on or emergent from configurations of primary or secondary properties of things" (Osborne, 1970: 59). That is to say, properties whose relation with the properties objectively present in objects (or primary properties) as well as those subjectively caused by them (or secondary properties) is one of dependence or supervenience (Mautner, 1997). Thus, emotional qualities can be defined as properties attributed to things/objects based on the aesthetic impact their appearance, touch and feel causes on us.

It is important to realise that, even though our emotional behaviour is defined as irrational, it does not mean that it is unconscious and disorganised. Indeed, it brings out a sort of consciousness about the world: a way to aprehend it that transforms the relation of the individual with the world, providing an alternative way to organise his/her perceptions of it (Sartre, 1971). In this direction, feeling can also be seen from a cognitive stance given that "...it participates actively in, and is organically related to cognition in the more general accepted sense" (Reid, 1982: 19).[197] To such an extent that Joseph LeDoux (1994: 39), a professor of neural science and psychology at New York University, has asserted that "...the subjective experiences we call feelings are not the primary business of the system that generates them... [since] consciousness is a prerequisite to subjective/emotional states". Therefore, what we call here emotional qualities are, within aesthetic transactions, "...always affected by and integrated into extra-aesthetic experience and information" (Wolff,

[196] The notion of *Emotional qualities* comes from Harold Osborne's (1970) division of aesthetic qualities into: sensory qualities, intersensory qualities, emotional qualities, and formal qualities.

[197] In Louis Arnaud Reid's view "it is a radical mistake to think of cognition as if it functions as a separate faculty" (Reid, 1982: 19).

1983: 81). On the other hand, one should not forget that emotion also "...functions guiding rational behaviour in terms of survival and the way of living...", i.e. with respect to decision making (Branco et.al., 2004: 374). This is possible given the fact that affective reactions are made sooner and with greater confidence than cognitive judgements, since they do not need to rely on extensive perceptual and cognitive encoding (Zajonc, 1980).

With this in mind and following Harold Osborne's (1970) understanding of this subject, we can envisage emotional qualities as being of two kinds: physiognomic or those qualities of objects that depict or describe external manifestations of emotion, and affecttive or those qualities alluding to the emotional reaction or internal manifestation of emotion in the perceiver/beholder. Thus, whereas *physiognomic qualities* are determined by the physical properties of the thing described or depicted (e.g. the smile-like treatment given to the border line of a computer monitor to make it look friendly), *affective qualities* are determined by the condition of the perceiver (e.g. to look at something as pompous given that it reminds the perceiver a pompous event). Whatever the sort of qualities we focus on, the important thing is to understand that emotions are not elicited by product characteristics in their own but by construals based on those characteristics (Desmet and Hekkert, 2002; Demirbilek and Sener, 2004).

In this latter sense, a number of studies have been developed in recent years to see how physiognomic qualities of products can be turned into affective qualities. In these studies, the use of graphic characterisations of emotions in lineal terms (facial expressions) has been found to be quite useful to help users to describe the affective nature of products (Desmet, Overbeeke and Tax, 2001). These graphic characterisations has also allowed researchers to identify the presence of six emotional categories of cross-cultural nature: surprise, fear, disgust, anger, happiness and sadness (Demirbilek and Sener, 2004). On the other hand, researchers have also began to realise that the manipulation of line in products can be a powerful tool for expressing emotions, this being even translatable into three dimensions to configurate products (McDonagh-Philp and Lebbon, 2000). In this direction, experiments carried out with 88 respondents (consumers) at Delft University of Technology (Holland) have shown that emotional features presented as part of two-dimensional design proposals (i.e. design sketches) can be indeed identified by potential consumers as such (Govers, Hekkert and Schoormans, 2004).

Another important tool for designing with emotion in mind is colour. To such an extent that despite of existing cultural semantic differences (Descamps, 1986; Ortiz, 2004), at least three cross-cultural categories have been experimentally identified for single colours (i.e. colours not combined with other colours): colour activity, colour weight, and colour heat (Ou and Luo, 2004). They are described following Charles Osgood's (1957a) notion of semantic poles. Thus, colour activity has been associated with semantic pairs of words such as active-passive, fresh-stale, clean-dirty, and modern-classic; colour weight with hard-soft, masculine-femenine, and heavy-light; and colour heat with warm-cool. But, what is more important about all these experimental findings using either lines or colours is that emotional communication between designers and consumers has been proved to be possible.

In relation to the second important notion for our understanding of the representativeness of products, that is *experiential reference*, it can be said that it is derived from the fact that our "sense-perception is always coloured by experience..." (Sommerville, 1988: 210). This implies that it is more detached from the materiality of objects than emotional qualities (since experiential references work around our impressions and ideas about things) but definitely more rooted in our minds given that people assign to experiential references the status of facts. Indeed, experiential reference alludes to the act of looking at things as standing for other things based on the experiences accumulated in our memory (Maquet, 1999). This happens in such a way as postcards bring back to our minds affective states of nostalgia, and trophies revive the happiness and effort once experienced in competitions.

In this sense, while emotional qualities correspond to that described by DiSalvo, Hanington and Forlizzi (2004)[198] as short and reflexive emotional responses, experiential reference takes place as part of sustained and reflective responses. Hereof that emotional qualities can be classified as part of Donald Norman's (2004)

[198] For DiSalvo, Hanington and Forlizzi (2004) there are two basic types of emotional responses: short and reflexive or *pure emotional responses,* and sustained and reflective or *moods*.

pre-thought or *visceral level of emotion*, whereas experiential reference corresponds to the thought or *reflective level of emotion*.[199] Bearing this in mind, it is clear that experiential reference has to do with our apprehension of design products in conceptual and discoursive terms, i.e. based on what we think they are about and what they mean to us. Therefore, it has to do with our cognition, i.e. with the way in which we interpret, understand and reason about the things we get to know (Norman, 2004) and hence, it is inevitably mediated by attention (Csikszentmihlayi and Rochberg-Halton, 1981): by what is important to each of us. Let us not forget that everyone does not feel interested for the same things neither people necessarily look at things in the same manner.

Thus, from the standpoint of experiential reference, what turns a product into an emotionally desired item may have its roots in people's childhood, provided the fact that our main beliefs, values and thoughts normally take shape at this stage of our lives (Demirbilek and Sener, 2004). On the other hand, studies such as those carried out by Mihaly Csikszentmihlayi and Eugene Rochberg-Halton (1981) in the Chicago area (USA) with 315 interviewees as well as the one developed by Özlem Savas (2004) at the Middle East Technical University (Turkey) with 54 respondents (consumers/users), show that individuals have a tendency to envisage their relationship with products based on their past or present experiences. This is the reason why some recent design studies have suggested that in order to create products that users can feel attached to, designers have to "...facilitate ways to form associations between products and people, places and events (memories)" or design products that evoke enjoyment (Schifferstein, Mugge and Hekkert, 2004: 331).

Such a suggestion, however, is not an easy task since the relationship people have with products changes with use and need, and throughout time and experience (Moles, 1975; Csikszentmihlayi and Rochberg-Halton, 1981; Packard, 1992; McDonagh-Philp and Lebbon, 2000). In this particular respect, Abraham Moles (1975) has realised the existence of seven distinctive periods in the relationship between subjects and objects (i.e. between people and products). They are: (1) that

[199] According to Donald Norman (2004), our emotional system comprises three levels: *visceral* or that about immediate responses and first impressions of things, *behavioral* or that about use and the user's performing experience with the product, and *reflective* or that where the full impact of thought and emotion are experienced since it involves memories and culture.

in which *the object is desired* or the longing for a need to be satisfied through an object, (2) that in which *the object is adquired* or catharsis of the previous longing through the selection of an object and renounce to other alternatives, (3) that in which *the object is discovered* or cognitively aprehended in terms of how it works and what it is about, (4) that in which *the object is loved* or hated based on its virtues and flaws, (5) that in which *the person gets used to the object* and where the object is only brought back to the person's attention when it is needed, (6) that in which the object is maintained/repaired or that period where the object gains back all the attention of its owner, and finally (7) that in which *the object is subtituted by other object* or simply forgotten. In each of these periods changes are experienced not much in the object itself (which naturally wears by use) but in the way people look at them in terms like those described by Jean Baudrillard (1969) in his logic of the symbolic exchange. That is to say, a part of a logic where the meaning and value of objects are primarily realised in subjective terms, leading us to cyclic semantic transformations similar to those suggested by authors like Paul Levinson (1979) and Ding-Bang Luh (1994) for different models of the same product, but this time for the same product along time.

Such a situation is perhaps one of the hardest aspects to deal with in product design, since every person is different and the natural human thing is the longing for products to stand for individualistic statements (Conran, 1994). Thus, designers are faced with the search of alternatives between two extremes: designing products 'as little as possible' – i.e. avoiding the use of superficial redundance to offer people pleasant and agreeable products based on the idea that "the fewer the opportunities used to create informative design, the more design serves to evoke emotional responses" (Rams, 1989: 112) – and designing products with some personality in mind (Jordan, 2002). Indeed, studies on narcissism have indicated that nothing appeals more to people than themselves (Packard, 1992), and psychological studies carried out at Yale University during the 1980s showed that "people express their self-identities and interact with their environments through their mental and physical objects" (Prentice, 1987: 993). This has been also confirmed in recent design studies where people tend to feel emotionally attached to products according to how appropriate they are to reflect or define who and how they are, i.e. as a medium for self-definition (Savas, 2004). Indeed, products such as shavers, depilators, irons, hair dryers and even coffee makers are designed specifically with this in mind (Jordan, 2002), that is, expressing "...something of the values of the person for whom the product is being designed" (Jordan, 2000).

Besides emotional qualities and experiential references, products also represent for people what Irvin Child (1969) called *expectational meanings*. As we have already explained in section 2.2.6 of chapter 2, these are meanings derived from the act of taking objects[200] as standing for the expectations they are capable of arousing in their beholders or users. This sort of meaning is also referred by Gombrich (1998) as 'projection'.[201] Indeed, objects can stand for expectations based on the materiality of objects or syntactic expectations (e.g. a big object is expected to be heavy, and a big box is expected to contain a big object), (2) for expectations focused on our ideas about things or causal expectations (e.g. an specialised or high technology object is expected to be difficult to use by non-specialists), or (3) for expectations based on the effects some objects can have in people or pragmatic expectations (e.g. when people have their own car they tend to feel safer in relation to traffic eventualities). Thus, differently from emotional qualities (which essentially have to do with affection) and from experiential references (which primarily deal with cognition), expectational meanings refer to *conation* (from the Latin conari = to try or strive): to the act of being interested in whatever one is pursuing (Reid, 1982).

In this sense, expectational meanings are manifestations of what Charles Sanders Peirce (1908) defined as 'Thirdness' or that way of being where something is outlined in relation to a second and a third thing: in this case in relation to the emotional qualities of products and people's experiences. Furthermore, these meanings are also equitable to what Abraham Moles (1975) describes as 'forces' that drive people to acquire things, to Csikszentmihlayi and Rochberg-Halton's (1981) idea of 'goals' in our objects/possessions, and to Wolfgang Haug's (1989) notion of aesthetic promise of use value - particularly its subjective side or that in which the aesthetics of the object is taken as a basis to evoke those things objects

[200] Irvin Child (1969) basically refers to aesthetic creations such as works of art. However, since design objects/products area also aesthetic creations the word 'object' is here used to encapsulate both art works and design objects.

[201] A clear example of Gombrich's projection takes place during the psychiatric *test of Rorschach.*

could possibly do for people (e.g. to help them to be part of certain social group). Therefore, expectational meanings are focused on our idea of what things can do for us, something beyond what things actually are and do. Let us not forget that as part of our perception of reality "...we may also include the constructive manipulation of reality by hope, dreams, imagination, inventiveness..." (Maslow, 1987: 172). Hereof, it is the side of product's representativeness least attached to the materiality of objects of the three here considered.

Since expectations about design objects are conditioned by all sort of things (fashion, magazines, movies, etc.), it is hard to gather expectational meanings under a single tag. Nevertheless the best known attempts to describe them in product design have been as encapsulating types or phases of pleasure. In this respect, John Walker (1989: 186 -187) has outline the existence of five types of pleasures that can be aroused by products: (1) *Pleasures of desire* or "day dreams and fantasies concerning the future possession of designed goods", (2) *pleasures of purchase* or those derived from activities such as shopping, spending money and ownership, (3) *pleasures of the object itself* or those rooted in the appeal to the senses that each product provides in terms of colour, form, texture, and so on, (4) *pleasures of use* or the satisfaction stemming from the fact that a product performs its function as well as promised, and (5) *pleasures in respect to others* or the sort of social impression one can caused in other people through the ownership of goods.

This idea of pleasure through products has been taken further by authors such as Patrick Jordan (2000) who, based on the classification proposed by the Canadian anthropologist Lionel Tiger, has developed a method to approach product design within a holistic understanding of consumers/users. Thus, following Tiger, he highlights the existence of four types of pleasures: (1) *physio-pleasures* or those linked to the stimulation of our sensory organs, (2) *socio-pleasures* or those whose enjoyment is derived from the capacity of products to facilitate the social interaction of their users, (3) *psycho-pleasures* or those pertaining to people's cognitive and emotional reactions, and (4) *ideo-pleasures* or those stemming from the values embodied in products in relation to issues such as environmental concerns and social responsibility. In this respect, some authors have even arrived at the conclusion that there are types of forms in design which are definitely pleasurable (Chang and Wu, 2007). In their view pleasurable forms can be of five types: *aesthetic* (with an intrinsic beauty derived from their form), *bios* (those resembling aspects of existing things), *cultural* (representative of values and customs), *novelty* (unique in appearance, structurally novel or conceptually creative), or *ideo forms* (those reflecting personal values and preferences).

Nevertheless, pleasure is only one way to look at the expectational meanings in products. Indeed, studies carried during the 1950s as part of the depth approach for merchandising (or psychoanalysis of the masses in order to influence their behaviour as consumers) acknowledges the presence of eight hidden human needs whose nature can be also catalogued as expectational in relation to products. They are (Packard, 1992): (1) *Emotional security* or the possession of products seen as a way to guarantee that needs seen as 'basic' are satisfied (including among these safety), (2) *reassurance of worth* or the way of looking at the possession of products as a depiction of how valuable a person can be for others, (3) *ego-gratification* or the acquisition of products as a way to manifests that one does the right thing according to the circumstances, (4) *sense of power* or the feeling of having products that extent the power of people in physical, psychological and sociological terms, (5) *sense of roots* or the visualization of objects as means to be part of something whether a human group, moment, or place, (6) *immortality* or the need of feeling that one's presence will remain through some of the things or objects one has left to others after dying, (7) *love objects* or the visualization of certain objects as reminders of one's or other's love, and (8) *creative outlets* or the need of having products that leave room for creative ways of using them.

In this respect, recent studies such as that of DiSalvo, Hanington and Forlizzi (2004) at the Carnegie Mellon University (USA), have come to the realisation that design objects can function as: stimuli for new experiences, extenders for current experiences, and proxies for past experiences. Indeed, people's expectations about products depend to some degree upon how well they accommodate their visual and conceptual prejudices (Vickers, 1991). This is the reason why authors such as Gillo Dorfles (1972), Christopher Williams (1984) and Victor Papanek (1994) have been drawing designers' attention toward the need of designing products with some features or components that can be modified by their users as a way to help them fulfil their expectations.

Having outlined a way to approach the emotional side of products and its corresponding theoretical antecedents, it is hard to see how at the end of the 1990s some authors dare to assert that "emotional processes involved in generating and using industrial design objects have only begun to be explicated" (Cupchik in Chapman, 2005: 97). What is actually true about it is that emotion has established itself as "...a fundamental branch of design discourse within the latter part of the 20th century" (Chapman, 2005: 96). The reason for this might be due to the maturity achieved by this sort of studies but also to the mixture of feelings normally brought forward every time we have to begin a new century in the relatively short history of industrial design, where the nostalgia of the past blends with the uncertainty of the future to arouse emotional responses that help us to deal with continuity and change.

4.1.6. EXPRESSIVENESS

The verb 'express' comes from the Latin *expressare* which literally means "to press out" and metaphorically alludes to "formed by pressure" (Ayto, 1991). Hereof that what we know as an *expression* is "...an embodiment of some sort in a body with the purpose of 'squeezing out' or reveal something of that what was embodied: an outer state revealing an inner one" (Reid, 1954). In this sense, *expressiveness* has to do with the capacity of products to reveal things. But given the fact that in our theoretical account it has been considered as the counterpart of representativeness, it will be used here to refer to the product's capacity to reveal through its overt the socio-cultural values from which it has emerged. Let us not forget that "...one can correlate particular material qualities with distinct cultural values" (Macdonald, 2002). Thus, among other things, products also play an essential role in the construction of social/cultural representations (Dormer, 1990; Vickers, 1991; Solomon, 1992; Taylor and Taylor, 2004).

Indeed, this is the reason behind the aesthetic differences between the designs of different countries. That is to say, for instance, between the organic forms of

American design used as a metaphor of freedom and material excess, and the German abstract rigidity used to express order and discipline, quality and performing reliability; it is also the difference between the protective, all-embracing forms of Scandinavian design that emphasize its concern for social welfare, and the argumentative, controversial and ideologically changing Italian design (Dormer, 1990). Hereby products become mirrors of the social mentality of a particular culture. In this respect, the work of individual designers can be regarded as social / cultural given that (Walker, 1989): (1) They may have benefited from the education in design provided by society as a whole, (2) few designers escape the influence of their peer group or that of current trends, (3) new design is always dependant to some degree from accumulated knowledge and previous achievements, (4) the codes and styles used in design are developed according to the needs of social groups and classes, and (5) designers depend upon the existence of clients and consumers (users). Nevertheless, in Edgar Morin's (1998) view, what actually turns any man's work into social/cultural is the *cultural imprinting* or stamp made by culture in people's ways of knowing and acting, which is manifested in what designers create since they are part of those ways of knowing and acting.[202]

From the standpoint of design, cultural imprinting may assume different forms. In the particular case of the subject of this research (i.e. design concepts), it may either work at the level of people's *sensitivities* – i.e. their capacities to "...react to certain properties or magnitudes" [sensorial intensities] - or at the level of people's *sensibilities* – i.e. their "...dispositions or propensities to identify certain features, properties or relations... as either being value-making or value-lowering" (Bender, 2001: 74 and 77). At the level of sensitivities, authors like M. Wober (1966) and McLuhan and Powers (1989) have asserted that culture tend to support the development of particular modes of sensory elaboration over others. These modes are understood by Wober (1966) as patterns by which people learn to perceive the world and cultivate their abilities, and he calls those patterns *Sensotypes*. Indeed, investigations have shown that, for example, Americans and Arabians live in different sensorial worlds since they favour the use of different senses in their everyday actions (Hall, 1973). Thus, we should not be surprised by the fact that

[202] One way to understand *culture* as the result of people's capacity - as *Homo Faber* - to invent unexpected uses and create artificial substitutes of things (Gombrich, 1998)

cultures value products differently based on the relevance given to sensorial features such as tactile properties, dimensions, sounds, smells and even the product's weight (Macdonald, 2002). This is the reason why, for instance, in cultures like the Japanese the most common thing is to have small products (Ekuan, 1984), similarly as in other cultures the heaviest models of a type of product are considered to be more resistant to wear or to have better quality.

In Marshall McLuhan and Bruce Powers' view these modes of sensory elaboration respond to *sensorial spaces* culturally determined, so that cultures can be differentiated based on them. In this respect, McLuhan and Powers (1989) have substantiated the idea that the sensorial space of Western culture is *visual* whereas the sensorial space of Eastern culture is *auditory*. Such a metaphor finds its translation based on matters such as the way in which these cultures conceive time, support certain way of thinking about things, and mould their attitude toward the establishment of hierarchies. From this perspective, Western culture is defined as having: a linear or sequential notion of time - clearly exemplified by the presence of a past, a present and a future tense -, a quantitative way of reasoning focused on the development of the left hemisphere of the brain, and an understanding of the role of hierarchies as central since everything is seen in terms of causes and effects (i.e. in terms of what goes first and after). Differently from this, the Eastern culture is described by McLuhan and Powers as having: a circular or gyroscopic notion of time – in which people tend to understand time as if everything would be happening in present tense (i.e. as if things were rotating over and over around the same facts), a qualitative way of reasoning focused on the development of the right hemisphere of the brain, and a general understanding of hierarchies as irrelevant since they are only accepted in a transitory manner and easterners visualize the world as having more than one possible cardinal centre. In this sense, it is not by chance that in Japanese design the creation of individual objects is "...less important than the creation of relations whereby a set of objects function as a whole" in the building of a new civilization, whereas in American design "a good product is the economically viable... that which offers competitive services and prices" no matter if it does it individually or as part of a set of products (Solomon, 1992: 147 and 148). The equation of cultures with the features above described as sensorial spaces have also inspired studies of cross-cultural marketing nowadays.

As a matter of fact, some authors have established distinctions between what they call *monochronic* and *polychronic cultures* (Grande, 2004). That is to say, cultures where people either carry out one or several things at the same time, where information is either highly pondered or only considered to a certain extent, where arguments are either based on numbers or on reasoning, and so on.

At the level of sensibilities, cultural imprinting may work with our *ideas* and *beliefs* about things. In this respect, our ideas can be defined as those things we consciously built in our mind (Ortega y Gasset, 1986): mental contents or mental representations (Mautner, 1997). Our beliefs, on the other hand, can be defined as those certainties we have about some things without knowing neither where they are from nor how they come to be part of our life (Ortega y Gasset, 1986): they are those functional interpretations that - without being thought as such[203] – help us to assume things as real (Marías, 1993). Indeed, our trust in our sensory experience is the most primitive belief of all (Bem, 1970). Thus, while ideas have an imaginary and therefore theoretical nature; beliefs are vital - i.e. inextricably linked to our experiences in life (Marías, 1993). Hereof, we may have many ideas but we only live by some beliefs (Ortega y Gasset, 1986; Marías, 1993), since beliefs are ideas that people have stopped to look at as mere ideas.[204] This is the reason why authors such as Richard Buchanan (1989) and Ann Tyler (1992) have suggested that the role of designers is about shaping people's beliefs. That is to say, shaping those ideas people live by or use to interact with reality on a daily basis. This happens to such an extent that recent research is beginning to include beliefs – together with norms and conventions – as part of the standards by which design is developed (Desmet, Overbeeke and Tax, 2001; Desmet and Hekkert, 2002).

In this sense, such an approach to beliefs is quite close to the notion of *image* developed by Kenneth Boulding, given that what Boulding calls 'images' shares with 'beliefs' the fact of being both originated in experience and holding the rank of truth in terms of how they affect human behaviour (cf. Boulding, 1964). On the

[203] According to Julián Marías (1993), when beliefs are enunciated as ideas they stop from being beliefs, since from that moment on they acquire a theoretical status which is contrary to the vital nature of beliefs. In other words, people start to question whether they should believe or not in them.

[204] In this sense, our ideas have the role of filling in the empty spaces left by our beliefs (Ortega y Gasset, 1986).

other hand, the social foundations of Boulding's images are the same mentioned by authors such as Daryl Bem (1970) for beliefs. That is to say, persuasion via mass media, interpersonal influence (i.e. people influencing other people), social norms (i.e. models that show what behaviours are seen as appropriate), and the beliefs of reference groups (i.e. those from particular groups of people within a society). In this respect, within an anthropo-social division of the world (Morin, 1998), beliefs may primarily exist in the sphere defined by the interaction between individuals or socio-sphere, particularly in the form of knowledge, whereas ideas are to be mostly located in the sphere of the individual or psycho-sphere.[205] Despite of this, it is clear that the by-products of both spheres are equally necessary, since culture affects individuals as individuals affect culture (Morin, 1998). Thus, our artefacts are inextricably part of certain time, place and society, even though they are generally discovered, invented or adapted by individuals for society.

Thus, beliefs are not exclusively about religion as some people may think. They are epistemological and psychological human necessities. Indeed, beliefs can also be understood as particular ways of thinking and acting based on the perception of certain relationship between things of any kind (Bem, 1970). In this sense, Gustave Le Bon (1983), one of the founding fathers of social psychology in the 19th century, was right when he asserted that the convictions of the masses (of people) sometimes assume a sense similar to that of religious beliefs. The actuality of this notion is indeed somehow present in the five dimensions of culture suggested by the Dutch anthropologist Gert Hosftede during the 1980s. These dimensions are (Grande, 2004): *Distance to power* (the extent to which the members of a culture accept that power is unequally distributed among them based on age, roles, look, economical status, knowledge, etc.), *aversion to uncertainty* (the extent to which the members of a culture feel either threat or not by unknown situations in their families, work, economy, politics, etc.), *individualism and collectivism* (the way in which certain activities and roles are taken as being individual or collective within the family, education, work, etc.), *masculinity and femininity* (the assignation of values characteristic of men or women to different activities, roles, objects and situations),

205 In this respect, beliefs do not come exclusively from social interaction but also from individual experience.

and *time orientation* (the way in which the achievement of goals is defined in terms of time).

These dimensions are not so far from the reality of product design. Indeed, for instance, products for women are made as feminine as possible (to the point of even compromising their performance in some cases), whereas products such as tools are designed for men following a "...rugged, militaristic and active look" (Dormer, 1990: 92). Similarly, it is not a secret that some products are purposely created to: reflect status (social, economic, technological, etc.), be individually used or shared, help people achieve goals step by step or at once, and even purposely designed to reduce uncertainty by means of clearer and more visible interfaces than others. Our artefacts, however, are just overt manifestations of culture, since culture is an abstraction of human behaviour (Silva, 1998): a psychogenetic ordering of collective character (Chardin, 1967; Morin, 1998),[206] structured as "...a system of inherited conceptions expressed in symbolic forms" (Geertz, 2004).

With all the previous ideas in mind, two ways for encapsulating culture as part of design can be here suggested. Both of them are based on what cognitive psychologists have described as the bottom-up and top-down ways in which we process information in our minds. That is to say, cognitive processes originated either in physical stimuli which have worked all their way up to more abstract cognitive operations or bottom-up processes (e.g. our generalizations), or "...in general principles, thoughts or ideas about the nature of the material [physical stimuli] being processed" or top-down processes (Reber, 1995: 804). In this respect, a culturally conscious design can be tackled using any or both of the following procedures (Lacruz-Rengel, 2004):

1. <u>The analysis of stylemes</u> or study of the formal aspects (shapes, colours, materials, finishes) and formal arrangements that prevail in the configuration of objects in certain place and during certain period of time. Therefore, this type of analysis is not merely focused on the material reality of artefacts since it works around the notion of style. That is to say, around those characteristic ways of understanding, imagining and thinking culture (Tatarkiewicz, 1976), which are

[206] For Edgar Morin (1991) culture provides the conditions for the formation of individual thought.

reflected in the materiality of artefacts. Indeed, a style cannot be defined previous to its manifestation. Thus, the analysis of stylemes is based on bottom-up cognitive processes where the materiality of objects is visualized as a means to access to the ideas and beliefs behind a style. It is in this latter respect that – following the classification already suggested by Pineda, Sánchez and Amarilles (1998) in chapter 2 – three basic types of stylemes can be studied. They are: (1) **Contextual stylemes** or those of a nature different to that of the object at stake (i.e. aspects surrounding the object), which contribute to position them as part of a culture (e.g. the colourful plants used to decorate the surface of Hawaiian shirts), (2) **Paradigmatic stylemes** o those present in the different models of a type of object within a culture, e.g. the differences in terms of composition, materials and forms between a Chesterfield and a utility style sofa), and (3) **Positioned stylemes** or those initially proposed by a designer but now seen as icons of a culture (e.g. the Vespa scooter in Italy and the Citröen DS 19 in France).

2. <u>The realisation of mentalemes</u>. Differently from the term 'styleme' - which already exists in semiotic studies - the word 'mentaleme' is here suggested as a term to describe the counterpart of 'styleme'. *Mentaleme* is a term inspired in Gaston Bouthoul's notion of 'social mentality' or set of representations, ideas and beliefs used by a social group or society to define its relations with human and physical environs (Bouthoul, 1971).[207] Hereof, by *mentalemes* we allude to mental constructions socially built and learned, which reflect particular aspects of the mentality of a society and intervene in the top-down processes of interpretation (i.e. those giving primacy to the subjective over the objective in people's understanding of things) with particular reference to artefacts as well as the activities those artefacts are supposed to support. As such mentalemes are units of an analytic strategy for designing products. On the other hand, it is worth noticing that the notion of mentalemes is by no means a revival of the old Cartesian division between soul and matter, since as part of them ideas and beliefs are not studied in their own or as if they were totally detached from artefacts but in relation to them. Indeed, the idea behind mentalemes has been already proposed and appraised in

[207] As a matter of fact, 'mentaleme' is a term designated following the semiotic tradition of using the suffix *"– eme"* to name a type of unit for the study of meaning (similarly to other semiotic units such as: *graphemes* = gaphic units, *gestemes* = gesture units, etc.).

anthropological studies even though for applications quite different to those of designing.[208]

Following Bouthoul's ideas about the social mentality, mentalemes can be grouped into three basic types (Lacruz-Rengel, 2004): **Cosmologic mentalemes** or those reflecting the causal chain of interpretations by which a social group understands the 'universe'[209] (e.g. the ideas and beliefs by which Italians consider more appropriate to serve supper at noon than in the late afternoon), **technical mentalemes** or those reflecting the way in which a culture defines and organises its procedures to carry out acts or intervene the materiality of things (e.g. the procedural model by which Western people introduce the spoon in their mouth to eat soup instead of sipping from it as happens in Eastern cultures), and **moral mentalemes** or those reflecting the set of values by which a social group defines its activities and relations (including those involving objects), in terms of what is considered to be right or wrong (e.g. the type and quantity of decoration seen as acceptable in objects by each culture).[210]

Mentalemes are thus quite useful to help designers understand cultures in their own terms. Especially since products that advance cultural standards or challenge cultural imagination tend to have little authority with the mass of users or consumers (Buchanan, 1989). Indeed, the useful life of products is determined by their cultural significance (Pibernat, 1996). That is to say, by the way in which culture make us to understand and value them. In this sense, Rudolf Arnheim (1978) reminds us that: (1) The most powerful expressions / representations are those derived from the most elemental sensations and perceptions, and that (2) an expression/representation which is not standardised (i.e. subject to social conventionalisation) has the risk of being used in any manner. These two points has found actual confirmation in what is known as *Transitive Design*: A design trend in which products are formulated to "...connect the past and the future without any

[208] According to Mosterín (1993), this sort of cultural units or features has been already named as: *Cultural Instructions* by F. Cloak in 1975, *Memes* by Richard Dawkins in 1976, and *Culturgens* by C. Lumsden and E.Wilson in 1981.

[209] The term 'universe' is used here to refer to the 'world and life as a whole'.

[210] Alain Findeli (1994) remind us that design aesthetics is connected with ethics since both deal with values and with choosing the most appropriate means to create artefacts. Similarly Ezio Manzini (1994b: 40) asserts that no true aesthetic renewal "...can take place without being based on a value system".

nostalgic intent or futuristic ambition, but with an attitude of continuity in change" (Castelli, 1999: 18). Thus, images about events, objects and sensations from the past are harmonically reconcile with the latest functional and technological developments in an attempt to make the most advanced ideas more friendly and acceptable. As such it outlines what Herbert Marcuse (1979) once defined as 'a true trend of aesthetic formation'. That is, a stylization that allows at the same time the transvaluation of the norms of an established reality to create cultural renewal.

4.2. A semiotic translation and modelling of concept ideation

Within semiotics there are many different ways of modelling situations. Since the aim of this research is to describe the way in which meaning is built as part of design concepts, the formulation of our model will follow two routes. The first will focus on the synthesis of an appropriate semiotic terminology to describe the nature of each dimension whose theoretical implications were outlined in the previous sections. To this aim, notions and terms from the semiotic models revised in chapter 2 will be introduced as 'descriptors' of our dimensions. The second route to be followed will establish the meaningful relations that take place within and among the different dimensions of our model. In order to achieve this goal the modelling technique known as the **semiotic square** will be applied to articulate four basic design strategies of meaning construction for each dimension of our model. Thus, the idea is to illustrate the general potential of our model to describe situations of meaning construction by presenting the most obvious design strategies, bearing in mind that these do not represent the whole of possibilities.

4.2.1. The communicative and semiotic nature of the proposed dimensions for concept ideation

Communication can be understood as the "process of emitting, receiving and utilizing of information" (Maldonado, 1961a: 48), and design as a means to produce and pass information, among other things. This information is knowledge which has been given certain form or put 'in-form' by someone (Flusser, 2002). In this sense, communication can be visualised as having to do with the designer's ability to deal with two basic problems: people's capacity to discover new ways to re-encode the information they receive (Miller, 1973), and the degenerative dynamics imposed by the 'noise' (interferences added to the message between encoder and decoder) present in all process of communication (Ockerse, 1984).

In relation to the first problem, besides defining in advance the context and circumstances in which the communication process will take place, designers need to find an appropriate balance between the things they want to communicate and the ways they will use to do it. In this sense, any communication system is at the crossroad of two sub-systems: one, where the mechanisms of communication are given but the content is absent, and another, where the content of communication is given but the mechanisms of communication are absent (Lotman, 1974). Hereof the importance of counting on a systematic model to help designers realise the sort of things they communicate, as well as the sort of combinations they can make without affecting the total coherence of the message.

In relation to the second problem, designers should learn to deal with two basic types of noise (Quiroga, 2001): a **semantic noise** resulting from the incompatibility between the material features of the message and its intention, and a **syntactic noise** derived from the absence of an adequate order in the composition of those features. Thus in order to avoid semantic noise, designers should be quite careful in their choice of forms, materials, finishes, etc. since depending on the context and circumstances of use, each of these features may elicit different associations. As a matter of fact, it will be contradictory to use a metallic handle for a saucepan, when such a handle is expected to be capable of isolating instead of transferring the heat to the user's hand. On the other hand, syntactic noise can be avoided with an appropriate composition of the elements implicit in the message (forms, colours, materials, finishes). Thus, for instance, the use of wrong proportions may induce users to believe that the top of a product is its base when it is actually the other way around.

Bearing in mind the above considerations, our modelling of meaning construction for concept ideation will be developed based on Roman Jakobson's model (see section 2.2.6. of Chapter 2) given that: it is among the most comprehensive models of communication in terms of content, its is widely accepted in design studies (cf. Llovet, 1979; Ashwin, 1984; Quarante, 1992; Negrin and Fornari, 1992), and the fact that it is quite suitable for the study of reference in product design. Therefore, Jakobson's communicative functions will be related to each of our six dimensions for concept ideation in the following way:

1. UTILITY will be associated to Jakobson's *referential function* given that it is at the basis of the perception and understanding of any design object (i.e. what is the object about?).

2. COMPETITIVENESS will be linked to the *metalingual function* provided that the judgement on how convenient or good a design product is a "metalingual" activity by nature (it assesses something which is already formed).

3. ORIGINALITY will be related to the *poetic function* since its contribution to the meaning of the object within product design has mostly to do with the way in which its form and concept are presented.

4. PERTINENCE will be seen as part of Jakobson's *phatic function* provided that this dimension focuses on the establishment of communicative connections between the design product and its potential user as well as the design product and its context of use.

5. REPRESENTATIVENESS will be associated to the *conative function* given that it encapsulates the effect the design product can cause in its potential user.

6. EXPRESSIVENESS will be linked to the *emotive function* given that it reflects the knowledge and attitude of the designer toward the culture he/she is designing for.

This first theoretical approach leads us to realise that any design product implicitly contains all the six basic types of references above suggested: denotative,[211]

[211] When Jakobson originally presented his *referential function*, he used the terms 'cognitive' and 'denotative' as equivalent adjectives to designate it (cf. Jakonson,1960: 353).

metalingual, poetic, phatic, conative, and emotive. These types of references, however, may assume different degrees of importance in the configuration of each design product given that there is always one of them prevailing over the others. Besides this there are some aspects about each type of reference that need to be characterised for the sake of clarity. To this aim, those aspects will be expressed using some of the semiotic nomenclatures already revised in Chapter 2, especially those derived from: Charles Morris' (1985) dimensions of semiotics, Max Bense's (1972) references about the way in which the material properties of a product stand for something, and Danielle Quarante's (1992) translation of the work carried out by designers based on Morris' dimensions. Thus, the dimensions for concept ideation proposed as part of this research are semiotically characterised in the following terms (see figure 55):

1. The UTILITY dimension encapsulates the *denotative reference* of the object (i.e. what the object is about) based on a *pragmatic* view of it (i.e. meaning derived from the product's use or realisation of its practicality), rooted in the presence of *indexical marks* (i.e. indicative marks and affordances). Thus, the Utility dimension is here associated to a *functionalist* design emphasis.

2. The ORIGINALITY dimension defines the *poetic reference* of the object (i.e. the different or new in the conception of certain type of object) based on a *syntactic* view (i.e. meaning derived from the arrangement and configuration of the different parts of the object), focused on changing or keeping *iconic marks* (i.e. those things characteristics of each object). Therefore, the design emphasis of Originality is *formalist.*

3. The PERTINENCE dimension outlines the object's *phatic reference* (i.e. that linking the object to particular contexts and users), using a *syntactic* view based on the rescue and use of *iconic marks.* Hereof the design emphasis of Pertinence is also *formalist.*

4. The REPRESENTATIVENESS dimension encapsulates the *conative reference* of the object (i.e. the sort of effect the object can exert on the user), following a *semantic* view (i.e. meaning derived from our ways of conceiving things based on

the linkage of material features and objects with certain ideas) stemming from *symbolic marks* (i.e. those resulting from some sort of agreement). Thus, the design emphasis of Representativeness is *stylistic*.

5. The EXPRESSIVENESS dimension defines the expressive reference of the object (i.e. the attitude of the designer toward the culture he / she is dealing with), based on *semantic* view derived from *symbolic marks*. Therefore, the design emphasis of Expressiveness is also *stylistic*.

6. Finally, the COMPETITIVENESS dimension outlines the *metalingual reference* of the object (i.e. what is said and thought about a design). Herefrom it encapsulates judgements derived from all the three Morrisian dimensions (i.e. pragmatic, semantic, and syntactic). In this sense, the marks of Competitiveness can be indexical, iconic or symbolic depending on the Morrisian dimension at stake. Similarly, the design emphasis of Competitiveness can be functionalist, stylistic or formalist based on the Morrisian dimension at work.

CONCEPTUAL DIMENSION	Type of reference (Roman Jakobson)	Prevailing Semiotic Dimension (Charles Morris)	Reference's content (Max Bense)	Design emphasis (D. Quarante)
UTILITY	Denotative (Basic content of the message)	Pragmatic	Indexical	Functionalist
COMPETITIVENESS	Metalingual (Critique discourse)	Pragmatic Semantic Syntactic	Indexical Iconic Symbolic	Functionalist Stylistic Formalist
ORIGINALITY	Poetic (Form of the message)	Syntactic	Iconic	Formalist
PERTINENCE	Phatic (Contact)	Syntactic	Iconic	Formalist
REPRESENTATIVENESS	Conative (Effect on the receiver)	Semantic	Symbolic	Stylistic
EXPRESSIVENESS	Emotive (Sender's attitude towards the message)	Semantic	Symbolic	Stylistic

Fig. 55 – Semiotic correspondence among the six conceptual dimensions of our model.

4.2.2. Relations within and among the proposed dimensions for concept ideation

In order to define the relations between the six dimensions of our model, they were placed along two types of theoretical axes: vertical or diachronic and horizontal or synchronic. Vertical axes register the changes experienced by a design product throughout time. That is to say, the differences among the commercial models developed for the same object throughout time. Horizontal axes, on the other hand, are used to register the particular configuration of each commercial model. Therefore these axes are expressed as part of planes of competitiveness.

Since design products are utilitarian by nature, the Utility dimension has been taken as the starting point or lower theoretical threshold[212] for the ideation of design concepts, as well as the common root of all the other theoretical dimensions of our model. Given that competitiveness is what triggers the search of new commercial models capable of superseding the achievements of previous ones, the Competitiveness dimension has been envisaged as the upper threshold of concept ideation. Hereby it is placed vertically opposed to the Utility dimension. Since the content of the other four dimensions of our model (i.e. Originality, Pertinence, Representativeness and Expressiveness) is in one or another way moulded around the utilitarian nature of design products, they are represented in our model as four vertical axes departing from Utility and arriving at planes of Competitiveness. They follow a growing pattern graphically expressed through their slant. Thus, our theoretical model for concept ideation ends up having the three-dimensional form of an inverted pyramid whose square base represents the upper threshold (the Competitiveness dimension), its apex the lower threshold (the Utility dimension), and each of its vertical edges the Originality, Pertinence, Representativeness and Expressiveness dimensions respectively (see figures 56 and 57).

[212] In general terms, a *threshold* is defined as a point that separates two different domains. In our case, the lower treshold may allude, for instance, to the distinction between art and design or that between handcraft and design. The *upper threshold* in our model, on the hand, refers to a point of saturation. That is, a point at which certain new product modifications are hard to be accepted by the consumer/user.

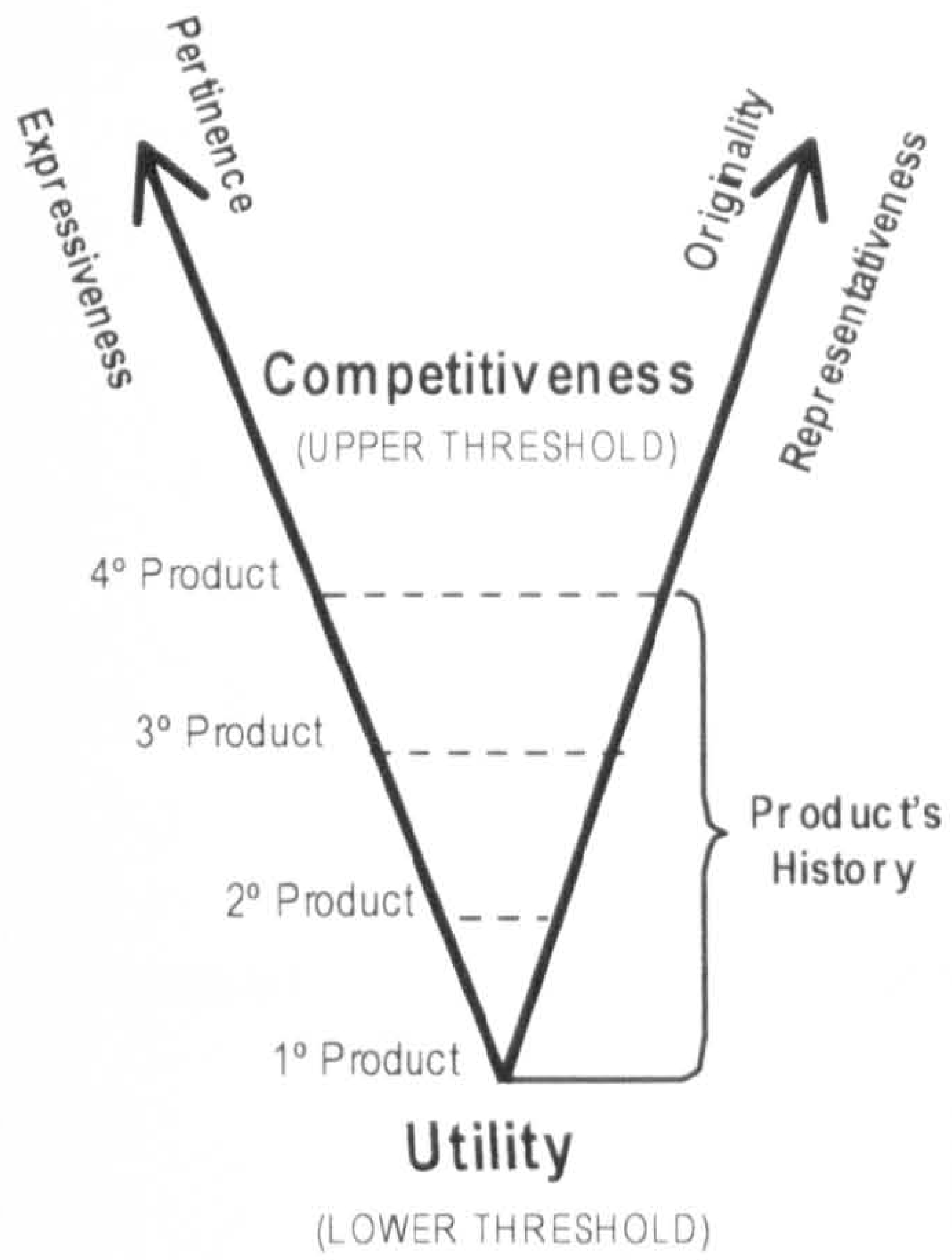


Fig. 56 – Lateral view of the proposed model.

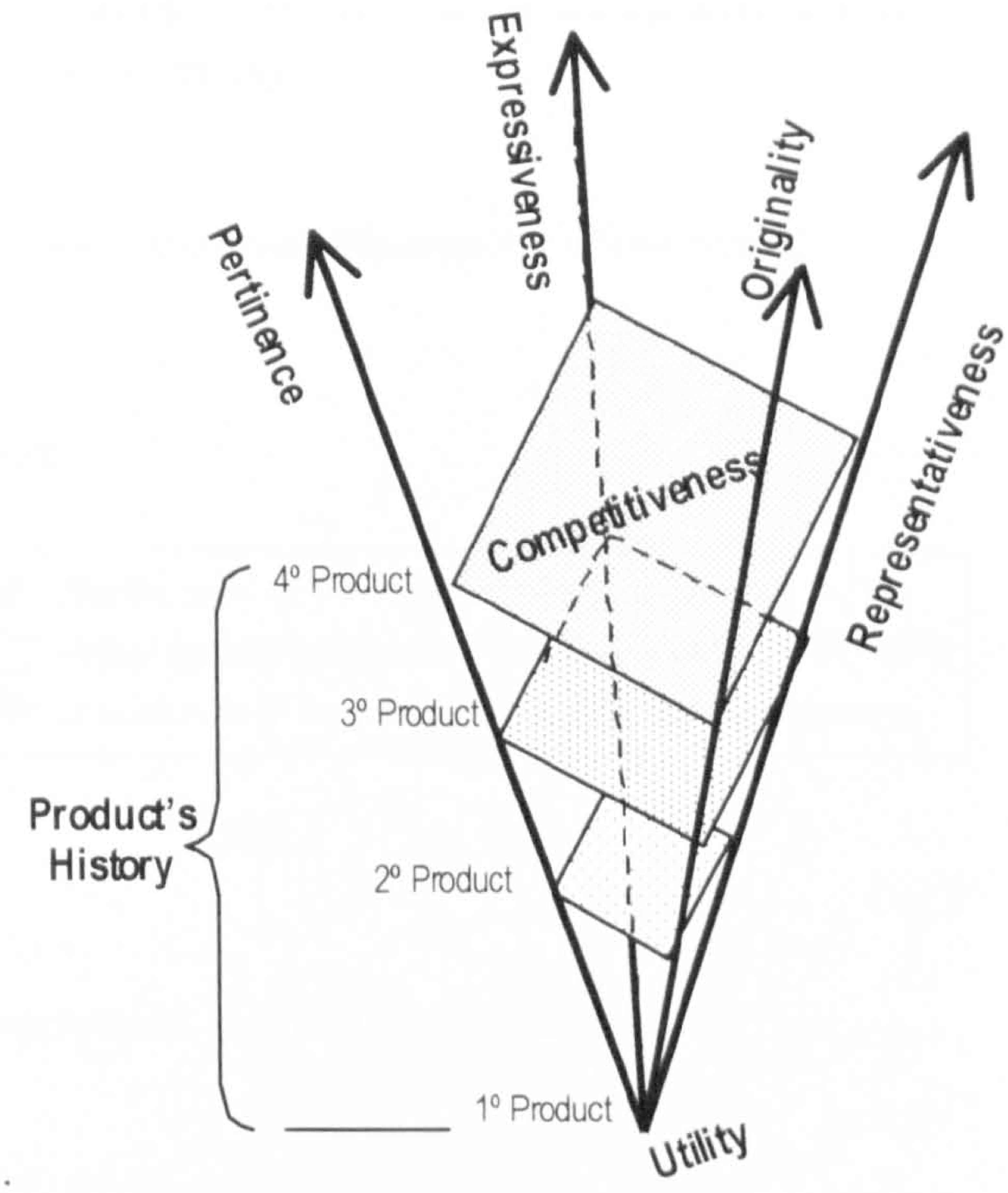


Fig. 57 – Three-dimensional view of the proposed model.

Beyond this, it is worth noticing that the location assigned in this model to the four vertical axes corresponding to Originality, Pertinence, Representativeness and Expressiveness is not random at all. Indeed, the semiotic characterisation carried out in the previous section clearly shows that Originality and Pertinence share both the same design emphasis and type of content. Therefore, they can be seen as opposite poles/terms of the same matter. The same happens with the dimensions Representativeness and Expressiveness. Indeed, the logic within each of these two pairs of terms is inversely proportional. Thus, the more original a product is, the less pertinent it is. The more personal the understanding of a product is (Representativeness), the less it reflects agreed cultural meanings (Expressiveness). Following a logic based on the opposition between the individual and collective nature of these four theoretical dimensions, they were placed in the model using the *semiotic square* technique (see figures 58 and 59).

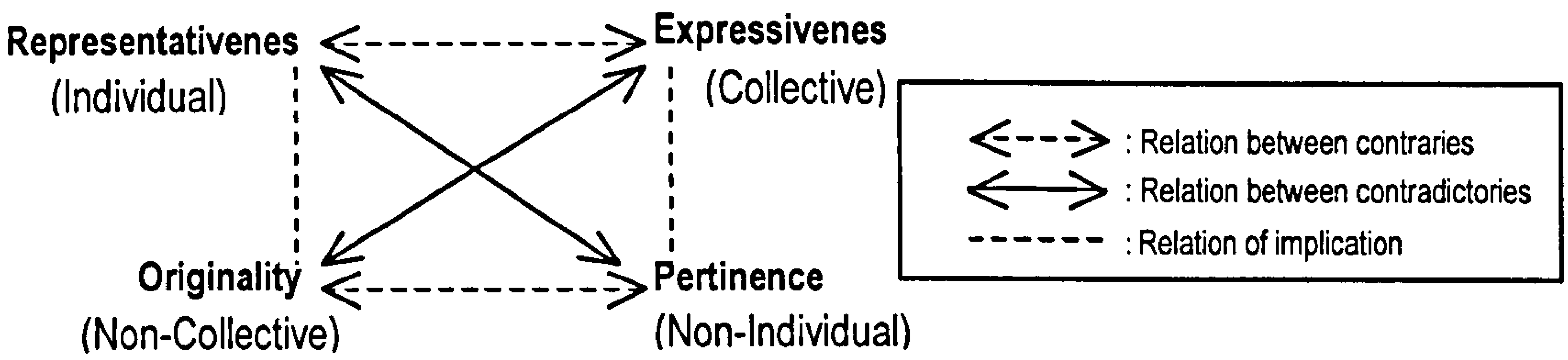


Fig. 58 – Semiotic square for the location of four dimensions of our model.

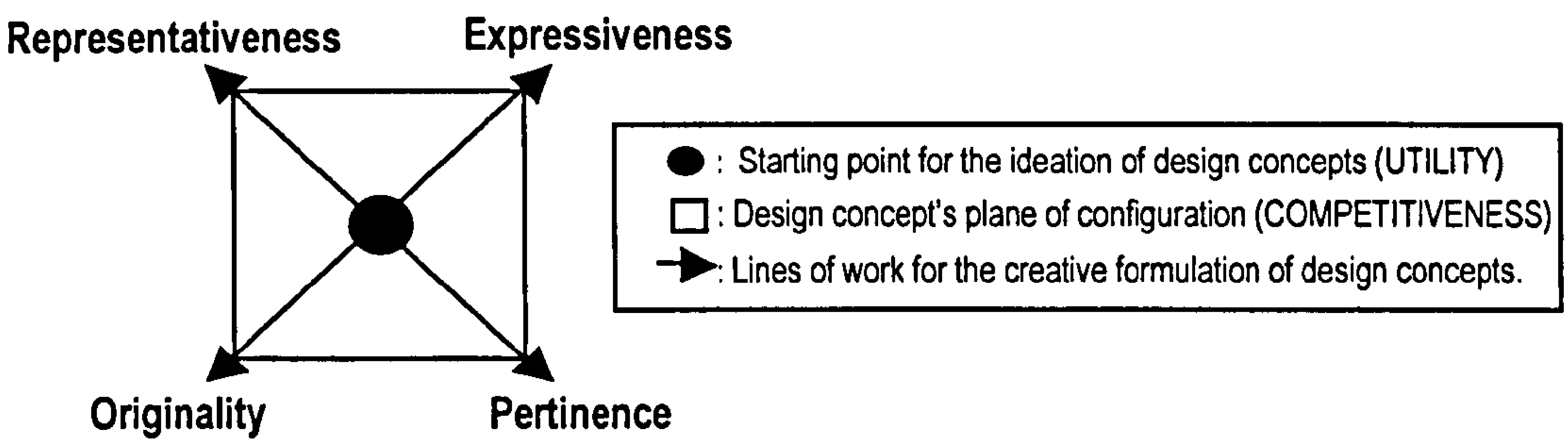


Fig. 59 – Upper view of the proposed model for concept ideation.

The *semiotic square* is a technique to represent the logical articulation of an elementary structure of meaning (Greimas and Courtés, 1982). As such, it is an adaptation made by Algirdas Greimas of the *square of oppositions* used in traditional sylogistic logic to show the logical relations between concepts or between basic propositional forms (cf. Mautner, 1997) – see figure 60. Thus, like squares of oppositions, semiotic squares also comprise the following kinds of logical relations (Greimas, 1968):

- *Relations of contrariety* or those where two statements/terms are compared to realise that both of them cannot be true at once.

- *Relations of contradiction* or those where two statements/terms are compared to realise that one of them is true and the other is false.

- And *relations of implication* or that where statements/terms are presented as if they were naturally derived from other statements/terms by complementarity.

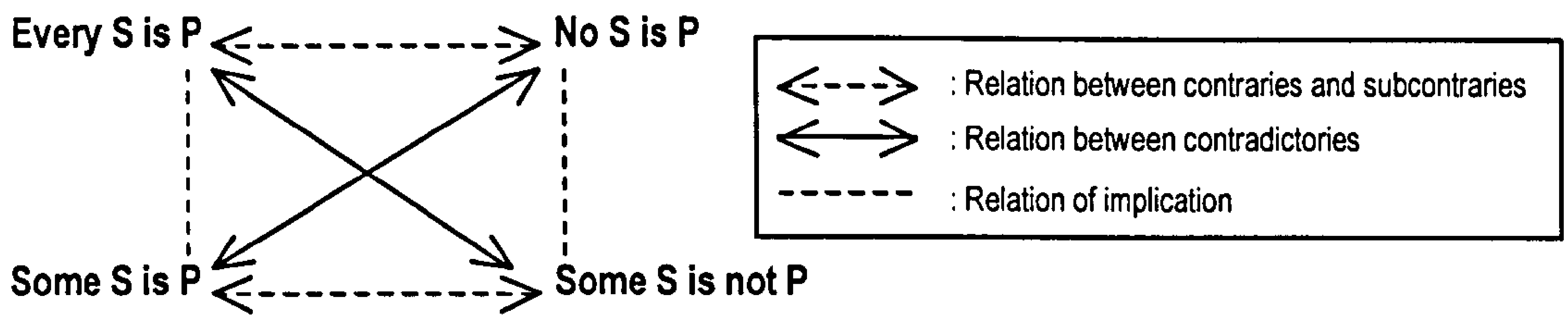


Fig. 60 – Logical relations in a square of oppositions.

But differently from the square of oppositions, in the semiotic square *contrariety relations* are based on the acknowledgement of a common meaningful substance called **semantic axis** (Greimas, 1968), and the terms (S_1, S_2, $\hat{S}_1$ and $\hat{S}_2$) are **semes** (S = *seme* in singular) or instances of that semantic axis taken as the minimal units of the relation of which they are part (Greimas and Courtés, 1982). Thus, the basic outline of a semiotic square is as follows:

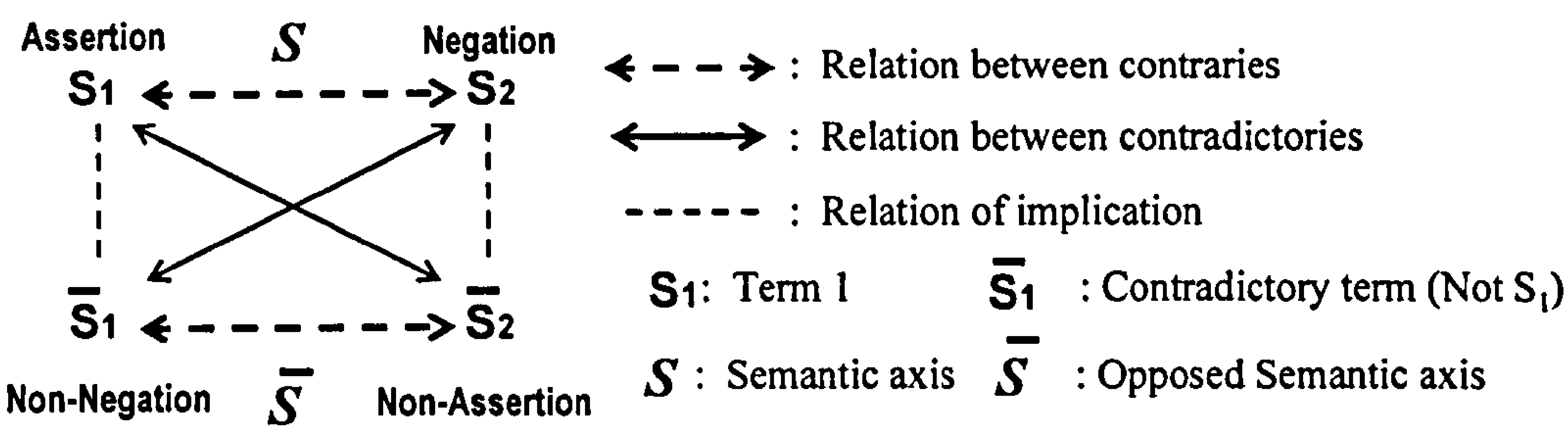


Fig. 61 – Basic elements of a semiotic square.

The relations in the semiotic square, however, change according to whether the comparison involved has to do, for instance, with what is:

- Possible, necessary, impossible or contigent, in which case the relations in the square are *alethic* in nature.

- Obligatory, permissible and optional, in which case the relations in the square has a *deontic* character.

- Known and believed, in which case the relations in the square are *epistemic* in nature.

These variations in the way of conceiving the relations taking part between the terms are known as **modal categories** and their particular instances are referred as **modal structures** (Greimas and Courtés, 1982). Of all of the modal categories, the deontic one is particularly useful for the study of design since its logic shows "...certain analogies with the logic of necessity and possibility" (Mautner, 1995: 130). The same can be said of its 'Should-perform' modal structure (see figure 62).

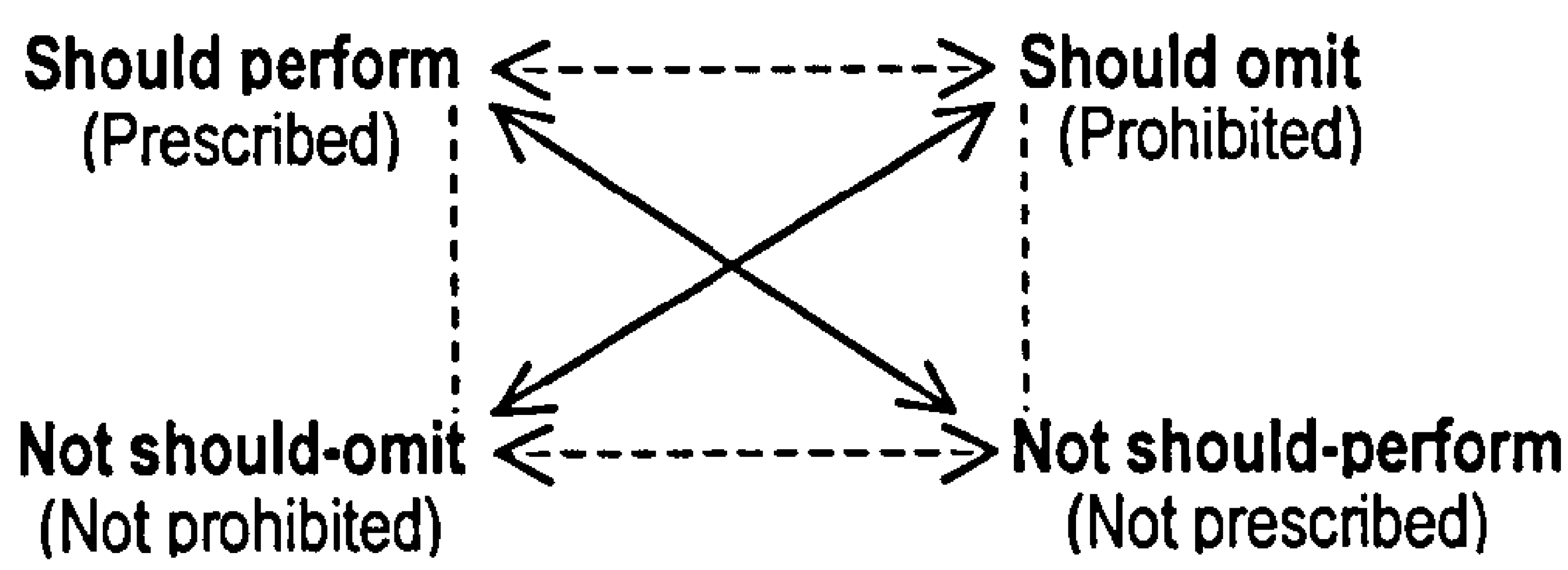


Fig. 62 –'Should-perform' deontic modal structure.

With this in mind, the final task to complete the semiotic modelling proposed as part of this research is to characterise the logic prevailing in each of the theoretical dimensions of our model. To this aim, the technique of the semiotic square was taken to outline logical relations of first and second generation (relations built on top of the relations of contrariety, contradiction and implication already explained).[213] The idea is to characterise the practical outcomes that can be expected in each dimension and produce the **metaterms** needed to name these design outcomes. These latter are here envisaged as effects derived from the simultaneous presence of two terms. This means that the terms placed in the four corners of each semiotic square play the role of semantic poles in between of which the nature of each design outcome can be determined. Hereof, for instance, the metaterm or outcome 'seduction' in the square of the Competitiveness dimension is placed somewhere in between 'displayed benefits' and 'non hidden benefits' (see figure 64). Thus, the six dimensions of our model were characterised using the 'Should-perform' modal structure. The idea was to exemplify instead of exhausting the possible outcomes of our model. In this sense, only the most common relations

[213] To this aim, the correlation of two relations of contrariety is said to produce a new relation of contradiction, so as the correlation of two relations of implication is said to produce a new relation of contrarierty. On the other hand, the metaterms located in the relations of contrariety of first generation are contradictory metaterms and those assigned to the relations of implication of first generation are contrary metaterms (Greimas and Courtés, 1982).

behind each dimension were explored, bearing in mind that other design outcomes can be defined by changing the terms of each semiotic square. Hence, the basic logic of each of our dimensions was defined as follows (*terms* in bold types and *metaterms* in capitals):

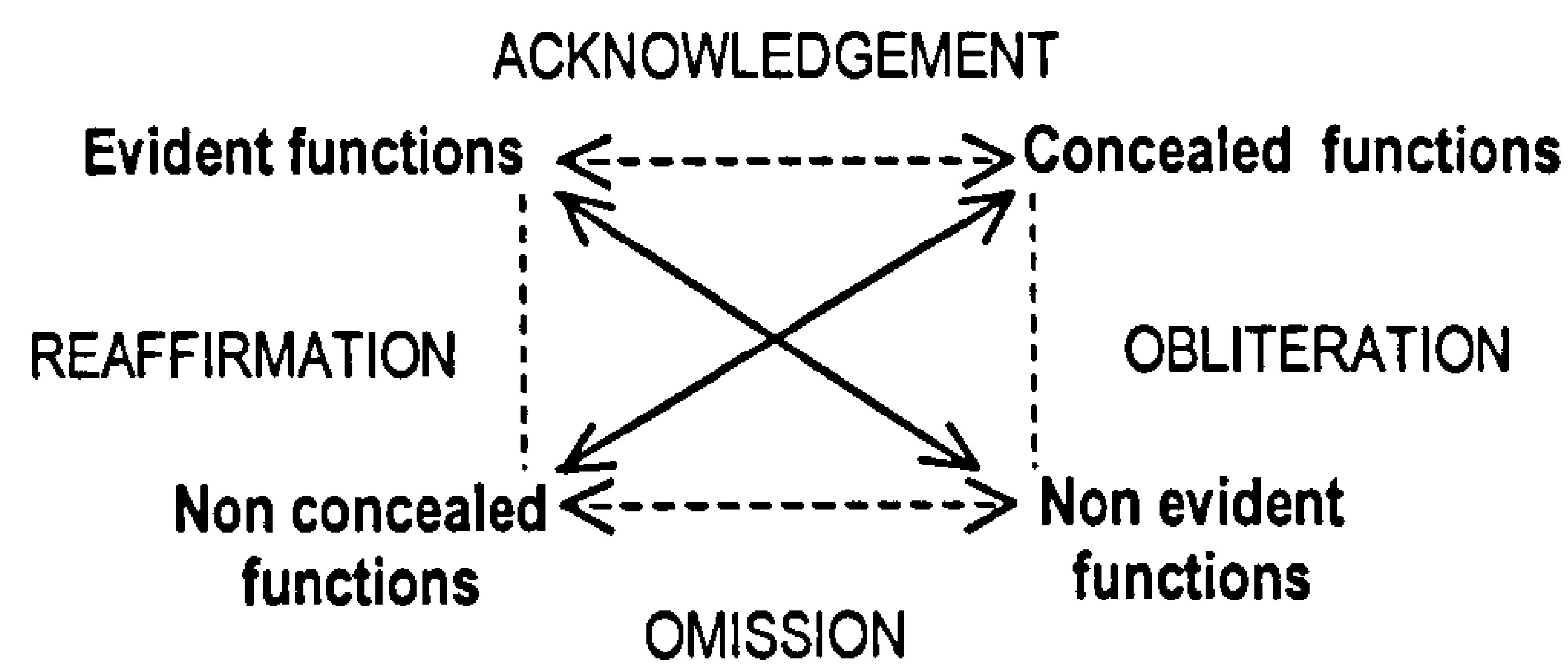


Fig. 63 - Basic logical relations within the Utility dimension.

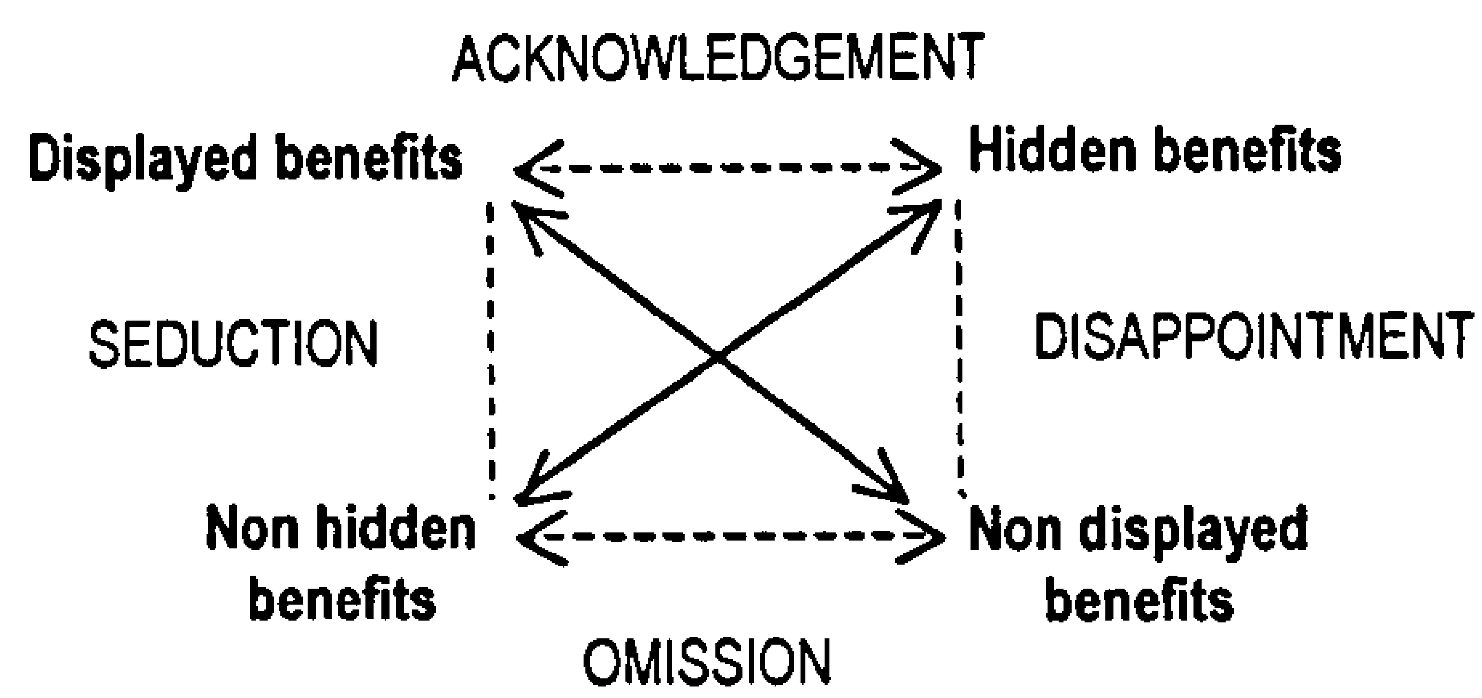


Fig. 64 – Basic logical relations within the Competitiveness dimension.

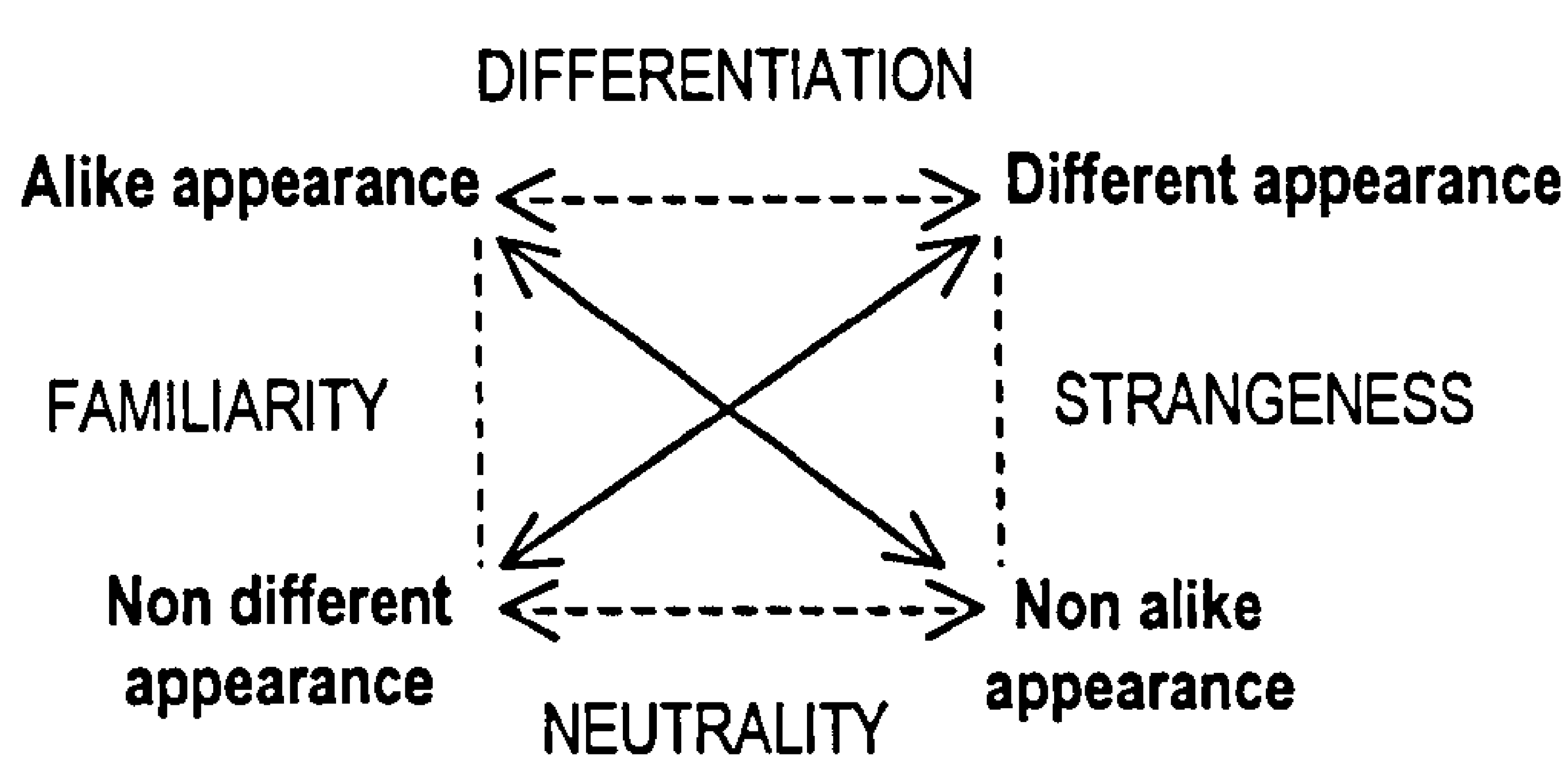


Fig. 65 - Basic logical relations within the Originality dimension.

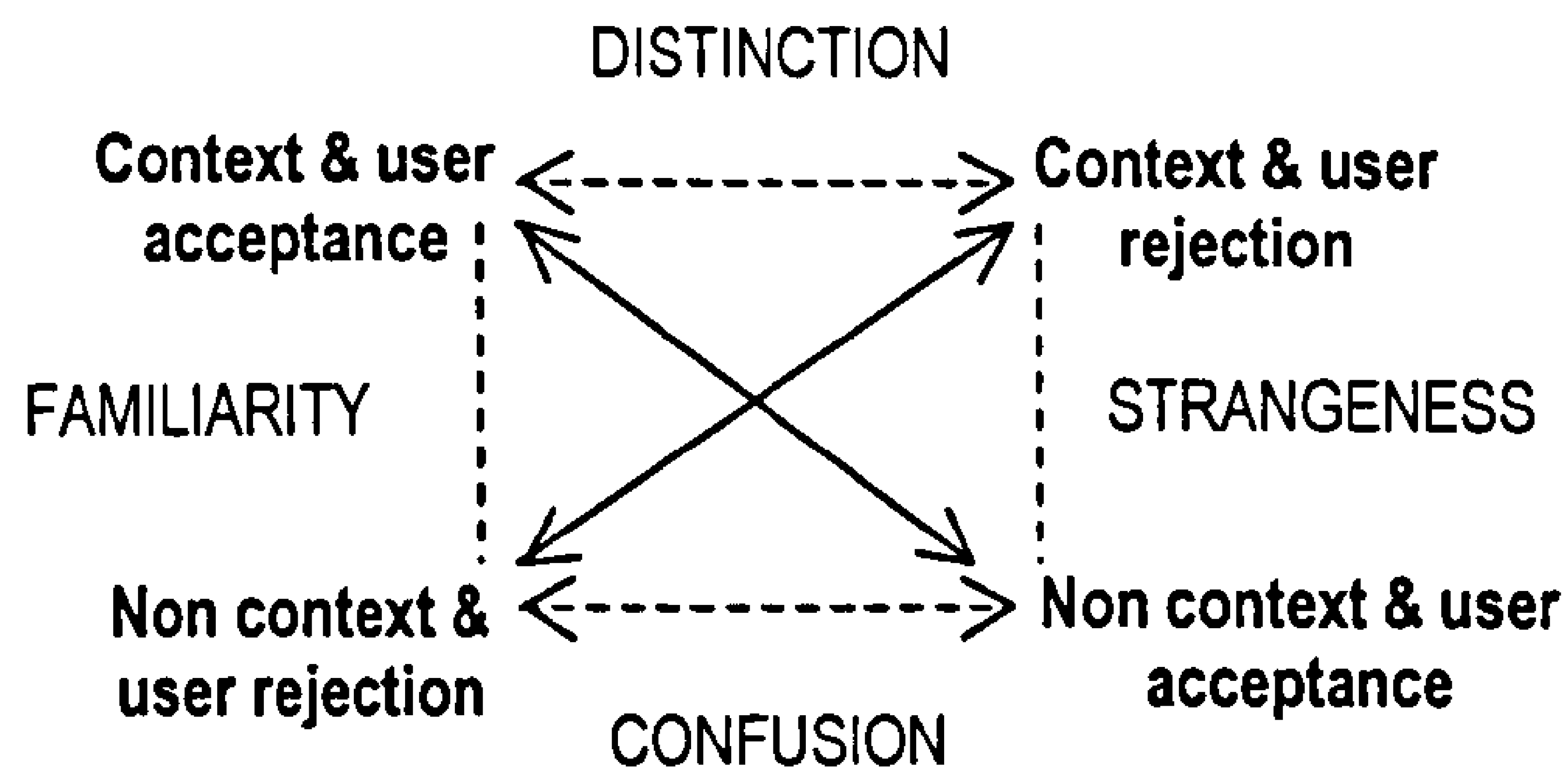


Fig. 66 - Basic logical relations within the Pertinence dimension.

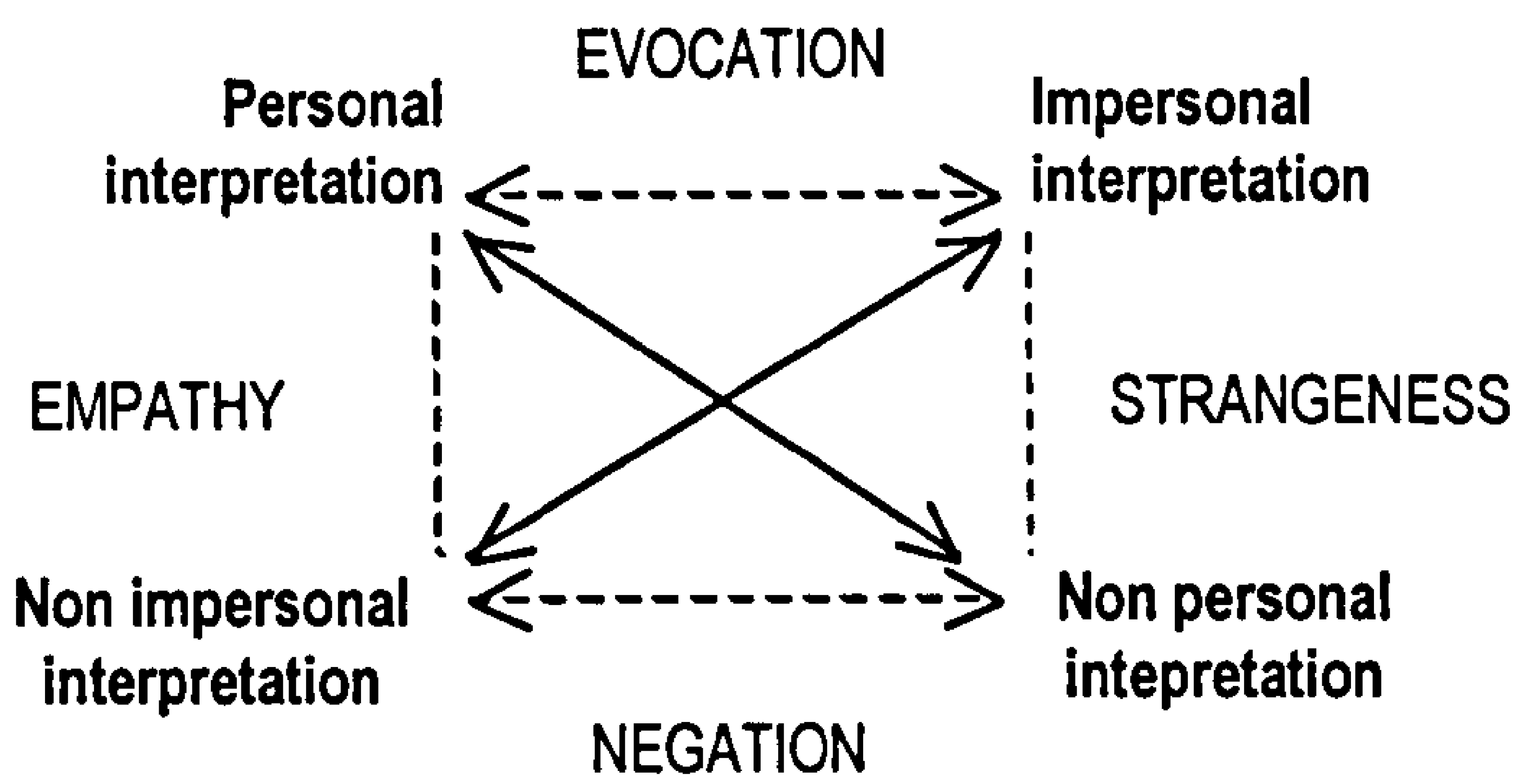


Fig. 67 - Basic logical relations within the Representativeness dimension.

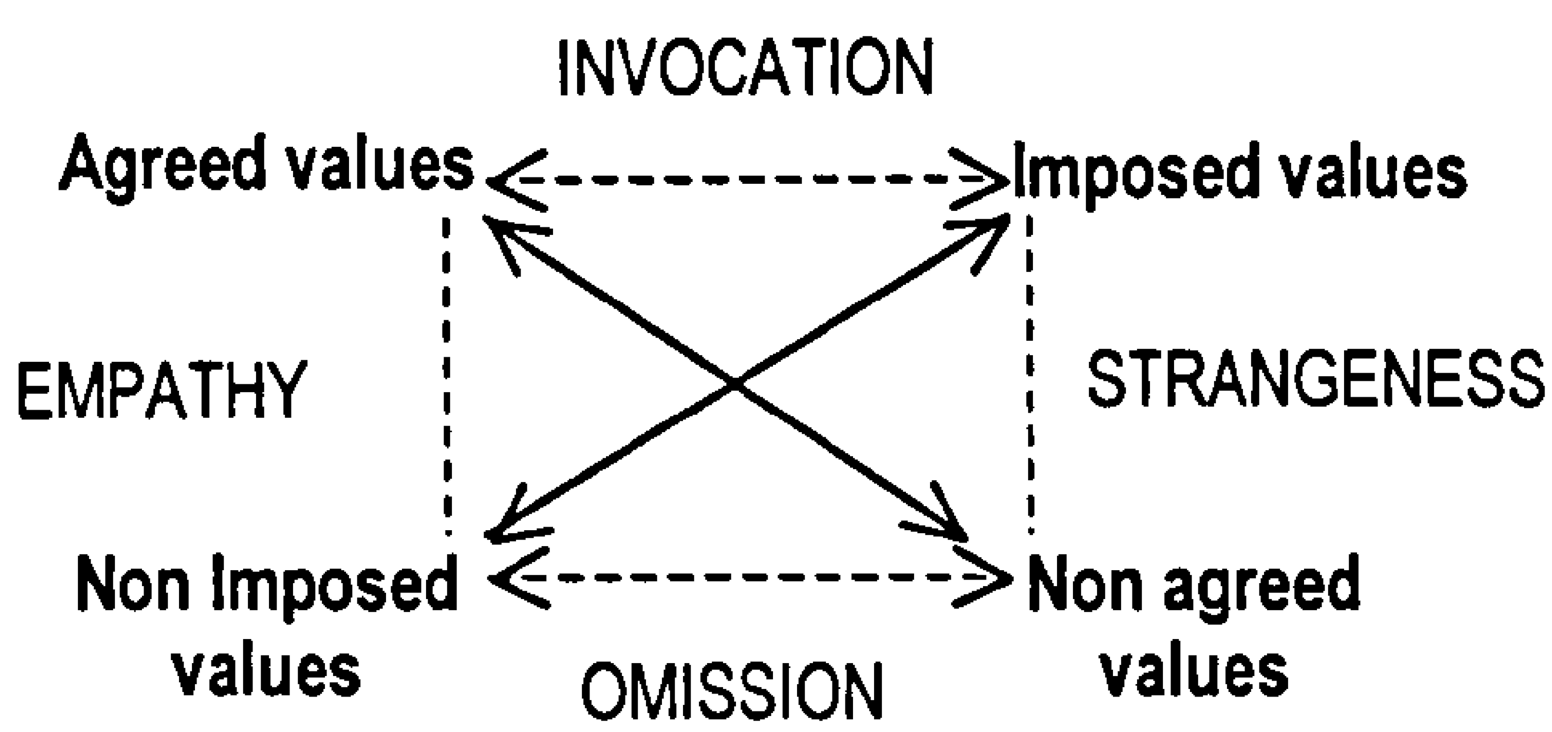


Fig. 68 – Basic logical relations within the Expressiveness dimension.

It is worth noticing that the semiotic squares above presented also respond to the logic derived from their grouping into the theoretical pairs comprising our model: Utility-Competitiveness, Originality–Pertinence, and Representativeness-Expressiveness. Therefore, the semiotic squares corresponding to each of these pairs have two similar and two different metaterms. For instance, Representativeness and Expressiveness have 'empathy' and 'strangeness' as common metaterms but differ in the other two. This is indeed a condition inherent to all the *terms* and *metaterms* which are part of the meaningful relations expressed in our model. Otherwise neither a comparison would be possible nor opposite conceptual poles could be established. Thus, we can summarise the basic design outcomes of each pair of opposite dimensions as follows:

SEMANTIC ARTICULATION (Semantic Poles)		Design outcome	Conceptual Dimension
Evident functions	Concealed functions	ACKNOWLEDGEMENT	UTILITY
Non concealed functions	Non evident functions	OMISSION	
Evident functions	Non concealed functions	RE-AFFIRMATION	
Concealed functions	Non evident functions	OBLITERATION	
Displayed benefits	Hidden benefits	ACKNOWLEDGEMENT	COMPETITIVENESS
Non hidden benefits	Non displayed benefits	OMISSION	
Displayed benefits	Non hidden benefits	SEDUCTION	
Hidden benefits	Non displayed benefits	DISAPPOINTMENT	

SEMANTIC ARTICULATION (Semantic Poles)		Design outcome	Conceptual Dimension
Alike appearance	Different appearance	DIFFERENTIATION	ORIGINALITY
Non different appearance	Non alike appearance	NEUTRALITY	
Alike appearance	Non different appearance	FAMILIARITY	
Different appearance	Non alike appearance	STRANGENESS	
Context & user acceptance	Context & user rejection	DISTINCTION	PERTINENCE
Non context & user rejection	Non context & user acceptance	CONFUSION	
Context & user acceptance	Non context & user rejection	FAMILIARITY	
Context & user rejection	Non context & user acceptance	STRANGENESS	

SEMANTIC ARTICULATION (Semantic Poles)		Design outcome	Conceptual Dimension
Personal interpretation	Impersonal interpretation	EVOCATION	REPRESENTATIVENESS
Non impersonal interpretation	Non personal interpretation	NEGATION	
Personal interpretation	Non impersonal interpretation	EMPATHY	
Impersonal interpretation	Non personal interpretation	STRANGENESS	
Agreed values	Imposed values	INVOCATION	EXPRESSIVENESS
Non imposed values	Non agreed values	OMISSION	
Agreed values	Non imposed values	EMPATHY	
Imposed values	Non agreed values	STRANGENESS	

It is important to bear in mind that, even though some *metaterms* (design outcomes) may have the same name, they are not exactly the same. Thus, for instance, 'omission' within the Utility dimension has to do with functions, whereas this same *metaterm* within the Competitiveness dimension is about benefits. On the other hand, metaterms (design outcomes) such as 'omission' and 'negation' normally refer to a disregard of the meaningful content of the dimension where these metaterms are present. In this sense, our model also takes into account the possibility of producing no meaning in some of our dimensions for the ideation of design concepts.

Chapter 5

Experiments on reference and design concepts

The presence of different types of *referents* in people's understanding and interaction with design products has been confirmed by experimental studies. Within the design field these experimental studies have gone from those concerned with how people interpret the functional features of products (e.g. Chapanis and Mankin, 1967; Moles, 1975, Woolley, 1992; Monö, 1992; Stanton and Young, 1998) to those about how people associate design features to non-functional aspects such as social status (Espe, 1992), colour and emotion (Ou and Lou, 2004), personality (Jordan, 2002; Govers, Hekkert and Schoormanns, 2004), and emotional attachment (Schifferstein, Mugge and Hekkert, 2004). There are also experimental design studies about the power of words to capture the semantic essence of products (Coates, 1998; Lenau and Boelskifte, 2005), and attempts to create databases of images and descriptive words to aid concept ideation through the use of pre-established referents (Hsiao and Chen, 1997; Wu and Johnston, 2005). Even more, there are studies about reference carried out outside design which have become quite relevant to designers such as the depth-psychology studies presented in Vance Packard's (1992) *Hidden persuaders*, and those about the meaningful transactions between people and the objects in their homes developed by Csikszentmihalyi and Rochberg-Halton (1981).

This short outline does not intend to be a comprehensive list of the experimental studies about reference in design objects, but a brief overview of its main directions to date. With this general framework in mind, the present chapter will introduce eight experiments carried out as part of the present research. The data gathered in these experiments was used to develop three different but complementary studies. Therefore, in this chapter general information about the experiments as a whole will be presented in advance followed by sections about each study.

5.1. General description and method

5.1.1. Aim of the experiments

The central aim of this phase of the present research was to develop short experiments on concept ideation with design students, using a method whose outcomes enable us to measure whether the act of concept ideation can be divided into the six dimensions outlined in the model presented in chapter 4.

5.1.2. Types of experiments and design briefs

Even though our theoretical model for concept ideation comprises six dimensions, only four types of experiments were developed based on the following criteria:

- Since theory divides reality into parts to ease the study of particular situations, all six dimensions of our theoretical model were taken as present at once -in a lesser or major proportion- in every design product. However, as products differentiate from each other for being more practical, expressive, pertinent, and so on, it was also assumed that there is always a dimension prevailing over the others, and therefore in charge of defining the main competitive nature of each product. Thus, for instance, if the prevailing dimension is Utility, the product should be primarily competitive in practical terms. This also implies that since Competitiveness derives from the other five dimensions of our models, it cannot be studied alone (at least we agree to disregard the presence of the other five dimensions). In this sense, no experiment was devised for the Competitiveness dimension.

- Representativeness is a dimension whose final form only takes place in the mind of the consumer/user. Therefore, it can be hardly singled out in experiments in which no consumers/users are involved. As our experiments only consider the contribution of designers to Representativeness, it was worked out in conjunction with the Expressiveness dimension in a single type of experiment. Indeed, the presence of the Representativeness dimension can be roughly determined by correlating it to the Expressiveness dimension (since both are inversely proportional).

Thus, the four types of experiments developed were: Utility + Competitiveness, Originality + Competitiveness, Pertinence + Competitiveness, and Representativeness + Expressiveness + Competitiveness. Given that part of our experiments aimed to test the method of concept ideation especially devised for this research (see Study 1), two different experiences were formulated for each type of experience, using the same product (radio, stove, etc.). The idea was to count on experiments free of any particular method of concept ideation (or pre-induction) to contrast them with experiments where a particular method is imposed to the participants (post-induction). The briefs for each of the eight experiments carried out were as follows:

DIMENSION	PHASE OF ASSESSMENT	BRIEF:
UTILITY + Competitiveness	Pre-Induction	To design a radio: portable, mono or stereo sound, for elders who practice sports (jugging, attend to bullfights, play baseball, etc.), unisex, to be operated with batteries and plugged.
	Post-Induction	To design a radio: portable, for teenage either masculine or feminine, to be used in their bedrooms or during meetings with friends, to be operated with batteries and plugged.
PERTINENCE + Competitiveness	Pre-Induction	To design an electric stove: portable, with two hobs, to be used as part of a small office kitchenette, capable of complying with the office's decorative requirements (travel agents, solicitors, etc.), designed to be hidden when out of use.
	Post-Induction	To design an electric stove: portable, for travelling families with 2 children (age under 2 years old), with a configuration contextualized by the means used to travel (car, bus, plain, ship), with a switch to change from 110 to 220 volts. The family socio-economic level is of free choice.
ORIGINALITY + Competitiveness	Pre-Induction	To design a sound recorder: portable, operated with batteries and with DC, for children aged between 5 and 8 years (for boys, girls or both), who are beginning to use a sound recorder for the first time in their lives.
	Post-Induction	To design a sound recorder: portable, for young journalists (aged between 25 y 40 years). The product should comply with the needs of one or more of the following scenarios: entertainment, social and political events, cultural events (forums, conferences, etc.) and sports.
EXPRESSIVENESS + REPRESENTATIVENESS + Competitiveness	Pre-Induction	To design a television: portable, for adults aged between 35 and 50 years, masculine, feminine or unisex, with high purchasing power, capable of expressing a particular life style and the place where it will be used (bedroom, kitchen, etc.).
	Post-Induction	To design a television: portable, for university students aged between 17 and 30 years, socio-economic level low and medium-low. The product should enhance its user personality, life style and future aspirations.

Each experiment was designed to be done in an average time of three hours. This timing was based on the times employed by participants in similar experiments whose extent goes from two and a half to five hours (cf. Akin, 1979; Thomas and Carrol, 1979; Chan, 1990; Cross, 1997; Eisentraut and Günther, 1997). Indeed, three hours can be considered as an extent of time that allows participants to realise the most obvious constraints of the design problems normally used in this sort of experiment (Lacruz-Rengel, 2008). Besides this, precautions were taken to avoid tiring and demotivating the participants during the realisation of the eight experiments. Indeed, experiments were organised in two blocks of four experiments each (one for pre-induction experiments, and another for the post-induction ones) and three days were placed in between each block. Additionally to it, no more than one experiment was carried out per day allowing one free day in between experiments. Besides this, each design brief had a different emphasis to maintain the participants' interest.

In relation to the objects whose design concepts were asked students to formulate, all of them were portable[214] box-shaped electrical appliances. This particular choice of objects was due to three reasons. Firstly, because these products are vested with a level of semantic neutrality that challenges the imagination of those designers willing to create something meaningful out of them. Secondly, these products have become one of the most common cases of product design in the present technological scenario. Thirdly, there was the need of establishing the extent of the design problems to be used given the limited time allowed for each experiment.

5.1.3. The participants

The sample employed in the eight experiments carried out was comprised of 20 third-year industrial design students from University of Los Andes, Venezuela, who voluntarily registered to take part in a summer Seminar especially created to develop these experiments. 55% of these students were women and 45% were men, all of them with an average age of 22 years old. Differently from other studies, for this research the short experience and incomplete knowledge of participants about

[214] The term 'portable', aside from its usual implications, does only refer here to products with a size easy to carry by a single person.

concept ideation were seen as necessary conditions to ease the participants' acceptance and use of the method for concept ideation suggested as part of this study. The number of participants was determined based on similar experiments which have involved between 15 and 40 people (cf. Thomas and Carroll, 1979; Eisentraut and Günther, 1997; Atman et.al. 1999; Austin et.al. 2001).

5.1.4. Controlled variables

Three variables were carefully considered for the formulation of the experiments:

- Level of instruction of the participants. All participants were undergraduate students of a Bachelor of Industrial Design with three years of experience as students of design studios, and basic technological knowledge on material and manufacturing processes. The fulfilment of these requirements was checked at their enrolment in the summer seminar developed as part of this research.
- Provision of equal physical conditions during the experiments. All participants were required to work with a limited type of utensils (pencils, crayons and markers), using a specific format (A3 sheets of white pasteboard) and work stations equally equipped (a cushioned chair and table with a working surface of 40"x 26").
- Motivation of participants toward the experiments. Since the experiments were carried out as part of a summer seminar at the University of Los Andes, all participants received academic grades for their design concepts at the end of the course and the credits derived from this seminar counted as part of the bachelor degree they were studying. This particular fact, together with the idea of getting new knowledge and hands-on experience on concept ideation, helped to keep the interest and enthusiasm of the participants throughout all the eight experiments.

5.1.5. Procedure

Before going into the two blocks of experiments a session of one and half hour was employed to present the participants definitions of design concepts and illustrations of concepts developed by professional designers. At the end of this session participants are presented with the definition of design concept developed as part of this research (see section 2.1.3. of chapter 2).

Previous to the first experiment, each participant was assigned a work station (table and chair) within the room where experiments were developed. Participants were required to bring their own drawing utensils as well as several A3 sheets of pasteboard to write and draw in for each experiment (both sides of the sheets could be used). Each experiment was carried out between 8:30 am and 12 m. During that time, no participant was allowed to communicate or look at the work of the others (enough space was provided between the work stations to keep participants comfortably apart). At the beginning of each experiment the brief was handed out to the participants and ten minutes allowed to be read it aloud by the experimenter. After reading the brief, five minutes were given to clarify doubts about the brief by asking questions aloud to the experimenter. Questions were answered aloud by the experimenter for the whole group of participants. After this, participants were informed of having a maximum of three hours to produce their concepts by writing or drawing what they considered useful to explain it in their A3 sheets. No further communication was allowed between the participants and the experimenter (who remains in the room away from all participants). At the end of the experiment a maximum of two A3 sheets were collected per participant (this was also notified to them at the beginning of the experiments).

This general procedure was followed in the eight experiments carried out. However, for the last four experiments some changes were purposely introduced. The first important change was the use of the **ASCHASKET method** (ASsociation, CHAracterisation and SKETching) formulated in chapter 3 of this dissertation. Indeed, in a session previous to the beginning of this block of experiments, the experimenter introduced the participants into the use of ASCHASKET and explained them the particular way in which their design outcomes should be presented in the A3 sheets. In this sense, the front side of the first A3 sheet (in case two sheets were used) was destined to write the brief, verbal expressions (free associations and intentional associations), and draw some exploratory sketching; whereas the back side of the last A3 sheet was destined to present the final sketch of the design concept achieved (see figures 69 and 70).

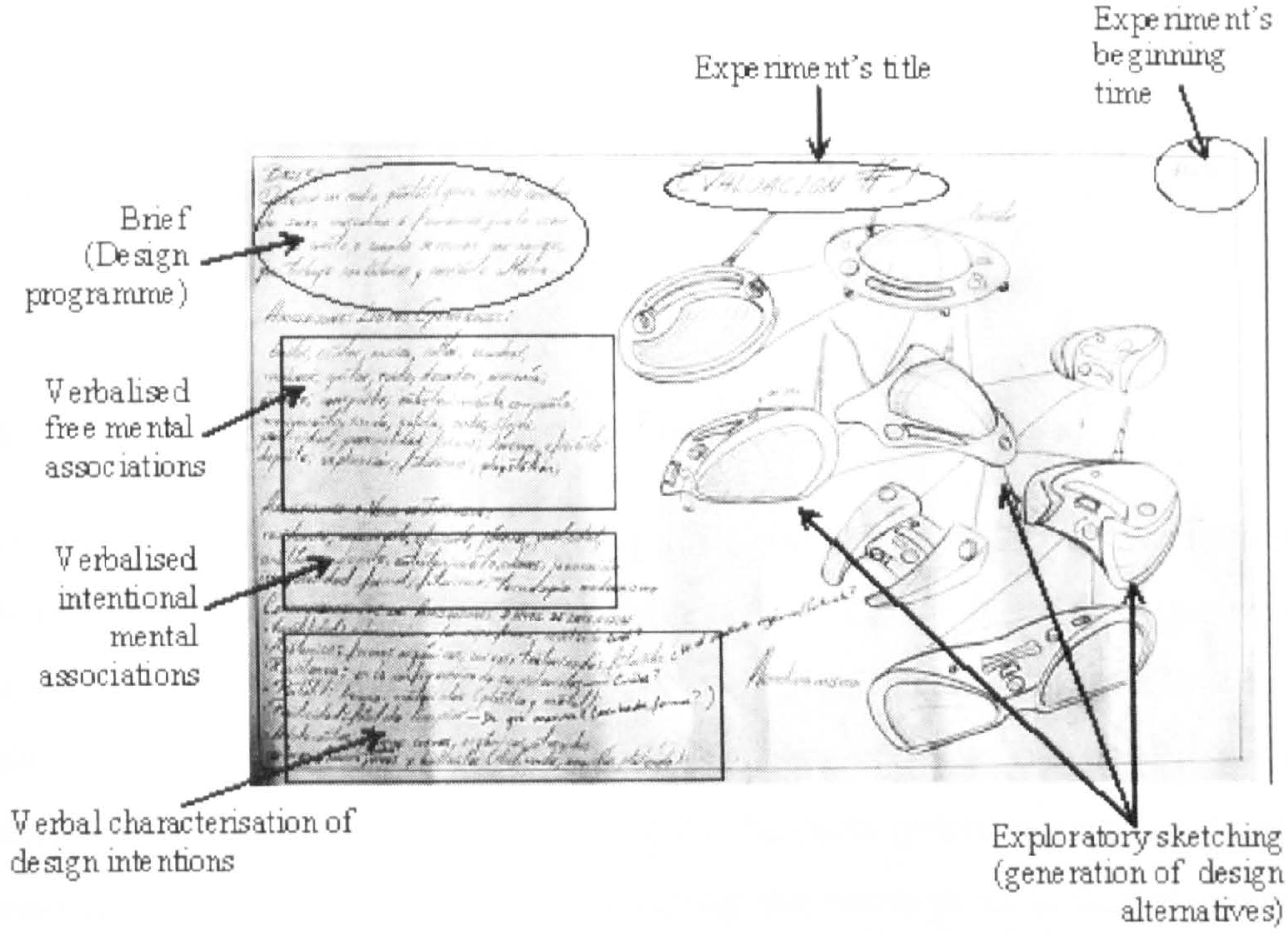


Fig. 69 – Front side of first A3 sheet using the ASCHASKET method.

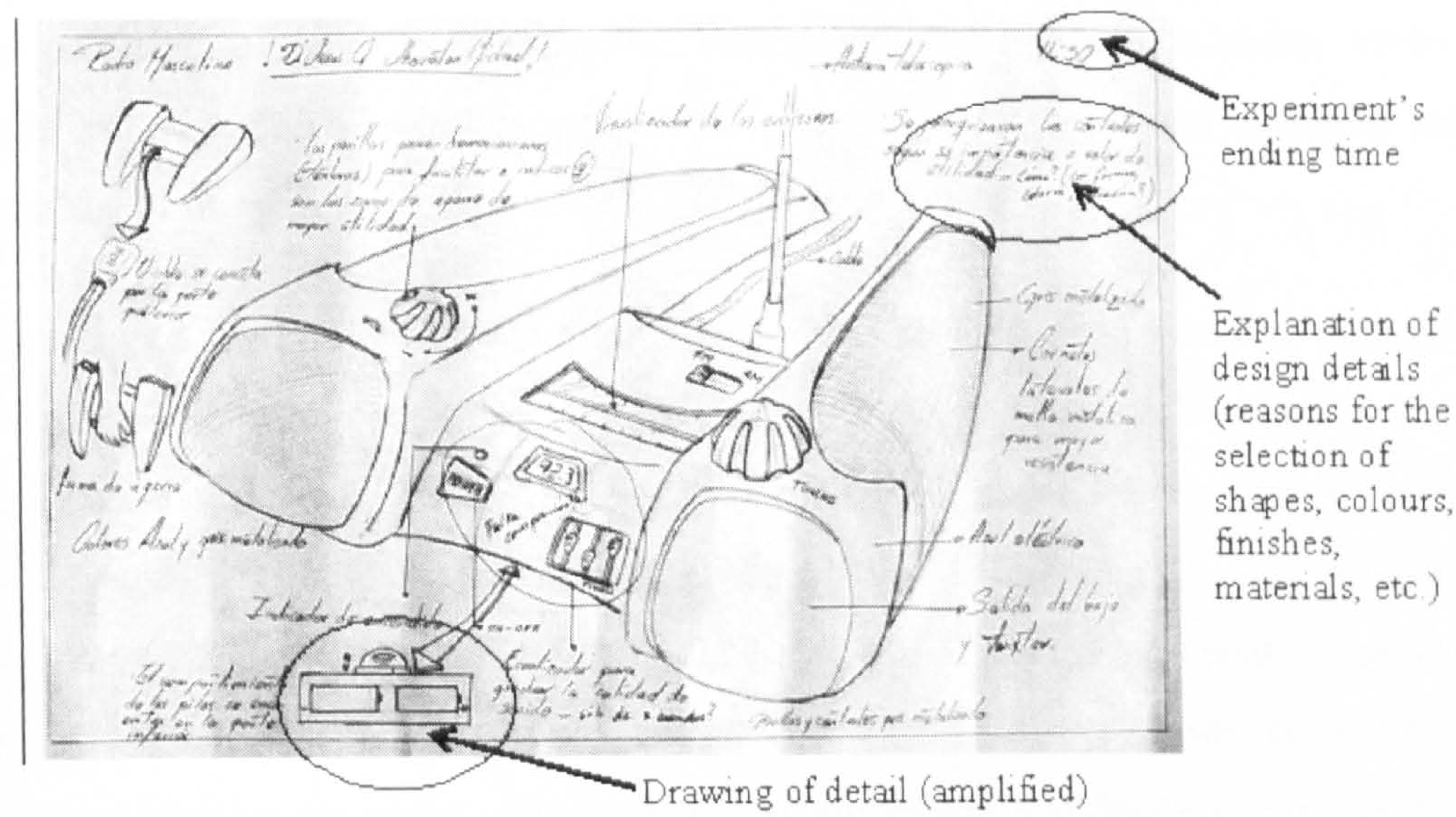


Fig. 70 – Back side of the last A3 sheet using the ASCHASKET method.

The other important change introduced in the second block of experiments was the induction of participants into the knowledge developed as part of this research for the dimensions of concept ideation (section 4.1. of chapter 4). The idea was to unify the participants' interpretation of each dimension to guarantee the success of the last four experiments. This knowledge, however, was not introduced at once but through different sessions of one and a half hour of extent, which took place the day before the experiments for each set of dimensions (e.g. Utility + Competitiveness). Thus, there were four induction sessions separately placed before the beginning of each of the four last experiments.

5.1.6. Collected data and dependent measures

Three types of data were collected in the studies carried out: units of time (minutes and hours), pictorial expressions and verbal expressions. By **pictorial expressions** we refer to drawings used by the participants to explore ideas or define preliminary aspects of a design concept during its process of ideation. By **verbal expressions** we allude to words or chains of words used by the participants to name or describe the associations coming to their minds during the ideation of a design concept. Given that, from a semantic standpoint, pictorial expressions are holistic (i.e. they may involve more than one subject matter at once) and verbal expressions are generally subject-specific, the former were taken as indications of possible changes in the participants' pattern of behaviour during concept ideation, whereas verbal expressions were taken as indications of the presence of associations linked to the dimensions of our theoretical model.

In this respect, the number of pictorial expressions allowed us to measure changes in the rate of drawing production before and after the participants' induction into the method of concept ideation especially devised for some of the experiments. Such a number also helped us to study possible differences in the drawing behaviour of male and female designers. The number of verbal expressions, on the other hand, allowed us to measure: (1) the success or failure of the proposed method for concept ideation (in terms of increasing the participant's verbalization of mental associations), (2) the possible differences in the production of associations by designers of different gender, and (3) the differences and similarities between the dimensions of our model based on the production of verbal associations and the clarity of intention of the design concepts generated. Similarly to pictorial expressions, the units of time were taken as indications of the degree of exploration of ideas during concept ideation. Insomuch that it was assumed that the longer the time employed in the ideation of a concept, the higher the degree of mental exploration, regardless of the number of verbal and pictorial expressions produced.

Thus, throughout the eight experiments carried out a total of **153 design concepts**, presented in A3 sheets, were processed to establish the number of different pictorial expressions and different verbal expressions present in each of them. In order to determine the number of different pictorial expressions, drawings referring to the same things or ideas were quantified only once. The same was done to establish the number of different verbal expressions but this time counting repeated words and synonyms only once. Hereof, the number of verbal expressions can be taken as equitable to the number of verbal associations in these studies. Additionally to it, verbal expressions were divided into two subgroups: **general verbal expressions** or those generated during the ideation of a concept regardless of the dimension to which they refer, and **dimension-specific verbal expressions** or those directly linked to matters dealt at a particular dimension of our model. The number of *dimension-specific verbal associations* was particularly important to establish the participants' clarity of intention during concept ideation since the design briefs of each experiment were formulated with a particular set of two or three theoretical dimensions of our model in mind. Thus, the more dimension-specific associations produced, the clearer the participant's understanding of the brief. In order to recognize what a dimension-specific verbal expression is, the following guidelines were formulated for the processing of the data:

Dimension (Type of emphasis)	Specific marks to identify words related to each dimension:
UTILITY (The product's functionality)	Feedback signals, functional similarities with other products, ways of amending errors of use, outline of controls, clues about the product's functionality, considerations of the user's aptitudes and abilities.
PERTINENCE (Formal adaptation to particular contexts and users)	Forms, colours, materials and finishes linked to particular contexts of use and things consumers/users are surrounded with.
ORIGINALITY (Aspects turning a product into a different or new proposal)	Formal or functional features different from similar products, promotion of scarce links with familiar and particular contexts and users, levels of functional complexity or simplicity different to most products of its type.

Dimension (Type of emphasis)	Specific marks to identify words related to each dimension:
REPRESENTATIVENESS + EXPRESSIVENESS (Aspirations, dreams and pleasures of consumers/users + aspects of their lifestyles and culture)	Attempts to satisfy pleasures of: shopping, ease of use, status, aesthetics. Promotion of feelings of: emotional security, affirmation of the self, improvement of personal capacities, etc. Use of forms, beliefs, ideas and values culturally rooted (Stylemes and Mentalemes).

5.2. STUDY 1: Testing of an ideation method for design concepts

5.2.1. Introduction

From the beginning, the experimental phase of this research was concerned with increasing the participants' rates of verbalization to obtain clearer indications of the presence of dimensions of our model during the experiments. To this aim, the ASCHASKET method was taught to the participants and its effects verified by contrasting the verbalization rates of experiments without knowledge of this method (pre-induction) with experiments where the method was purposely used (post-induction). On the other hand, this study was also concerned with verifying whether some important patterns of behaviour related to concept ideation were changing with the use of ASCHASKET. In this sense, the participants' drawing behaviour as well as the amount of time employed by them during the ideation of concepts were registered to show these changes. Consequently, pictorial expressions (drawings) present in all the design concepts and the time employed to produce them were contrasted before and after the induction of ASCHASKET. In this sense, this study had two hypotheses:

H_1: ASCHASKET is a method that elicits a significant increase in the verbalisation of mental associations and the use of more time during concept ideation.

H_2: The importance assigned by ASCHASKET to verbalisation reduces the production of drawings during concept ideation.

5.2.2. Method of analysis

The numbers of *general verbal expressions* and *pictorial expressions* present in the **153 design concepts** produced during the eight experiments carried out as well as the *time employed* in them by the participants were processed using the version 10.0.6 for Windows of the Statistical Package for the Social Sciences (SPSS). Results were analysed in a descriptive manner taking their arithmetic means as measures of distribution and their Standard Deviations as measures of spread. The inferential analysis was carried out using a t-test for related samples in which the means of the four pre-induction experiments were compared to the means of the four post-induction experiments with a significance level of 0.05 ($\alpha = 0.05$).[215]

5.2.3. Results

In the two experiments with emphasis on the **dimensions Utility + Competitiveness**, before induction the production of different verbal expressions had a mean of 13.74 ± 7.72. After induction this mean increased to 21.95 ± 4.70. The major change was registered in the minimum number of verbal expressions whose values went from 6 before induction to 13 after it. The differences between the arithmetic means before and after induction was -8.21, which shows that *the increase experienced by the mean of verbal expressions after induction was statistically significant* (t = -5.286; df = 18; p = 0.000). Differently from these results, the mean of pictorial expressions before induction (4.21 ± 2.74) experienced a decrease after it (3.8 ± 2.71). The minimum-maximum values of pictorial expressions were 1 and 10 in pre-induction with little changes after induction (1 and 12). The difference between the means of pictorial expressions before and after induction was 0.84, which shows that *the decrease experienced by the mean of pictorial expressions was not statistically significant* (t =1.166; df= 18; p = 0.256). In relation to the time spent by the participants, the mean in the post-induction experiment (2.8647 ± 0.4093 hours) was higher than the mean of the pre-induction one (2.1706 ± 0.3562 hours). The difference between these means was -0.6941 which implies that *there was a statistically significant increase in the mean of time employed* (t = -6.003; df= 17; p = 0.000).

[215] A significance level of 0.05 implies that no more than a 5% of possible error is acceptable for the determination of a result as statistically significant. Therefore, to be significant all p-values should be $p < 0.05$.

In the two experiments with emphasis on the **dimensions Originality + Competitiveness**, before induction the production of different verbal expressions had a mean of 15.50 ± 4.66. After induction this mean increased to 29.88 ± 8.62. The major change was registered in the maximum number of verbal expressions whose values went from 26 before induction to 43 after it. The differences between the arithmetic means before and after induction was -14.38, which shows that *the increase experienced by the mean of verbal expressions after induction was statistically significant* (t = -7.050; df = 15; p = 0.000). Differently from these results, the mean of pictorial expressions before induction (4.71 ± 3.02) experienced a decrease after it (4.31 ± 2.60). The minimum-maximum values of pictorial expressions were 1 and 10 in both pre and post induction. The difference between the means of pictorial expressions before and after induction was 0.44, which shows that *the decrease experienced by the mean of pictorial expressions was not statistically significant* (t = 0.536; df = 15; p = 0.600). In relation to the time spent by the participants, the mean in the post-induction experiment (2.5171 ± 0.5752 hours) was higher than the mean of the pre-induction one (2.4136 ± 0.2343 hours). The difference between these means was -0.1036 hours, which implies that *there was not a statistically significant increase in the mean of time employed* (t = -0.722; df = 13; p = 0.483).

In the two experiments with emphasis on the **dimensions Pertinence + Competitiveness**, before induction the production of different verbal expressions had a mean of 16.10 ± 8.51. After induction this mean increased to 27.75 ± 7.42. The major change was registered in the minimum number of verbal expressions whose values went from 4 before induction to 17 after it. The differences between the arithmetic means before and after induction was -11.65, which shows that *the increase experienced by the mean of verbal expressions after induction was statistically significant* (t = -7.95; df = 19; p = 0.000). Differently from these results, the mean of pictorial expressions before induction (4.60 ± 3.00) experienced an increase after it (5.15 ± 3.51). The minimum-maximum values of pictorial expressions were 1 and 13 in pre-induction with little changes after induction (1 and 10). The difference between the means of pictorial expressions before and after induction was -0.55, which *was not statistically significant* (t =-0.516; df = 19; p = 0.611). In relation to the time spent by the participants, the mean in the post-induction experiment (2.7225 ± 0.3904 hours) was higher than the mean of the pre-induction one (1.9013 ± 0.4535 hours). The difference between these means was -0.8212 which implies that *there was a statistically significant increase in the mean of time employed* (t = -6.589; df = 15; p = 0.000).

In the two experiments with emphasis on the **dimensions Representativeness + Expressiveness + Competitiveness,** before induction the production of different verbal expressions had a mean of 11.33 ± 4.90. After induction this mean increased to 14.94 ± 3.57. The major change was registered in the minimum number of verbal expressions whose values went from 4 before induction to 10 after it. The differences between the arithmetic means before and after induction was -3.61, which shows that *the increase experienced by the mean of verbal expressions after induction was statistically significant* (t = -2.819; df = 17; p = 0.012). Differently from these results, the mean of pictorial expressions before induction (4.78 ± 2.62) experienced a decrease after it (3.22 ± 1.63). The minimum-maximum values of pictorial expressions were 2 and 10 in pre-induction with changes after induction (1 and 7). The difference between the means of pictorial expressions before and after induction was 1.56, which shows that the decrease in the mean of pictorial expressions after induction *was statistically significant* (t =2.280; df = 17; p = 0.036). In relation to the time spent by the participants, the mean in the post-induction experiment (1.4667 ± 0.5420 hours) was lower than the mean of the pre-induction one (2.1053 ± 0.3313 hours). The difference between these means was -0.3613 which implies that there *was a statistically significant decrease in the mean of time employed* (t = -3.083; df = 14; p = 0.008).

5.2.4. Discussion of results

In relation to the first hypothesis regarding the extent to which ASCHASKET helps designers to improve their rates of verbalised associations, the comparison of the results from the eight experiments carried out shows that ASCHASKET indeed changes the production of verbalised associations during concept ideation. Nevertheless, only in 75% of the dimensions comprising our theoretical model such changes were about increasing the rates of verbal associations, since in the experiments on Representativeness + Expressiveness a decrease instead of an increase in the number of verbalised expressions took place after induction. This latter result is presumed to come from the fact that Representativeness + Expressiveness were the only two inversely-proportional dimensions tested together in the experiments,[216] which may have turned more difficult the task of producing verbal associations. But, given the results in most of the dimensions, we can conclude that ASCHASKET was a determinant factor in the increase of verbal associations. Besides this, we should realise that the increase of verbal associations experienced by 75% of the dimensions of our model cannot be taken as even in all of them. Indeed, Originality (with a difference between its means of 14.38 verbal expressions) was the dimension in which the verbalisation propounded by ASCHASKET had a major impact, whereas Utility (with a difference between its means of 8.21 verbal expressions) was the dimension where such a method produced less increments.

Regarding the second part of the first hypothesis, it can be said that the time spent for concept ideation only increased significantly with the use of ASCHASKET in the Utility and Pertinence dimensions, whereas in the Originality dimension the times employed without and with ASCHASKET were practically the same, and in the Representativeness + Expressiveness experiments a significant decrease of time took place. The situation in the Originality dimension might be due to the fact that it is a dimension equally difficult to tackle during concept ideation with and without the use of any method. In the case of the Representativeness + Expressiveness experiments, the use of two simultaneous design emphases of inversely-proportional nature may have hindered the production of further verbal associations, minimizing the time spent by the participants to tackle the tasks of these experiments. From this situation, however, we can conclude that the search of a concept with two main design emphases does not favour concept ideation, especially if the main emphasis has been posed in two inversely-proportional dimensions.

In relation to the second hypothesis, regarding the possible impact of verbalisation on the production of drawings during concept ideation, in 75% of the experiments carried out there was not a significant decrease of drawing production with the use

[216] Competitiveness, which is the other dimension worked in conjunction with others during the experiments, is directly proportional to the other five dimensions of our model (e.g. the more practical a product is, the more competitive in the Utility dimension).

of ASCHASKET. Only in the Representativeness + Expressiveness experiments a significant decrease took place, presumably for the same reasons alluded in the discussion of results for the first hypothesis of this study.

5.3. STUDY 2: Gender differences in the ideation of design concepts

5.3.1. Introduction

Since the group of participants of our experiments was comprised by designers of different genders, such a composition of participants was thought to have particular implications for the results. In order to study these latter, the outcomes of both genders were compared in terms of the time employed for concept ideation and the arithmetic means of pictorial expressions, general and dimension-specific verbal expressions during the realisation of the second block of experiments. The idea was to take advantage of the fact that, in this block of experiments, participants shared the same method for concept ideation (ASCHASKET) as well as the same way of presenting such concepts, besides having a common understanding of the theoretical dimensions of our model linked to each experiment. In this sense, this study had two hypotheses:

H_1: Male designers produce more verbal associations and have clearer design intentions in terms of dimension-specific verbal associations than female designers in some dimensions of our model for concept ideation, and vice versa.

H_2: Male designers produce more pictorial expressions than female designers in some dimensions of our model for concept ideation, and vice versa.

H_3: Male designers spend less time than female designers in some dimensions of our model for concept ideation, and vice versa.

5.3.2. Method of analysis

The numbers of *general and dimension-specific verbal expressions* and the number of *pictorial expressions* present in the **80 design concepts** produced during the four experiments carried out after induction as well as the *time employed* in them by the participants were processed using the version 10.0.6 for Windows of the Statistical Package for the Social Sciences (SPSS). Results were analysed in a descriptive manner taking their arithmetic means as measures of distribution and their Standard Deviations as measures of spread. The inferential analysis was carried out using a t-test for independent samples to compare the means obtained by each gender during the four post-induction experiments with a significance level of 5% ($\alpha = 0.05$).

5.3.3. Results

In the experiment for the ideation of design concepts with emphasis on the **Utility + Competitiveness** dimensions, female designers had a mean of general verbal expressions (22.0909 ± 3.8329) higher than that of male designers (21.1111 ± 5.9043). The difference between the arithmetic means of both was -0.9798, which shows that *the difference between the means of general verbal expressions of female and male designers was not statistically significant* (t = -0.448; df = 18; p = 0.659). In relation to the clarity of intention during concept ideation, female designers had a mean of dimension-specific verbal expressions (10.4545 ± 4.45) higher than that of male designers (8.3333 ± 1.50), with a difference between both means of -2.1212 which implies that *the difference between the means of the dimension-specific verbal expressions of female and male designers was not statistically significant* (t = -1.360; df = 18; p = 0.191). Regarding the number of pictorial expressions (drawings), female designers had a mean (2.3636 ± 1.2863) far lower than that of male designers (5.5556 ± 3.3953), presenting a difference between both means of 3.1919 which shows that *the difference between the means of the pictorial expressions of female and male designers was indeed statistically significant* (t = 2.8889; df = 18; p = 0.01). Finally, in relation to the time employed for concept ideation, it was found that the mean of female designers (2.6270 ± 0.8316 hours) was not too different to that of male designers (2.8762 ± 0.3981 hours), with a difference between both means of 0.2492 which suggests that *the difference between the means of time employed by female and male designers was not statistically significant* (t = 0.776; df = 16; p = 0.449).

In the experiment for the ideation of design concepts with emphasis on the **Originality + Competitiveness** dimensions, female designers had a mean of general verbal expressions (28.4545 ± 6.9045) quite similar to that of male designers (28.6667 ± 10.1242). The difference between the arithmetic means of both was 0.2121, which shows that *the difference between the means of general verbal expressions of female and male designers was not statistically significant* (t = 0.056; df = 18; p = 0.959). In relation to the clarity of intention during concept ideation, female designers had a mean of dimension-specific verbal expressions (10.2727 ± 3.5522) also similar to that of male designers (10.6767 ± 3.00), with a difference between both means of 0.3939 which implies that *the difference between the means of the dimension-specific verbal expressions of female and male designers was not statistically significant* (t = 0.264; df = 18; p = 0.795). Regarding the number of pictorial expressions (drawings), female designers had a mean (4.0909 ± 2.5082) similar to that of male designers (4.2222 ± 2.5874), presenting a difference between both means of 0.1313 which shows that *the difference between the means of the pictorial expressions of female and male designers was not statistically significant* (t = 0.115; df = 18; p = 0.91). Finally, in relation to the time employed for concept ideation, it was found that the mean of female designers (2.4855 ± 0.6572 hours) was not too different to that of male designers (2.6575 ± 0.3211 hours), with a difference between both means of 0.1720 which suggests that *the difference between the means of time employed by female and male designers was not statistically significant* (t = 0.680; df = 17; p = 0.506).

In the experiment for the ideation of design concepts with emphasis on the **Pertinence + Competitiveness** dimensions, female designers had a mean of general verbal expressions (29.4545 ± 6.4709) higher than that of male designers (25.6667 ± 8.3367). The difference between the arithmetic means of both was -3.7879, which shows that *the difference between the means of general verbal expressions of female and male designers was not statistically significant* (t = -1.145; df = 18; p = 0.267). In relation to the clarity of intention during concept ideation, female designers had a mean of dimension-specific verbal expressions (7.6364 ± 3.2946) higher than that of male designers (6.0000 ± 3.6742), with a difference between both means of -1.6364 which implies that *the difference between the means of the dimension-specific verbal expressions of female and male designers was not statistically significant* (t = -1.050; df = 18; p = 0.308). Regarding the number of pictorial expressions (drawings), female designers had a mean (4.2727 ± 3.0030) lower than that of male designers (6.2222 ± 3.3916), presenting a difference between both means of 1.9495 which shows that *the difference between the means of the pictorial expressions of female and male designers was not statistically significant* (t = 1.253; df = 18; p = 0.226). Finally, in relation to the time employed for concept ideation, it was found that the mean of female designers (2.6450 ± 0.3730 hours) was not too different to that of male designers (2.8611 ± 0.3914 hours), with a difference between both means of 0.2161 which suggests that *the difference between the means of time employed by female and male designers was not statistically significant* (t = 1.280; df = 17; p = 0.218).

In the experiment for the ideation of design concepts with emphasis on the **Representativeness + Expressiveness + Competitiveness** dimensions, female designers had a mean of general verbal expressions (14.8182 ± 3.7635) slightly higher than that of male designers (14.1111 ± 3.6893). The difference between the arithmetic means of both was -0.7071, which shows that *the difference between the means of general verbal expressions of female and male designers was not statistically significant* (t = -0.422; df = 18; p = 0.678). In relation to the clarity of intention during concept ideation, female designers had a mean of dimension-specific verbal expressions (11.5455 ± 3.2051) quite similar to that of male designers (11.5556 ± 2.9627), with a difference between both means of 0.01 which implies that *the difference between the means of the dimension-specific verbal expressions of female and male designers was not statistically significant* (t = 0.007; df = 18; p = 0.994). Regarding the number of pictorial expressions (drawings), female designers had a mean (2.9091 ± 1.4460) lower than that of male designers (3.7778 ± 2.2236), presenting a difference between both means of 0.8687 which shows that *the difference between the means of the pictorial expressions of female and male designers was not statistically significant* (t = 1.055; df = 18; p = 0.306). Finally, in relation to the time employed for concept ideation, it was found that the mean of female designers (2.6518 ± 0.3848 hours) was higher than that of male designers (2.1600 ± 0.6855 hours), with a difference between both means of -0.4918 which suggests that *the difference between the means of time employed by female and male designers was not statistically significant* (t = -1.918; df = 15; p = 0.074).

5.3.4. Discussion of results

In relation to the first hypothesis of this study, regarding the possibility of significant differences in the rates of verbalisation and clarity of intention between male and female designers during concept ideation, the results suggest that there is no such a difference in all the dimensions of our conceptual model. This may be due to the fact that -regardless the designers' gender- the members of the sample used for the experiments have the same level of instruction and experience in product design. In this sense, it is clear that similar results could not be achieved with professional designers given their varied experience at designing.

Regarding the second hypothesis about the extent to which gender affects the production of pictorial expressions during concept ideation, the only significant difference found between genders was in the Utility dimension where male designers tend to draw more than female designers. In this respect, the similarity in the drawing behaviour present in 75% of the dimensions of our model showed how significant has been the provision of the same design education for both genders. On the other hand, the presence of a significant difference in the Utility dimension can be attributed to what H. A. Witkin (1967) once described as the pre-eminence of a field-independent cognitive style in men. That is to say, the presence of a cognitive style that helps men to dare explore new things (unrelated to the contexts they already know). In this sense, some studies show that men tend to assess the user interactions with products in hard functional terms while women do the same in more emotive terms (McDonagh-Philp and Lebbon, 2000). However, the presence of such a situation is said to be socially conditioned (Witkin, 1967). Therefore, it may vary from one society to another (see the five dimensions of culture suggested by Gert Hosftede in section 4.1.6 of chapter 4).

Finally, in relation to the third hypothesis regarding the possibility of differences in the time spent by each gender to formulate design concept in some dimensions of our model, the results lead us to conclude that there is no significant difference in all the dimensions of our study. Hereof gender did not affect the time employed by the participants of our experiments.

5.4. STUDY 3: Differences among the dimensions for concept ideation

5.4.1. Introduction

The central hypothesis of this research is that: "The ideation of design concepts within product design is an activity of meaning construction whose understanding can be envisaged through an appropriate theoretical segmentation of the aspects it involves". Thus, this research has generated a theoretical model of six theoretical dimensions which can be grouped in three pairs of opposite semantic poles: Utility-Competitiveness, Originality-Pertinence, and Representativeness-Expressiveness (see section 4.2.2. of chapter 4). However, as the purpose of creating such a model was to enable designers improve their ideation of design concepts, it is necessary to verify the extent to which the proposed dimensions can be distinguished from each other in practical terms. To this aim, the arithmetic means of general and dimension-specific verbal expressions as well as those of pictorial expressions present in the four post-induction experiments were compared one to one, to find patterns that can lead to such distinctions. In this sense, three hypotheses were formulated:

H_1: The dimensions of our model for concept ideation can be distinguished from each other based on the number of verbal associations produced in each of them.

H_2: The clarity of intention, manifested through the number of dimension-specific verbal associations, is different from one dimension to another.

H_3: The behaviour drawing, manifested through the number of pictorial expressions, is different from one dimension to another.

5.4.2. Method of analysis

The numbers of *general* and *dimension-specific expressions* as well as the number of *pictorial expressions* present in the **80 design concepts** produced during the four experiments carried out after induction were processed using the version 10.0.6 for Windows of the Statistical Package for the Social Sciences (SPSS). Results were analysed in a descriptive manner taking their arithmetic means as measures of distribution and their Standard Deviations as measures of spread. The inferential analysis was carried out using a t-test for related samples in which the arithmetic means of the four post-induction experiments were compared one to one in order to see if there were significant differences among them, with a significance level of 5%. Thus, only six comparisons were carried out between experiments, since further comparisons were symmetrical (e.g. Utility and Pertinence is the same comparison to that between Pertinence and Utility). For the sake of simplicity experiments are here reported without using the word "Competitiveness" for the naming of each of them (e.g. "Utility" instead of "Utility + Competitiveness"), since Competitiveness is present in all four experiments and therefore, it does not make a significant difference to mention it for the understanding of results. Similarly, the word "experiment" is only mentioned at the beginning of each report of results. In this sense, readers should bear in mind that, each time a dimension is referred, what is actually at stake is the experiment carried out with emphasis on that particular dimension.

5.4.3. Results

In the comparison between the experiments focused on the **Originality dimension** and that focused on the **Utility dimension**, the mean of general verbal expressions in Originality (28.55 ± 8.2620) was higher than that of Utility (21.65 ± 4.7603). The difference between the arithmetic means of both experiments was -6.9, which shows that *the difference between the means of general verbal expressions of Originality and Utility was statistically significant* (t = -5.285; df = 19; p = 0.000). In relation to the clarity of intention during concept ideation, the mean of dimension-specific verbal expressions in Originality (10.45 ± 3.2359) was higher than that of Utility (9.5 ± 3.5467), presenting a difference between both means of -0.95, which implies that *the difference between the means of the dimension-specific verbal expressions of Originality and Utility was not statistically significant* (t = -0.894; df = 19; p = 0.382). Regarding the number of pictorial expressions (drawings), the mean of Originality (4.15 ± 2.4767) was higher than that of Utility (3.80 ± 2.8946), with a difference between both means of -0.35 which suggests that *the difference between the means of the pictorial expressions of Originality and Utility was not statistically significant* (t = -0.482; df = 19; p = 0.635).

In the comparison between the experiments focused on the **Pertinence dimension** and that focused on the **Utility dimension**, the mean of general verbal expressions in Pertinence (27.75 ± 7.4189) was higher than that of Utility (21.65 ± 4.7603). The difference between the arithmetic means of both experiments was -6.10, which shows that *the difference between the means of general verbal expressions of Pertinence and Utility was statistically significant* (t = -5.118; df = 19; p = 0.000). In relation to the clarity of intention during concept ideation, the mean of dimension-specific verbal expressions in Pertinence (6.9 ± 3.4777) was lower than that of Utility (9.5 ± 3.5467), presenting a difference between both means of 2.6, which implies that *the difference between the means of the dimension-specific verbal expressions of Pertinence and Utility was statistically significant* (t = 3.057; df = 19; p = 0.006). Regarding the number of pictorial expressions (drawings), the mean of Pertinence (5.15 ± 3.5135) was higher than that of Utility (3.80 ± 2.8946), with a difference between both means of -1.35 which suggests that *the difference between the means of the pictorial expressions of Pertinence and Utility was not statistically significant* (t = -1.906; df = 19; p = 0.072).

In the comparison between the experiments focused on the **Representativeness + Expressiveness dimension** and that focused on the **Utility dimension**, the mean of general verbal expressions in Representativeness + Expressiveness (14.50 ± 3.6491) was lower than that of Utility (21.65 ± 4.7603). The difference between the arithmetic means of both experiments was 7.15, which shows that *the difference between the means of general verbal expressions of Representativeness + Expressiveness and Utility was statistically significant* (t = 7.785; df = 19; p = 0.000). In relation to the clarity of intention during concept ideation, the mean of dimension-specific verbal expressions in Representativeness + Expressiveness (11.55 ± 3.0171) was higher than that of Utility (9.5 ± 3.5467), presenting a difference between both means of -2.05, which implies that *the difference between the means of the dimension-specific verbal expressions of Representativeness + Expressiveness and Utility was statistically significant* (t = -2.259; df = 19; p = 0.036). Regarding the number of pictorial expressions (drawings), the mean of Representativeness + Expressiveness (3.30 ± 1.8382) was higher than that of Utility (3.80 ± 2.8946), with a difference between both means of 0.5 which suggests that *the difference between the means of the pictorial expressions of Representativeness*

+ *Expressiveness and Utility was not statistically significant* (t = 0.717; df = 19; p = 0.482).

In the comparison between the experiments focused on the **Originality dimension** and that focused on the **Pertinence dimension**, the mean of general verbal expressions in Originality (28.55 ± 8.2620) was higher than that of Pertinence (27.75 ± 7.4189). The difference between the arithmetic means of both experiments was -0.80, which shows that *the difference between the means of general verbal expressions of Originality and Pertinence was not statistically significant* (t = -0.484; df = 19; p = 0.634). In relation to the clarity of intention during concept ideation, the mean of dimension-specific verbal expressions in Originality (10.45 ± 3.2359) was higher than that of Pertinence (6.9 ± 3.4777), presenting a difference between both means of -3.55, which implies that *the difference between the means of the dimension-specific verbal expressions of Originality and Pertinence was statistically significant* (t = -3.673; df = 19; p = 0.002). Regarding the number of pictorial expressions (drawings), the mean of Originality (4.15 ± 2.4767) was lower than that of Pertinence (5.15 ± 3.5135), with a difference between both means of 1.0 which suggests that *the difference between the means of the pictorial expressions of Originality and Pertinence was not statistically significant* (t = 1.624; df = 19; p = 0.121).

In the comparison between the experiments focused on the **Pertinence dimension** and that focused on the **Representativeness + Expressiveness dimension**, the mean of general verbal expressions in Pertinence (27.75 ± 7.4189) was higher than that of Representativeness + Expressiveness (14.50 ± 3.6491). The difference between the arithmetic means of both experiments was 13.25, which shows that *the difference between the means of general verbal expressions of Pertinence and Representativeness + Expressiveness was statistically significant* (t = 9.25; df = 19; p = 0.000). In relation to the clarity of intention during concept ideation, the mean of dimension-specific verbal expressions in Pertinence (6.9 ± 3.4777) was lower than that of Representativeness + Expressiveness (11.55 ± 3.0171), presenting a difference between both means of -4.65, which implies that *the difference between the means of the dimension-specific verbal expressions of Pertinence and Representativeness + Expressiveness was statistically significant* (t = -4.787;

df = 19; *p* = 0.000). Regarding the number of pictorial expressions (drawings), the mean of Pertinence (5.15 ± 3.5135) was higher than that of Representativeness + Expressiveness (3.30 ± 1.8382), with a difference between both means of 1.85 which suggests that *the difference between the means of the pictorial expressions of Pertinence and Representativeness + Expressiveness was statistically significant* (*t* = 2.794; *df* = 19; *p* = 0.012).

In the comparison between the experiments focused on the **Originality dimension** and that focused on the **Representativeness + Expressiveness dimension,** the mean of general verbal expressions in Originality (28.55 ± 8.2620) was higher than that of Representativeness + Expressiveness (14.50 ± 3.6491). The difference between the arithmetic means of both experiments was 14.05, which shows that *the difference between the means of general verbal expressions of Originality and Representativeness + Expressiveness was statistically significant* (*t* = 8.872; *df* = 19; *p* = 0.000). In relation to the clarity of intention during concept ideation, the mean of dimension-specific verbal expressions in Originality (10.45 ± 3.2359) was lower than that of Representativeness + Expressiveness (11.55 ± 3.0171), presenting a difference between both means of -1.1, which implies that *the difference between the means of the dimension-specific verbal expressions of Originality and Representativeness + Expressiveness was not statistically significant* (*t* = -1.218; *df* = 19; *p* = 0.238). Regarding the number of pictorial expressions (drawings), the mean of Originality (4.15 ± 2.4767) was higher than that of Representativeness + Expressiveness (3.30 ± 1.8382), with a difference between both means of 0.85 which suggests that *the difference between the means of the pictorial expressions of Originality and Representativeness + Expressiveness was not statistically significant* (*t* = 1.369; *df* = 19; *p* = 0.187).

5.4.4. Discussion of results

In relation to the first hypothesis regarding the extent to which the dimensions of our model for concept ideation can be distinguished from each other based on the number of general verbal associations produced in each of them, the results of our study suggest that in five out of the six comparisons (83.33%) carried out between the dimensions present means of general verbal associations which are significantly different. Nevertheless, in the comparison between the means of the Originality and Pertinence dimensions the difference was not significant. This latter result is presumed to come from the fact that Originality and Pertinence are the only two dimensions of our testing which have been compared despite of being part of the same theoretical axis of opposites in our model. In this sense, it is presumed that something similar could happen if the dimensions Representativeness and Expressiveness were not placed as part of a single experiment, and if the Utility dimension could be tested against the Competitiveness dimension alone. However, as referred in 5.1.2. this sort of distinction is quite hard to translate into experimental terms different to those presented in this study. Beyond this, it has become obvious that in those dimensions of our model where the ideation of design concepts depend more on a logic of analytical nature (e.g. how similar or different is a design concept from existent products? How appropriate is this design solution?), such as Originality and Pertinence, verbalisation presents the higher means of our study (28.55 and 27.75 verbal expressions respectively). Differently, in those dimensions of our model in which the logic is more of a synthetic-pictorial nature, such as Representativeness and Expressiveness, verbalisation shows the lower mean of our study (14.50 verbal expressions). On the other, Utility seems to be a dimension in between the two extreme previously described since its arithmetic mean of verbalisation was neither too high nor too low (21.65 verbal expressions).

Regarding the second hypothesis about whether the clarity of intention is different among the dimensions of our model, the results of our study show that it is true in four out of the six comparisons carried out (66.66%). Curiously the clarity of intention manifested through the number of dimension-specific associations was not significant in two comparisons where the Originality dimension was involved (i.e. Originality – Utility, and Originality – Representativeness + Expressiveness), with dimensions that do not belong to the same axis of opposites in our model. Such a situation makes sense if we consider that the remaining comparison involving the Originality dimension was that with the Pertinence dimension (i.e. the opposite pole of the relation to which Originality belongs). Thus, clarity of intention seems to take place in relation to Originality only in dimensions which are neither too factual (such as Utility) nor too subjective (such as Representativeness and Expressiveness), given that in these two conceptual extremes Originality tends to naturally blend with them. Furthermore, results show that designers tend to produce less dimension-specific verbal associations in dimensions where the design solutions are more evident (such as the Pertinence dimension = 6.9 verbal associations) and produce more dimension-specific verbal associations in those dimensions where designs solutions are less evident (i.e. Representativeness and Expressiveness = 11.55 verbal associations).

Finally, in relation to the third hypothesis regarding the extent to which the dimensions of our model can be distinguished in terms of the drawing behaviour of designers (number of pictorial expressions), the results show that the number of pictorial expressions is only significantly different in the comparison between Pertinence and Representativeness + Expressiveness. It seems logical since two radical extremes in terms of pictorial concepts were here compared: Pertinence, the easiest to express in pictorial terms (given that it deals with what is familiar to us), and Representativeness + Expressiveness, the harder to express graphically. In this sense, this third hypothesis was disproved given that only one comparison out of six shows to be significantly different (16.66%).

Conclusions

The ideas, facts and findings outlined and discussed throughout this dissertation have led us to the following conclusions:

1. From a methodological standpoint, the present research was developed following an approach based on the integration of contributions from different forms of knowledge working around a design situation or theme, as suggested by some design authors (Aicher, 1994a; Cross, 2001 and Margolin, 2005). From this perspective, this study is not very far from interdisciplinary methodologies like that of social history and material culture studies. In our case, semiotics was used as a theoretical paradigm to model the situation under study and cognitive psychology as the experimental paradigm to test it. The idea was to create a space of discussion and reflection capable of integrating complementary views at different levels such as those between: mental models (Craik, 1943; Norman,1988) and design concepts (Pugh, 1991; Lidwell, Holden and Buthler, 2003), the semiotic function in psychology (Piaget and Inhelder, 1969) and semiosis/signification in semiotics (Sebeok, 1986), the constructionist approach of social scientists (Mead, 1934, Berger and Luckmann, 1996 y 1997, Morin, 1994; Elias, 2000) and the constructivist approach of design theorists like Krippenddorff (1992).

2. Given the fact that we live in a world where the immaterial (i.e. information) is becoming more and more important in our understanding of reality, few aspects of design are becoming more relevant than dealing with the way products make sense to people. It is especially significant now that design has begun to deal with *real time* and the notion of *products as services* where the realisation of the possible meaningful relationships involved is a key aspect. On the other hand, the understanding of design as an aesthetic activity has experienced important changes. It has moved from focussing its attention on the object (product) to centre a significant part of its concerns on the subject (i.e. its user or consumer). Insomuch that design aesthetics has been redefined based on the Greek *aesthesis* (or sense perception), bringing along a variety of categories to appraise the contribution of products in people's lives.

3. Since our understanding of the world is based on those things which make sense to us, meaning is a key aspect in every human activity. In theoretical terms, meaning can be envisaged as comprised of three basic aspects: (1) A process - called **semiosis or signification** - by which our mind associates signs to things or events as if the former were standing for the latter (e.g. a cloudy sky for a storm or a golden finishing for luxury), (2) the presence of certain capacities and knowledge on the side of the beholder or interpreter of those signs to trigger semiosis, and (3) a conscious realisation of the fact that when something is standing for something else it is directing our mind toward some referent, i.e. toward that thing or situation which is seen as being represented by signs. This third aspect in particular allows us to see the construction of meaning in design products as a matter of reference, that is, as resulting from the mechanism by which the physical features of products (shapes, colours, materials, finishes, etc.) are seen as evoking formal similarities, functional aspects, social status, and so on. Thus, reference within design can be understood in a twofold way: as having to do with what the users or consumers associate with design products during their interaction with them, and as the way in which designers elicit mental associations in the mind of users/consumers through the selection and combination of shapes, materials, colours, finishes, etc. in their design concepts/proposals. In this sense, the present research was only focused on the latter given that its main aim was to develop "a theory of reference for product design". To this aim all our efforts were placed on design concepts.

4. Standing on the idea that concepts are ideas that help people structure their knowledge of reality and, therefore part of the so-called **semiotic function** of human behaviour (i.e. of our capacity to represent and evoke things), design concepts were here appraised from three different but complementary perspectives: that of design, that of philosophy and that of psychology. From the standpoint of design, we came to the conclusion that design concepts can be defined as: *holistic and mostly graphic descriptions of: (1) the physical configuration that will prevail in a design product, (2) the mental associations from which it has emerged and (3) the innovative intentions of its designer* (understanding innovation as the act of creating something different or new). From the philosophical standpoint, we envisaged design concepts as ideas derived from the personal experience and knowledge of each designer that: (1) respond to the particular circumstances of each design problem, (2) help designers to realise what is needed or possible, (3) involve

a variety of aspects, and (4) aim to the materialisation of products. Finally, from the standpoint of psychology, we have come to the conclusion that concepts are different to mental images even though this latter can be part of them. Furthermore, based on the pre-eminence of analytical or synthetic mental processes as well as the presence of verbal or perceptual codes in their configuration, design concepts were characterised as either more **symbolic** (verbal) or more **iconic** (perceptual) in nature. Consequently, the overt manifestations of concept ideation in product design were located in the crossroad of the **descriptive** (verbal) **and depictic** (pictorial) **representational systems.**

5. The existing theories about reference in the field of design represent a valuable tradition in terms of describing such a complex phenomenon. They all have something to offer for future theorisations. Hence it is hard to see how some theoretical views are formulated on the fringe of these contributions. Such is the case of authors like Klauss Krippendorff (1998), who has openly been opposed to the idea of conceiving meaning as a matter of reference. One thing is to have different sources of inspiration to develop theoretical formulations about the same sort of phenomena (as happens in most non-semiotic theories about reference in utilitarian objects) and another thing is to work in the explanation of the same phenomena purposely denying part of their nature. Bearing this in mind, some contributions from theories previous to this research were carefully incorporated to the theoretical model developed as part of this study. They were particularly used to characterise: the content and type of reference prevailing in each of the proposed dimensions for meaning construction, as well as to define the semiotic nature and design emphasis of each dimension.

6. Beyond the comprehensive literature review carried out as part of this research about concepts, design concepts and theories of reference, the major achievement of this study was the proposition of a model for the ideation of design concepts capable of encapsulating different ways to make sense out of products. Thus, the initial challenge posed by the central hypothesis of this study has been proved to be possible and therefore true (see the 'Introduction' of this dissertation). Indeed the model formulated as part of this research is not only comprehensive but also easy to understand and handle by designers to create design concepts with confidence. The practical feasibility of this model has been also proved to be true based on the results of the experiments described in chapter five. To this aim, a verbally-centred

method of four steps called ASCHASKET was formulated since the use of words in concept ideation tend to be dimension-specific in contrast with drawings which are generally holistic. In this sense, the results of the first experimental study presented in chapter five showed that ASCHASKET was successful in increasing the rate of verbal associations of designers, helping in this way to make more obvious the presence of each of the dimensions under study. On the other hand, the results of the second experimental study carried out showed that the gender of designers does not affect the rates of verbalisation, clarity of intention and time employed in all the dimensions under study. However, a significant difference was observed between the pattern of behaviour of male and female designers in the Utility dimension of our model, given that male designers tend to draw more than female designers. Finally, in relation to the third experimental study developed as part of this research, it can be said that clear distinctions between the dimensions under study were found, these being of an 83.33% of certainty in relation to the presence of significant differences in the verbal behaviour displayed by designers during concept ideation in each dimension, and of a 66.66% of certainty in relation to the clarity of intention with which designers tackle each of these dimensions as separate matters when forced to do so under experimental conditions.

7. Based on the knowledge acquired about concept ideation during this research, it can be said that a pre-scientific (speculative) rather than a scientific view is what prevails in the design literature about this subject. In this sense, it is desirable to see in a close future more scientific findings incorporated to the understanding of design concepts. On the other hand, it is clear that the definitions of design concepts reviewed as part of this research have inherited from Western culture their understanding of the visual as the way par excellence to conceive or imagine things (from the Greek 'Eidos'). Hereby, more research should be dedicated to explore the creative potential of multi-sensory ways of thinking. A first step in this direction can be the formulation of design concepts combining images with words, since images help to provide the holistic character concepts require whereas words can help to encapsulate what is not visual by definition. In this sense, this research has also shown that our working definition of design concepts was right when it stated that they should (1) *describe* (the product as a whole: its materials, forms and other properties), (2) *express* (in an explicit manner the mental associations and design intentions from which it is born), and (3) *suggest* (a general pattern of order).

References

Abercrombie, Nicholas; Hill, Stephen and Turner, Bryan (1994) **The Penguin dictionary of sociology**. London: Penguin Books.

Acero, Juan; Bustos, Eduardo and Quesada, Daniel (2001) **Introducción a la filosofía del lenguaje** [Introduction to the philosophy of language]. Madrid: Cátedra.

Acha, Juan (1990) **Introducción a la teoría de los diseños** [Introduction to the theory of designs]. Mexico: Trillas.

Acha, Juan (1999) **Los conceptos esenciales de las artes plásticas**. Mexico: Coyoacán.

Ahonen, Annu (ed) (1996) **CODE: 12 styles 60 small domestic appliances**. Helsinki: UIAH.

Aicher, Olt (1978) **"Analogous and digital"**. In Olt Aicher (1994) *The world as design*. Berlin: Ernst & Sohn, pp. 45-52.

Aicher, Olt (1987) **"Bauhaus and Ulm"**. In Olt Aicher (1994) *The world as design*. Berlin: Ernst & Sohn, pp. 85-93.

Aicher, Olt (1994a) **"The world as design"**. In Olt Aicher (1994) *The world as design*. Berlin: Ernst & Sohn, pp. 179 – 189.

Aicher, Olt (1994b) **"Design and philosophy"**. In Olt Aicher (1994) *The world as design*. Berlin: Ernst & Sohn, pp. 73 - 90.

Akin, Omer (1979) **"An exploration of the design process"**. In Nigel Cross (ed) (1984) *Developments in Design Methodology*. New York: John Wiley & Sons, pp. 189 – 207.

Alexander, Christopher (1964) **Notes on the synthesis of form**. Cambridge: Harvard University Press.

Alexander, Christopher (1969) **"Sistemas que generan sistemas"**. In Christopher Alexander (1969) *Tres aspectos de matemática y diseño*. Barcelona: Tusquets, pp.63 – 79 [Spanish trans. Beatriz de Moura from the English version entitled: *"Systems generating systems"*. In *Systemat* (pamphlet). Milwakee: Inland-Ryerson Construction Products Company. 1969].

Alger, John and Hays, Carl (1964) **Creative synthesis in design**. New Jersey: Prentice-hall.

Anderson, John R. (1978) **"Arguments concerning representations for mental imagery"**. *Psychological Review*, Vol.85, N° 4, pp. 249 – 277.

Archer, Bruce (1965) **"Systematic methods for designers"**. In Nigel Cross (ed) (1984) *Developments in design methodology*. New York: John Wiley & Sons, pp. 57 – 81.

Archer, Bruce (1979) **"Design as a discipline"**. *Design Studies*, Vol. 1, N° 1, July, pp. 17– 20.

Archer, Bruce (1981) **"A view of the nature of design research"**. In Robin Jacques and James Powell (eds) (1981) *Design: Science: Method*. Surrey: Westbury House, pp. 30 – 47.

Aristotle. **Metafísica** [Metaphysics] in (1947) *Obras completas de Aristóteles*, Vol II. Buenos Aires: Anaconda [Spanish trans. D. Patricio de Azcárate].

Argan, Giulio Carlo (1961) **"Calidad, función y valor del diseño industrial"** [Quality, function and value of industrial design]. In Giulio C. Argan (1969) *Proyecto y destino*. Caracas: Universidad Central de Venezuela, pp. 111 - 116 [Spanish trans. Marco Negrón].

Arnheim, Rudolf (1947) **"Perceptual abstraction and art"**. In Rudolf Arnheim (1966) *Toward a psychology of art.* Berkeley: University of California Press, pp. 27 – 50.
Arnheim, Rudolf (1961) **"The form we seek"**. In Rudolf Arnheim (1966) *Toward a psychology of art.* Berkeley: University of California Press, pp. 353 – 362.

Arnheim, Rudolf (1964) **"From function to expression"**. In Monroe Beardsley and Herbert Schuller (eds) (1967) *Aesthetic inquiry.* Belmont: Dickenson, pp. 199 – 214.

Arnheim, Rudolf (1969) **Visual thinking**. Berkeley: University of California Press.

Arnheim, Rudolf (1972) **Arte y percepción visual**. Buenos Aires: EUDEBA [Spanish trans. Rubén Masera from the English version entitled: *Art and Visual Perception.* Berkeley: University of California Press. 1957].

Arnheim, Rudolf (1978) **La forma visual de la arquitectura**. Barcelona: Gustavo Gili. [Spanish trans. Esther Labarta from the English version entitled: *The Dynamics of Architectural Form.* Berkeley: University of California Press. 1977].

Arnheim, Rudolf (1995) **"Sketching and the psychology of design"**. In Victor Margolin and Richard Buchanan (eds) *The idea of design.* Cambridge, Mass.: The MIT Press, pp. 70 –74.

Art-Union Journal (1846) **"Standards of design"**. In Christopher Harvie, Graham Martin and Aaron Scharf (eds) (1970) *Industrialisation and culture: 1830 - 1914.* London: Macmillan-The Open University, pp. 270 – 271.

Ashwin, Clive (1984) **"Drawing, design and semiotics"**. *Design Issues*, Vol. 1, No. 2. Autumn, 1984, pp. 42-52.

Asimow, Morris (1962) **Introduction to design**. New Jersey: Prentice-Hall.

Ask, Trygve (1998) **"To what extent does industrial design have a tradition of theoretical discussion? And what are the key issues in this tradition?"** [Online]. Available from: http://www.aho.no/ask/theory.html (15 July 2006)

Athavankar, Uday (1990) **"The semantic profile of products"**. In Susann Vihma (ed) (1990) *Semantic visions in design* [Proceedings from the 1989 Symposium on Design Research and Semiotics in Helsinki]. Helsinki: University of Industrial Arts, pp. d1 – d31.

Athavankar, Uday (1997) **"Cultural identity and design"**. *Formdiskurs*, Vol. 3, N° 11/1997, pp. 68 - 81.

Athavankar, Uday (1999) **"Gestures, imagery and spatial reasoning"** [Online]. Available from: http://wwwfaculty.arch.usyd.edu.au/kcdc/books/VR99/ATH.html (08 February 2006)

Atman, Cynthia et.al. (1999) **"A comparison of freshman and senior engineering design processes"**. *Design Studies*, Vol. 20, N°2, March, pp. 131 – 152.

Attoe, Wayne (1982) **La crítica en arquitectura como disciplina**. Mexico: Limusa [Spanish trans. Carlos Alberto García from the English version entitled: *Architecture and critical imagination.* John Wiley & Sons. 1978].

Austin, Simon et.al. (2001) **"Mapping the conceptual design activity of interdisciplinary teams"**. *Design Studies*, Vol. 22, No.3, May, pp. 211 – 232.

Ayto, John (1991) **Dictionary of word origins**. London: Bloomsbury.

Banham, Reyner (1955) **"The machine aesthetic"**. In Penny Sparke (ed) (1981) *Reyner Banham: Design by choice.* London: Academy Editions, pp. 44 - 47.

Banham, Reyner (1971) **Teoría y diseño arquitectónico en la era de la máquina**. Buenos Aires: Nueva Visión [Spanish trans. Luis Fabricant from the English version entitled: *Theory and design in the first machine age*. London: Architectural Press. 1960].

Barbacetto, Gianni (1987a) **"Key/word: Interface"**. In Gianni Barbacetto (ed) (1987) *Design interface. How man and machine communicate: Olivetti design research by King & Miranda.* Milan: Arcadia, pp. 11 - 12.

Barbacetto, Gianni (1987b) **"Interface is design: Beyond research"**. In Gianni Barbacetto (ed) (1987) *Design interface. How man and machine communicate: Olivetti design research by King & Miranda.* Milan: Arcadia, pp. 97 - 111.

Barbacetto, Gianni (1987c)**"Signs and messages: The results of the research"**. In Gianni Barbacetto (ed) (1987) *Design interface. How man and machine communicate: Olivetti design research by King & Miranda.* Milan: Arcadia, pp.79 - 95.

Barsalou, Lawrence (1982) **"Context-independent and context-dependent information in concepts"**. *Memory & Cognition*, Vol. 10, N° 1, pp. 82 – 93.

Barthes, Roland (1962) **"The imagination of the sign"**. In Susan Sontag (ed) (1993) *A Roland Barthes reader*. London: Vintage, pp. 211 – 217.

Barthes, Roland (1963) **"The advertising message"**. In Roland Barthes (1994) *The semiotic challenge*. Berkeley: The University of California Press, pp. 173 – 178.

Barthes, Roland (1964a) **"The kitchen of meaning"**. In Roland Barthes (1994) *The semiotic challenge*. Berkeley: The University of California Press, pp. 157 - 159.

Barthes, Roland (1964b) **"Semantics of the object"**. In Roland Barthes (1994) *The semiotic challenge*. Berkeley: The University of California Press, pp. 179 – 190.

Barthes, Roland (1969) **"Elementos de semiología"** [Elements of Semiology]. In Barthes et.al. (1972) *La semiología*. Buenos Aires: Tiempo Contemporáneo [Spanish trans. Silvia Delpy from the French version published in: *Le degré zéro de l'écriture.*Gonthier. 1969].

Barthes, Roland (1972) **Mythologies**. London: Vintage.

Barthes, Roland (1977) **"Change the object itself: Mythology today"**. In Roland Barthes (1977) *Image, music, text*. London: Fontana, pp. 165 – 169.

Barthes, Roland (1987) **Criticism and truth**. London: The Athlone Press.

Baudrillard, Jean (1969) **"The ideological genesis of need"**. In Jean Baudrillard (1981) *For a critique of the political economy of the sign*. St. Louis: Telos Press.

Baudrillard, Jean (1983) **Simulations**. New York: Semiotext.

Baudrillard, Jean (1993) **Symbolic exchange and death**. London: Sage.

Baudrillard, Jean (1994) **El sistema de los objetos** [The system of objects]. Mexico: Siglo XXI [Spanish trans. Francisco González Aramburu from the French version entitled: *Le système des objets*. Paris: Gallimard. 1968].

Baudrillard, Jean (1997) **Las estrategias fatales** [Fatal strategies] . Barcelona: Anagrama [Spanish trans. Joaquín Jordá from the French version entitled: Les stratégies fatales. Paris: Grasset & Frasquelle. 1983].

Baudrillard, Jean (1998) **The consumer society**. London: Sage.

Baudrillard, Jean (2002) **Contraseñas**. Barcelona: Anagrama [Spanish trans. Joaquín Jordá from the French version entitled: *Mots de passe*. Paris: Pauvert. 2000].

Baxter, Mike (1995) **Product design.** London: Chapman & Hall.

Bayley, Stephen (1983) **"Taste and design"**. In Stephen Bayley (ed) *Taste: An exhibition about values in design.* London: The Conran Foundation Boilerhouse Project – Victoria and Albert Museum, pp. 11 - 31.

Bayley, Stephen (1990) **"Classic statement"**. In Stephen Bayley (2000) *General knowledge.* London: Booth-Clibborn, pp. 227 – 229.

Bayley, Stephen (1991) **Taste the secret meaning of things.** London: Faber & Faber.

Bell, Daniel (1967) **"Notes on the post-industrial society"**. *The Public Interest,* Winter, pp.24 - 35.

Bell, Daniel (1973) **The coming of post-industrial society: A venture in social forecasting.** New York: Basic Books.

Bem, Daryl (1970) **Beliefs, attitudes, and human affairs.** Belmont, California: Brooks-Cole.

Bender, John (2001) **"Sensitivity, sensibility, and aesthetic realism"**. *The Journal of Aesthetics and Art Criticism,* Vol.59, No.1, Winter, pp.73 - 83.

Bense, Max (1960) **Estética: Consideraciones metafísicas sobre lo bello.** Buenos Aires: Nueva Visión [Spanish trans. Alberto Luis Bixio from the German version entitled: *Aesthetica.* Sttutgart: Deutsche Verlag-Anstalt. 1954].

Bense, Max (1972) **Introducción a la estética teórico-informacional** [Introduction to the Information-theory Aesthetics]. Madrid: Alberto Corazón [Spanish trans. Simón Marchán Fiz from the German version entitled: *Einfürung in die informationstheoretische Äesthetik.* Reinbeck bel Hamburg: Rowohlt Taschenbuch. 1969].

Bense, Max and Walther, Elisabeth (1975) **La semiótica: Guía alfabetizada** [Semiotics]. Barcelona: Anagrama [Spanish trans. Laura Pla from the German version entitled: *Wörterbuch der Semiotik.* Cologne: Kiepenheuer & Witsch. 1973].

Benton, Tim (1990) **"The myth of function"**. In Paul Greenhalgh (ed) *Modernism in design.* London: Reaktion Books, pp. 41 – 52.

Behrens, Roy (1998) **"Art, design and Gestalt theory"** [On line]. Available from: http://mitpress2.mit.edu/e-journals/leonardo/isast/articles/behrens.htm (10 October 2004)

Berger, Arthur (1989) **Seeing is believing.** Mountain View, California: Mayfield Publishing.

Berger, Peter and Luckmann, Thomas (1966) **The social construction of reality: A treatise in the sociology of knowledge** (Reissued, 1979, Norwich, England: Peregrine).

Berger, Peter and Luckmann, Thomas (1997) **Modernidad, pluralismo y crisis de sentido: La orientación del hombre moderno** [Modernity, pluralism and sense crisis]. Barcelona: Piadós [Spanish trans. Centro de Estudios Públicos (Chile) from the German version entitled: *Modernität, Pluralismus und Sinnkrise. Die Orientierung des modernen Menschen.* Gütersloh: Bertelsmann Stiftung. 1995].

Berlo, David (1969) **El proceso de comunicación.** Buenos Aires: Ateneo [Spanish trans. Silvina González and Giovanna Winckhler from the English version entitled: *The process of communication.* Holt, Rinehart and Winston. 1960].

Berlyne, Daniel (1974) **"Novelty, complexity, and interestingness"**. In Daniel Berlyne (ed) (1974) *Studies in the new experimental aesthetics: Steps toward an objective psychology of aesthetic apprecitation.* Washington, D.C.: Hemisphere, pp. 175 – 180.

Bermúdez, Guido (1993) **Diccionario del arquitecto.** Caracas: Miguel Angel García e hijo.

Bernabé, Alberto (ed) (1988) **De Tales a Demócrito: Fragmentos presocráticos.** Madrid: Alianza.

Besemer, Susan (2000) **"Creative product analysis to foster innovation".** *Design Management Journal*, Vol.11, N° 4, Fall, pp. 59 - 64.

Betts, Paul (1998) **"Science, semiotics and society: The Ulm Hochschule für Gestaltung in retrospect".** *Design Issues*, Vol. 14, N° 2, Summer, pp. 67 – 82.

Beveridge, William (1982) **El arte de la investigación científica.** 3ª ed. Caracas: Universidad Central de Venezuela [Spanish trans. Oswaldo Grillo from the English version: *The Art of Scientific Investigation.* New York: W.W. Norton & Co.].

Biederman, Irving; Glass, Arnold and Stacy, E. (1973) **"Searching for objects in real-world scenes".** *Journal of Experimental Psychology*, Vol. 97, N° 1, pp. 22 – 27.

Biederman, Irving (1987) **"Recognition-by-components: A theory of human image understanding".** *Psychological Review*, Vol. 94, N° 2, pp. 115 – 147.

Bird, John (1977) **"Art and design as a sign system".** In Terry Bishop (ed) (1977) *Leisure in the Twentieth Century* [Papers from the II Conference on Twentieth-Century Design History; Middlesex Polytechnic, 1976]. London: Design Council, pp. 86 – 91.

Bird, John (1978) **"The politics of advertising".** In Terry Bishop (ed) *Design history: fad or function?* [Papers from the III Conference on Twentieth-Century Design History, Brighton Polytechnic, September 1977]. London: Design Council, pp.49 - 55.

Boesch, Ernst (1990) **"Perception and meaning in design".** In Internationales Forum für Gestaltung Ulm (1990) *Cultural identity and design* [2nd International Forum of the Hochschule für Gestaltung Ulm, Tagung, 1989]. Berlin: Ernst & Sohn, pp. 50 –56.

Bonetto, Marco (1991) **"The simplicity of the everyday object".** *Ottagono*, N° 103, pp. 30 – 32.

Bonsiepe, Gui (1961) **"Persuasive communication: Towards a visual rhetoric".** *Uppercase*, N° 5, pp. 19 - 34.

Bonsiepe, Gui (1972) **Premisas del diseño y el subdesarrollo.** Series of documents on Modern Architecture, N° 7. Caracas: UCV – Facultad de Arquitectura y Urbanismo, pp. 1 – 13.

Bonsiepe, Gui (1978) **Teoría y práctica del diseño industrial.** Barcelona: Gustavo Gili [Spanish trans. Santiago Pey from the Italian version entitled: *Teoria e practica del disegno industriale.* Milan: Feltrinelli. 1975].

Bonsiepe, Gui (1980) **"Entrevista"** [Interview]. In Gui Bonsiepe (1985) *El diseño de la periferia.* Mexico: GG, pp. 54 – 89 [Spanish trans. from the Portuguese version entitled: *A tecnologia da tecnologia. Inovaçao tecnológica e desenho industrial.* Brazil]

Bonsiepe, Gui (1985a) **"Una experiencia de diseño de productos / diseño industrial"** [An experience about product design / industrial design]. In Gui Bonsiepe (1985) *El diseño de la periferia.* Mexico: GG, pp. 194 – 248.

Bonsiepe, Gui (1985c) **"Glosario no sistemático"** [Non systematic glossary]. In Gui Bonsiepe (1985) *El diseño de la periferia.* Mexico: GG, pp. 263 - 271.

Bonsiepe, Gui (1991) **"Las formas y sus para qué"** [Forms and their purpose]. In Gui Bonsiepe (1998) *Del objeto a la interfase.* Buenos Aires: Infinito, pp. 147 – 152 [Spanish trans. Luisa Dorazio from the Italian version entitled: *Dall'oggetto all'interfaccia.* Milan: Feltrinelli. 1995].

Bonsiepe, Gui (1992a) **"Las siete columnas del diseño"** [The seven columns of design]. In Gui Bonsipe (1998) *Del objeto a la interfase.* Buenos Aires: Infinito, pp. 15 – 23 [Spanish trans. Luisa Dorazio from the Italian version entitled: *Dall'oggetto all'interfaccia.* Milan: Feltrinelli. 1995].

Bonsiepe, Gui (1992b) **"Microestructuras estéticas"** [Aesthetic micro-structures]. In Gui Bonsiepe (1998) *Del objeto a la interfase.* Buenos Aires: Infinito, pp. 159 – 164 [Spanish trans. Luisa Dorazio from the Italian version entitled: *Dall'oggetto all'interfaccia.* Milan: Feltrinelli. 1995].

Bonsiepe, Gui (1995a) **"The chain of innovation: Science, technology, design".** *Design Issues,* Vol. 11, N° 3, Autumn, pp. 33 - 36.

Bonsiepe, Gui (1995b) **"The invisible facets of the HFG Ulm".** *Design Studies,* Vol. 11, N° 2, Summer, pp. 11 - 20.

Bonsiepe, Gui (1998a) **"Diseño de información en los hipermedios"** [Information design in hyper-Media]. In Gui Bonsiepe (1998) *Del objeto a la interfase.* Buenos Aires: Infinito, pp. 61 –66 [Spanish trans. Luisa Dorazio from the Italian version entitled: *Dall'oggetto all'interfaccia.* Milan: Feltrinelli. 1995].

Bonsiepe, Gui (1998b) **"Retórica verbal y visual"** [Verbal and visual rhetoric]. In Gui Bonsiepe (1998) *Del objeto a la interfase.* Buenos Aires: Infinito, pp. 71 – 86 [Spanish trans. Luisa Dorazio from the Italian version entitled: *Dall'oggetto all'interfaccia.* Milan: Feltrinelli. 1995].

Bonta, Juan Pablo (1973) **"Notes for a theory of meaning in design".** In Geoffrey Broadbent et.al. (eds) (1980) *Signs, symbols and architecture.* New York: John Wiley & Sons, pp. 275 - 310.

Bopry, Jeanette (2002) **"Semiotics, epistemology, and inquiry"** [Online]. Available from: http://www.und.edu/dept/ehd/journal/Fall2002/bopry.html (23 Sept. 2006).

Boudon, Pierre (1971) **"Sobre un status del objeto: Diferir el objeto del objeto"** [On a status of the object: Deferring the object of the object]. In Abraham Moles et.al. (1974) *Los objetos.* Buenos Aires: Tiempo Contemporáneo, pp. 95 – 117 [Spanish trans. Silvia Delpy from the French version entitled: *Les objets.* Communications (Journal), N° 13. Éditions du Seuil.].

Boulding, Kenneth (1956) **The image.** Ann Arbor: The University of Michigan Press.

Boulding, Kenneth (1958) **"Secular images of man in the social sciences".** In Larry Singell (ed) (1974) *Kenneth Boulding – Collected papers.* Vol.4. Boulder, Colorado: Colorado Associated University Press, pp. 75 - 84.

Boulding, Kenneth (1964) **"The place of the image in the dynamics of society".** In Larry Singell (ed) (1974) *Kenneth Boulding – Collected papers.* Vol.4. Boulder, Colorado: Colorado Associated University Press, pp. 225 – 236.

Bourdieu, Pierre and Passeron, Jean-Claude (1971) **"Social reproduction through education".** In Peter Worsley (ed) (1991) *The new modern sociology readings.* London: Penguin, pp. 216 - 221.

Bourdieu, Pierre (1979) **Distinction: A social critique of the judgement of taste.** 2nd reprint of the first English ed. London: Routledge.

Bouthoul, Gaston (1971) **Biología social.** Barcelona: Oikos-Tau [Spanish trans. Guillem Frontera from the French version entitled: *Biologie Sociale.* Presses Universitaires de France. 1964].

Braier, Leon (1980) **Diccionario enciclopédico de medicina** [Encyclopaedic Dictionary of Medicine]. 4° ed. Barcelona: JIMS.

Branco, João et.al. (2004) **"From Aristotle to Damasio: Towards a rhetoric on interaction".** In Deana McDonagh et.al. (eds) *Design and emotion: The experience of everyday things.* London: Taylor & Francis, pp. 372 – 376.

Branzi, Andrea (1988) **"A genetic mutation".** In Andrea Branzi (1988) *Learning from Milan: Design and the second modernity.* Cambridge: The MIT Press, pp. 75 – 79.

Braudel, Fernand (1958) "**Historia y ciencias sociales: La larga duración**" [History and social sciences: The long duration]. In Fernand Braudel (1991) *Escritos sobre historia.* Mexico: Fondo de Cultura Económica, pp. 39 – 51 [Spanish trans. Angelina Martín del Campo from the French version entitled: *Écrits sur l' histoire.* Paris: Flammarion. 1969].

Broadbent, Geoffrey (1969) "**Notes on design methods**". In Geoffrey Broadbent and Anthony Ward (eds) (1969) *Design methods in architecture.* London: Lund Humphries / The Architectural Association, pp. 198 – 204.

Broadbent, Geoffrey (1988) **Design in Architecture: Architecture and the human sciences.** London: David Fulton.

Bruner, Jerome (1991) **Actos de significado.** Madrid: Alianza [Spanish trans. Juan Carlos Gómez & José Luis Linaza from the English version entitled: *Acts of meaning.* 1990].

Bruseberg, Anne; McDonagh, Deana and Wormald, Paul (2004) "**The use of images to elicit user needs for the design of playground equipment**". In Deana McDonagh et.al. (eds) *Design and emotion: The experience of everyday things.* London: Taylor & Francis, pp. 114 – 118.

Buchanan, Richard (1989) "**Declaration by design: Rhetoric, argument, and demonstration in design practice**". In Victor Margolin (ed) *Design discourse: History, theory, criticism.* Chicago: The University of Chicago Press, pp. 91 - 109.

Bürdek, Bernhard (1994) **Diseño: Historia, teoría y práctica del diseño industrial.** Barcelona: GG [Spanish trans. Fernando Vegas from the German version entitled: *Design: Geschichte, Theorie und Praxis der Produktgestaltung.* Cologne: Du Mont. 1991].

Bürdek, Bernhard (1997) "**On language, objects and design**". *Formdiskurs,* Vol. 3, N° 11/1997, pp. 6 – 15.

Burkhardt, François and Franksen, Inez (1980) **Design: Dieter Rams.** Berlin: Gerhardt Verlag.

Burkhardt, François (1989)"**Tendencies of German design theories in the past fifteen years**". In Victor Margolin (ed) *Design discourse: History, theory and criticism.* Chicago: The University of Chicago Press, pp. 49 – 54.

Bush, Donald (1990) "**Body icons and product semantics**". In Susann Vihma (ed) *Semantic visions in design.* Helsinki: University of Industrial Arts, pp. $C_1 – C_{14}$.

Butter, Reinhart (1987)"**Product semantics. A new perspective on function in industrial design**". In Susann Vihma (ed) (1987) *Form and vision* [Papers from The International University of Industrial Arts Conference, Helsinki, 1987].Helsinki: UIAH, pp. 114 – 125.

Butter, Reinhart (1990) "**The practical side of a theory: An approach to the application of product semantics**". In Seppo Väkevä (ed) *Product Semantics '89* [Proceedings of the Product Semantics '89 Conference at the University of Industrial Arts, Helsinki]. Helsinki: The UIAH, pp. b1 – b17.

Byrne, Kevin (1990) "**A 'semantics' of visual design: The care and feeding of studio projects within a communication-theory context**". *Design Studies,* Vol. 11, N° 3, July, pp. 141 – 163.

Calabrese, Omar (1987) **El lenguaje del arte** [The language of art]. Barcelona: Paidós [Spanish trans. Rosa Premat from the Italian version entitled: *Il linguaggio dell' arte.* Milan: Bompiani. 1985].

Calabrese, Omar (1999) **La estética a finales del milenio.** *Forma* [Journal of the Faculty of Architecture and Art, Universidad de Los Andes, Venezuela], N° 4/1. Merida, Venezuela: Talleres Gráficos Universitarios, pp. 10 –19.

Cain, William Dennis (1969) **Engineering product design.** London: Business Books Ltd.

Campen, Crétien van (1996) **"Picture perception research: Gibson's continuation of the Gestalt and Bauhaus tradition"** [Online]. Available from: http://www.home-l.tiscali.nl/%7ecretien/pub/cheiron.htm (21 April 2004)

Carrier, David (1995) **"Art history"**. In David Cooper (ed) *A companion to Aesthetics*. Oxford: Blackwell, pp. 13 –17.

Carli, Fabrizio (2000) **Elettrodomestici spaziale.** Rome: Castelvecchi.

Carnap, Rudolf (1975) **Fundamentos de lógica y matemáticas.** Madrid: Taller de ediciones Josefina Betancor [Spanish trans. M. de Mora Charles from the English version entitled: *Foundations of Logic and Mathematics*. Chicago: University of Chicago Press. 1939].

Cassirer, Ernst (1945) **Antropología filosófica.** México: Fondo de Cultura Económica [Spanish trans. Eugenio Ímaz from the English version entitled: *Essay of Man*. New Haven: Yale University Press. 1944].

Cassirer, Ernst (1998) **Filosofía de las formas simbólicas: Fenomenología del reconocimiento.** Vol. III. México: Fondo de Cultura Económica [Spanish trans. Armando Morones from the German versión entitled: *Philosophie der Symbolischen Formen. Dritter Teil. Phänomelogie der Erkenntnis.* Darmstadt: Wissenschaftliche Buchgesellschaft. 1964].

Castelli, Clino (1999) **Transitive Design: A design language for the zeroes.** Milan: Electa.

Chan, Chiu -Shui (1990) **"Cognitive processes in architectural design problem solving"**. *Design Studies*, Vol. 11, N°2, April, pp. 60 – 80.

Chandler, Daniel (2005) **"Criticisms of semiotic analysis"**. In *Semiotics for beginners* [On line]. Available from: http://www.aber.ac.uk/media/Documents/S4B/sem11.html (23 June 2005)

Chang, Wen –Chih and Wu, Tyan-Yu (2007) **"Exploring types and characteristics of products forms"**. *International Journal of Design*, Vol. 1, N° 1, pp. 3 – 13.

Chapanis, Alphonse and Mankin, Donald (1967) **"Test of ten control-display linkages"**. *Human Factors*, Vol. 9, N° 2, pp. 119 - 126.

Chapman, Jonathan (2005) **Emotionally durable design: Objects experiences and empathy.** London: Earthscan.

Chaput, Thierry (1988) **"From Socrates to Intel: The caos of micro-aesthetics"**. In JohnThackara (ed.) *Design after modernism: Beyond the object*. London: Thames & Hudson, pp. 183 - 186.

Chardin, Pierre Teilhard de (1967) **El grupo zoológico humano.** 5° ed. Madrid: Taurus [Spanish trans. Carmen Castro from the French version entitled: *Le groupe zoologique humain*. Paris: Albin Michel. 1956].

Child, Irvin (1969) **"Esthetics"**. In Gardner Lindzey and Elliot Aronson (eds) (1969) *The handbook of social psychology*. 2° ed. Vol. 3. Reading, Mass.: Addison-Wesley, pp. 853 – 916.

Ching, Francis D.K. (1997) **Diccionario visual de arquitectura.** 6° Print. Barcelona: Gustavo Gili [Spanish trans. from the English version entitled: *A visual dictionary of architecture*. John Wiley & Sons. 1995]

Christensen, Niels E. (1968) **Sobre la naturaleza del significado.** Barcelona: Labor [Spanish trans.Juan Carlos García from the English version entitled: *On the nature of meanings. A philosophical analysis*. Copenhagen: Munksgaard. 1961].

Coates, Del (1988) **"Measuring product semantics with a computer"**. *Innovation*, Vol.7, Part 4, Fall, pp. 7 – 10.

Cohen, Benjamin & Murphy, Gregory (1984) **"Models of concepts"**. *Cognitive Science*, Vol.8, pp. 27 – 58.

Coleman, Roger (1994) **"Age: the challenge for design"**. In Jeremy Myerson (ed) (1994) *Design Renaissance* [Selected papers from the International Design Congress in Glasgow, 1993]. London: Open Eye, pp.135-138.

Collins, Peter (1970) **Los ideales de la arquitectura moderna**. Barcelona: GG [Spanish trans. Ignacio de Solá Morales Rubió from the English version entitled: *Changing ideals in Modern Architecture.* London: Faber & Faber. 1965].

Conran, Terence (1994) **"A well-developed desire for individuality"**. In Jeremy Myerson (ed) (1994) *Design Renaissance* [Selected papers from the International Design Congress in Glasgow, 1993]. London: Open Eye, pp.147 - 148.

Conway, Hazel (1978) **"The beginnings of product design? The American system of manufactures and design in America in the 1850s"**. In Terry Bishop (ed) *Design history: fad or function?* [Papers from the III Conference on Twentieth-Century Design History, Brighton Polytechnic, September 1977]. London: Design Council, pp. 36 – 40.

Crabbe, Anthony (2001) **"Expert systems and the emergence of teledesign"**. *Design Studies*, Vol. 22, No. 6, November, pp. 543 - 555.

Craik, Kenneth J.W. (1943) **The nature of explanation**. London: Cambridge University Press.

Croce, Benedetto (1973) **Estética como ciencia de la expresión y lingüística general**. Buenos Aires: Nueva Visión [Spanish trans. Angel Vegue y Goldoni from the Italian version entitled: *Estetica come scienzia dell' espressione e linguistica generale.* Bari: Gius, Laterza & Figli. 1969].

Cross, Nigel (1980) **"The recent history of post-industrial design methods"**. In Nicola Hamilton (ed) *Design and industry.* London: The Design Council, pp. 50 – 56.

Cross, Nigel (1981) **"The coming of post-industrial design"**. *Design Studies*, Vol. 2, No.1, January, pp. 3-8.

Cross, Nigel; Naughton, John and Walker, David (1981)**"Design method and scientific method"**. *Design Studies*, Vol. 2, N° 4, October, pp. 195 - 201.

Cross, Nigel (1983) **"The relevance of cognitive styles in design education"**. *Design Methods and Theories*, Vol. 17, N°1, pp. 37 - 48.

Cross, Nigel (1986) **"Understanding design: The lessons of design methodology"**. *Design Methods and Theories*, Vol. 20, N° 2, pp. 409 - 438.

Cross, Nigel and Cross, Anita (1995) **"Observations of teamwork and social processes in design"**. *Design Studies*, Vol. 16, N°2, April, pp. 143 – 170.

Cross, Nigel (1997) **"Creativity in design: Analyzing and modeling the creative leap"**. *Leonardo*, Vol. 30, No. 4, pp. 311- 317.

Cross, Nigel (1999) **Métodos de diseño**. México: Limusa - Wiley [Spanish trans. Fernando Pérez Vázquez from the English version entitled: *Engineering Design Methods*. John Wiley & Sons. 1994].

Cross, Nigel (2001) **"Designerly ways of knowing: Design discipline versus design science"** [Online]. Available from: http://www.cs.vu.nl/~gordijn/QRM/lib/DI_2001_Summer_Vol17_Nr3_Cross.pdf (02 July 2005).

Crozier, Ray (1994) **Manufactured pleasures: Psychological responses to design**. Manchester: Manchester University Press.

Csikszentmihalyi, Mihaly and Rochberg-Halton, Eugene (1981) **The meaning of things: Domestic symbols and the self.** Cambridge: Cambridge University Press.

Csikszentmihalyi, Mihaly (1995) **"Design and order in everyday life"**. In Victor Margolin and Richard Buchanan (eds) *The idea of design: A Design issues reader.* Cambridge, Mass.: The MIT Press, pp. 118 - 126.

Currie, Gregory (1982) **Frege: An introduction to his philosophy.** Sussex: The Harvester Press.

Dagmar, Steffen (1997) **"On a theory of product language"**. *Formdiskurs,* Vol. 3, N° 11/1997, pp. 17 – 27.

Dahl, Darren; Chattopadhyay, Amitava and Gorn, Gerald (1999) **"The use of visual mental imagery in new product design"**. *Journal of Marketing Research,* Vol. 36, No. 1, February 1999, pp. 18 - 28.

Daley, Janet (1982) **"Design creativity and the understanding of objects"**. *Design Studies,* Vol. 3, N° 3, July, pp. 133 – 134.

Danesi, Marcel (2004)**"Basic principles in semiotic theory"**, pp. 12 [Online]. Available from: http://jgalith.univ-lyon2.fr/Actes/Welcome.do (15 October 2007)

Darke, Jane (1978) **"The Primary Generator and the design process"**. In W.E. Rogers and W.H. Ittelson (eds) *New directions in environmental design research: Proceedings of EDRA 9.* Washington: EDRA, pp. 325 - 337.

Daru, Myriam (1973) **"Design and linguistics"**. In *Proceedings of the Design Activity International Conference of London,* 1973. Section 1: Design Morphologies, pp. 1-13-1 to 1-13-6.

Deely, John (1990) **Basic semiotics.** Bloomington: Indiana University Press.

Demirbilek, Oya and Sener, Bahar (2004) **"Emotionally rich products: The effect of childhood heroes, comics and cartoon characters"**. In Deana McDonagh et.al. (eds) (2004) *Design and emotion: The experience of everyday things.* London: Taylor & Francis, pp. 278 –283.

Descamps, Marc-Alain (1986) **Psicosociología de la moda.** Mexico: Fondo de Cultura Económica [Spanish trans. Felix Blanco Saseta from the French version entitled: *Psychosociologie de la mode.* Paris: Presses Universitaires de France. 1979].

Desiato, Massimo (1996) **Construcción social del hombre and acción humana significativa** [Social construction of man and the meaningful human action]. Caracas: Universidad Católica Andrés Bello.

Desmet, Pieter; Overbeeke, Kees and Tax, Stephan (2001) **"Designing products with added emotional value"**. *The Design Journal,* Vol. 4, Issue 1, pp. 32 – 47.

Desmet, P.M.A. and Hekkert, P.P.M. (2002) **"The basis of product emotions"**. In William Green and Patrick Jordan (eds) *Pleasure with products.* London: Taylor & Francis, pp. 61 – 68.

Deval, Juan (1982) **La inteligencia: su crecimiento y medida** [Intellingence: its growth and measurement]. Temas claves series, N° 63. Barcelona: Salvat.

Dewey, John (2005) **How we think.** New York: Barnes & Noble [Book originally published in 1910].

Di Bartolo, Carmelo (1991) **"Bionics and design"**. *Design DK,* Vol. 3, December, no pages numbered.

Dilnot, Clive (1982) **"Design as a socially significant activity: An introduction"**. *Design Studies,* Vol.3, No.3, July, pp. 139 – 146.

DiSalvo, Carl; Hanington, Bruce and Forlizzi, Jordi (2004) **"An accessible framework of emotional experiencesfor new product conception"**. In Deana McDonagh et.al. (eds) (2004) *Design and emotion: The experience of everyday things*. London: Taylor & Francis, pp. 251 – 255.

Do, Ellen Yi-Luen et.al. (2000) **"Intentions in and relations among design drawings"**. *Design Studies*, Vol. 21, No.5, September, pp. 483 – 503.

Dondis, A. Donis (1988) **La sintaxis de la imagen.** Barcelona: GG [Spanish trans. Justo Beramendi from the English version entitled: *A primer of visual literacy*. Cambridge: The MIT Press. 1973].

Doren, Harold Van (1954) **Industrial Design: A practical guide to product design and development.** 2nd ed. New York: McGraw Hill.

Dorfles, Gillo (1966) **"The man-made object"**. In Gyorgy Kepes (ed) *The man-made object*. London: Studio Vista, pp. 1 - 8.

Dorfles, Gillo (1968) **El diseño industrial y su estética** [Industrial design and its aesthetics]. Barcelona: Labor [Spanish trans. J.M. García from the Italian version entitled: *Il Disegno Industriale e la sua estetica*. Bologna: Capelli. 1963].

Dorfles, Gillo (1972) **Naturaleza y artificio** [Nature and Artifice]. Barcelona: Lumen [Spanish trans. Alejandro Saderman from the Italian version entitled: *Artificio e natura*. Turin: Enaudi. 1968].

Dorfles, Gillo (1979) **"Sociological and semiological aspects of design"**. In Terry Bishop (ed) *Design history: pass, process, product*. London: Design Council, pp.11-13.

Dorfles, Gillo (1984) **Símbolo, comunicación y consumo** [Symbol, communication and consumption]. Barcelona: Lumen [Spanish trans. María Rosa Viale from the Italian version entitled: *Símbolo, comunicazione, consumo*. Einaudi Editore. 1962].

Dormer, Peter (1990) **The meaning of modern design: Towards the twenty-first century.** London: Thames & Hudson.

Dormer, Peter (1993) **Design since 1945.** London: Thames & Hudson.

Dorst, Kees and Cross, Nigel (2001) **"Creativity in the design process: Co-evolution of problem solution"**. *Design Studies*, Vol. 22, No.5, September, pp. 425 – 437.

Dresser, Christopher (1973) **Principles of decorative design.** London: Academy Editions.

Dreyfuss, Henry (1955) **Designing for people.** New York: Simon & Schuster.

DTI [Department of Trade and Industry] (1992) **Managing product design projects.** *Managing into the '90s* series. London: HMSO / Design Business Association.

Dufrenne, Mikel (1964) **"The aesthetic object and the technical object"**. In M. Beardsley and H. Schueller (eds) (1967) *Aesthetic Inquiry*. Belmont, California: Dickenson, pp. 188 – 198.

Duijn, Jacob van (1981) **"Fluctuations in innovations over time"**. *Futures* [Journal of forecasting and planning],Vol. 13, N° 4, August, pp. 264 – 275.

Dumas, Angela and Mintzberg, Henry (1991) **"Managing the form, function and fit of design"**. *Design Management Journal*, Summer, pp. 26 – 31.

Dumas, Angela (1994) **"Building totems: Metaphor making in product development"**. *Design Management Journal*, Vol.5, N° 1, Winter, pp. 71 - 82.

Dune, Anthony (1999) **Hertzian tales: Electronic products, aesthetic experience and critical design.** London: Royal College of Art.

Eastman, Charles M. (1970) **"On the analysis of intuitive design processes"**. In Gary T. Moore (ed) *Emerging methods in environmental design and planning* [Proceedings of the *Design Methods Group First International Conference*, Cambridge, Mass., 1968]. Cambridge, Mass.: The MIT Press, pp. 21 – 37.

Eccles, John C. (1975) **Observando la realidad: Aventuras filosóficas de un especialista del cerebro**. Basilea: Roche.

Eco, Umberto (1980) **"Function and sign: The semiotics of architecture"**. In Geoffrey Broadbent et.al. (eds) *Signs, symbols and architecture*. New York: John Wiley & Sons, pp.11 - 69.

Eco, Umberto (1986) **"Las condiciones minimales de la interpretación"** [Minimal conditions for interpretation]. In (2000) *Los límites de la interpretación*. 3° ed. Barcelona: Lumen [Spanish trans. Helena Lozano from the Italian version entitled: *I Limiti dell' interpretazione*. Milano: Fabbri, Bompiani, Sonzogno.1990]

Eco, Umberto (1989) **"Semiosis ilimitada y deriva"** [Unlimited semiosis and drift]. In Umberto Eco (2000) *Los límites de la interpretación*. Barcelona: Lumen, pp. 357 –370 [Spanish trans. Helena Lozano from the Italian version entitled: *I Limiti dell' interpretazione*. Milan: Fabbri, Bompiani, Sonzogno. 1990].

Eco, Umberto (1993) **Lector in fabula**. Barcelona: Lumen [Spanish trans. Ricardo Pochtar from the Italian versión entitled: *Lector in Fabula*. Milan: Bompiani. 1979].

Eco, Umberto (1994a) **Signo** [Sign]. Barcelona: Labor [Spanish Trans. Francisco Serra Cantarell from the Italian version entitled: *Segno*. Milan: Instituto Editoriale Internacionale. 1973].

Eco, Umberto (1994b) **La estructura ausente**. Barcelona: Lumen [Spanish trans. Francisco Serra Cantarell from the Italian version entitled: *La struttura assente*. Bompiani. 1968].

Eco, Umberto (1995) **Tratado de semiótica general**. Barcelona: Lumen [Spanish trans. Carlos Manzano from the English version entitled: *A theory of semiotics*. Bompiani. 1976].

Eco, Umberto (1999) **Kant y el ornitorrinco**. Barcelona: Lumen [Spanish trans. Helena Lozano from the Italian version entitled: *Kant e l'ornitorinco*. Milano: RCS Libri. 1997].

Eekels, J. (1982) **"Industrial engineering design: A fundamental category in the management of industrial innovation"**. In *Design '82 Conference*, Institute of Chemical Engineers. Symposium series, N° 76, EFCE Pbl series, N° 22. Rugby, England: EFCE, pp. 1 - 11.

Ehses, Hanno (1989) **"Representing Macbeth: A case study in visual rhetoric"**. In Victor Margolin (ed) (1989) *Design discourse: History, theory and criticism*. Chicago: The University of Chicago Press, pp. 187 197.

Eisentraut, Renate and Günther, Joachim (1997) **"Individual styles of problem solving and their relation to representations in the design process"**. *Design Studies*, Vol. 18, N° 4, October, pp. 369 – 383.

Ekman, Paul and Friesen, Wallace (1976) **"Origen, uso y codificación: Bases para cinco categories de conducta no verbal"** [Origin, use and codification: Bases for five categories of non verbal behaviour]. In Eliseo Verón. *Lenguaje y communicación social.* Buenos Aires: Nueva Vision, pp. 51 – 105.

Ekuan, Kenji (1984) **"Smallness as an idea"**. In Richard Langdon (ed) *Design policy: Design and industry* [Proceedings of the International Conference on Design Policy, London, 1983]. London: The Design Council, pp. 140 – 143.

Elias, Norbert (1999) **Sociología fundamental**. Barcelona: Gedisa [Spanish trans. Gustavo Muñoz from the German version entitled: *Was ist Soziologie?*. Munich: Juventa. 1970].

Elias, Norbert (2000) **Teoría del símbolo.** Barcelona: Península [Spanish trans. José Manuel Álvarez from the English version: *The Symbol Theory.* 1991].

Enaudeau, Corinne (1999) **La paradoja de la representación.** Barcelona: Paidós [Spanish trans. Jorge Piatigorsky from the French version entitled: *Là-bas comme ici. Le paradoxe de la representation.* Paris: Gallimard. 1998].

Engel, James; Blackwell, Roger and Miniard, Paul (1995) **Consumer behavior.** 8° ed. International edition. New York: The Dryden Press.

Espe, Harmut (1992) **"Symbolic qualities of watches".** In Vihma, Susann (ed) *Objects and images: Studies in design and advertising.* Helsinki: UIAH, pp. 124 – 131.

Esté, Aquiles (1997) **Cultura replicante: El orden semiocentrista** [Retorting culture: The semio-centric order]. Barcelona: Gedisa.

Estrada, David (1988) **Estética** [Aesthetics]. Barcelona: Herder.

Eyot, Yves (1980) **Génesis de los fenómenos estéticos.** Barcelona: Blume [Spanish trans. Graziella Baravalle from the French version entitled: *Genèse des phénomènes esthétiques.* Paris: Editions Sociales. 1978].

Eysenck, Michael and Keane, Mark (1990) **Cognitive psychology.** Hove, UK: Laurence Erlbaum.

Fabbri, Paolo (2000) **El giro semiótico** [The semiotic turn]. Barcelona: Gedisa [Spanish trans. Juan Vivanco Gefaell from the Italian version entitled: *La svolta semiótica.* Rome: Gius, Laterza & Figli, 1998].

Ferebee, Ann (1970) **A history of design from the Victorian era to the present.** New York: Van Nostrand-Reinhold.

Ferrater-Mora, José (1999) **Diccionario de filosofía.** 4 Vols. Barcelona: Ariel.

Feijs, Loe and Kyffin, Steven (2005) **"A taxonomy of semantic design knowledge".** In Loe Feijs, Steven Kyffin and Bob Young (eds) *Design and semantics of form and movement.* The Netherlands: Konninklijke Philips Electronics N.V., pp. 70 – 83.

Findeli, Alain (1990) **"Moholy-Nagy's pedagogy in Chicago (1937 - 46)".** *Design Issues,* Vol. VII, N° 1, Fall, pp. 4 - 19.

Findeli, Alain (1994) **"Ethics, aesthetics and design".** *Design Issues,* Vol. 10, N° 2, Summer, pp. 49 - 68.

Findeli, Alain (2001) **"Rethinking design education for the 21st century: Theoretical, methodological, and ethical discussion".** *Design Issues,* Vol.17, N° 1, Winter, pp. 5 - 17.

Finke, Ronald (1989) **Principles of mental imagery.** Cambridge: The MIT Press.

Finkelstein, Joseph (1992) **"Capitalismo y tecnología: la tercera revolución industrial va a empequeñecer todas las experiencias anteriores de la vida económica".** *Facetas,* No. 98, 4 / 1992, pp. 17 - 21.

Fish, Jonathan and Scrivener, Stephen (1990) **"Amplifying the mind's eye: Sketching and visual cognition".** *Leonardo,* Vol. 23, No. 1, pp. 117 - 126.

Fiske, John and Hartley, John (1978) **Reading television.** London: Methuen & Co.

Fiske, John (1990) **Introduction to communication studies.** 2° ed. London: Routledge.

Flusser, Vilém (2002) **Filosofía del diseño.** Madrid: Síntesis [English version entitled: *The shape of things.* Reaktion Books. 1999].

Fornari, Tulio (1989) **Las funciones de la forma** [The functions of shape]. Mexico: Tilde.

Foz, Adel (1973) **"Observations on designer behavior in the Parti"**. In *Proceeding of the Design Activity Conference* at London. Section 1: Design Morphologies, pp. 4.

Francastel, Pierre (1948) **"Técnica y estética"** [Technique and aesthetics]. In Pierre Francastel (1988) *La realidad figurativa.* Vol. 1. Barcelona: Paidós, pp. 67 - 82 [Spanish trans. Godofredo González from the French version entitled: *La réalité figurative.* Paris: Editions Dënoel. 1965]

Freeman, Christopher (1981) **"The diffusion of innovations – microelectronic technology"**. In Robin Roy and Daniel Wield (eds) (1986) *Product design and technological innovation.* Milton keynes: Open University Press, pp. 193 -200.

Frege, Gottlob (1892a) **"Sobre sentido y referencia"**. In Gottlob Frege (1996) *Escritos filosóficos.* Barcelona: Crítica, pp. 172 – 197 [Spanish trans. Ulises Moulines from the German version entitled: *Über Sinn und Bedeutung*].

Frege, Gottlob (1892b) **"Sobre concepto y objeto"**. In Gottlob Frege (1996) *Escritos filosóficos.* Barcelona: Crítica, pp. 207- 222 [Spanish trans. Ulises Moulines from the German version entitled: *Über Begriff und Gegenstand*].

Frege, Gottlob (1892 - 1895) **"Consideraciones sobre sentido y referencia"**. In Gottlob Frege (1996) *Escritos filosóficos.* Barcelona: Crítica, pp. 198 - 206 [Spanish trans. Ulises Moulines from the German version entitled: *Ausführungen über Sinn und Bedeutung*].

French, Michael Joseph (1985) **Conceptual design for engineers.** 2° ed. London / Berlin: The Design Council / Springer.

Friedländer, Uri (1989) **"Produkt-semantik und steinzeit"**. *FORM* (Zeitschrift für Gestaltung), N° 128, pp. 13 - 14.

Fry, Tony (1992) **"Against an essential theory of 'need': Some considerations for design theory"**. *Design Issues,* Vol. VIII, N° 2, Spring, pp. 41 - 53.

Furones, Miguel (1980) **El mundo de la publicidad** [The world of advertising]. Temas Claves series N° 2. Barcelona: Salvat.

Gadamer, Hans-Georg (1961) **"Poetizar e interpretar"**. In H.G. Gadamer (1998) *Estética y hermenéutica.* Madrid: Tecnos, pp. 73-80. [Spanish trans. Antonio Gómez Ramos from the German version entitled: *Dichten und deuten*].

Galle, Per and Kovács, László (1992) **"Introspective observations of sketch design"**. *Design Studies,* Vol. 13, N° 3, July, pp. 229 – 272.

Gandelsonas, Mario (1974) **"Linguistic and semiotic models in architecture"**. In William Spillers (ed) *Basic questions of design theory* [Papers of the *Symposium on Basic Questions of Design Theory,* Columbia University, 1974]. Amsterdam: North-Holland Publishing Company, pp. 39 - 54.

García de Zúñiga, E. (ed.) (1997) **Leonardo Da Vinci. Aforismos.** 2ª ed. Barcelona: Óptima.

Garner, Steve (2005) **"Is sketching still relevant in virtual design studios?"** [Online]. Available from: http//www.arch.usyd.edu.au/kcdc/journal/vol3/dcnet/garner/ (23 October 2005).

Garvin, Lucius (1968) **"The paradox of aesthetic meaning"**. In Susanne Langer (ed.) *Reflections on art: A source book of writing by artists, critics and philosophers.* London: Oxford University Press, pp. 62 -70.

Gasparski, Wojciech (1984) **Understanding design: The praxiological-systemic perspective.** Seaside, California: Intersystems Publications.

Gaver, William (1991) **"Technology affordances"**. In papers from the *Conference on Computer and Human Interaction de 1991.* Association for Computing Machinery (ACM), pp. 79- 84.

Gay, Paul Du; Hall, Stuart; Janes, Linda; Mackay, Hugh and Negus, Keith (1997) **Doing cultural studies: The story of the Sony Walkman.** London: Sage – Open University.

Geddes, Norman Bel (1934) **Horizons**. London: John Lane.

Geertz, Clifford (2004) **HyperGeertz World Catalogue 2004** [Online]. Available from: http://www.iwp.uni-linz.ac.at/lxe/sektktf/GG/HyperGeertz-1950-1959.htm (22 August 2005).

Gelernter, Mark (1973) **"The objective evaluation of value judgements in design"**. In *Proceedings of the Design Activity International Conference* at London. Section 3: Design Objectives, pp.6.

Gelernter, Mark (1995) **Sources of architectural form: A critical history of Western design theory**. Manchester: Manchester University Press.

George, F. H. (1974) **Introducción a la semántica**. Madrid: Fundamentos [Spanish trans. Rosario and Ignacio Alvarez from the English version entitled *Semantics.* The English University Press].

Gfesser, Karl (2004) **"The genesis of semiosis"**, pp. 8 [Online]. Available from: http://jgalith.univ-lyon2.fr/Actes/Welcome.do (15 October 2007).

Gibson, James Jerome (1979) **"The theory of affordances"**. In James Gibson (1979) *The ecological approach to visual perception.* Boston: Houghton Mifflin, pp. 127 - 143.

Giard, Jacques (1990) **"Product Semantics and communication: Matching the meaning to the signal"**. In Susann Vihma (ed) *Semantic visions in design.* Helsinki: University of Industrial Arts, pp. b1 – b7.

Giedion, Sigfried (1960) **"The roots of symbolic expression"**. In Gyorgy Kepes (ed) *The visual arts today.* Middletown, Conn.: Wesleyan University Press, pp. 24 - 33.

Gilles, Willem (1991) **Form organization**. Oxford: Butterworth-Heinemann.

Girbau, Dolors (2002) **Psicología de la comunicación** [Psychology of communication]. Barcelona: Ariel.

Glass, Frederick (1927) **The industrial arts**. London: University of London Press.

Glegg, Gordon (1981) **The development of design**. Cambridge: Cambridge University Press.

Goldberg, Elkhonon (2002) **El cerebro ejecutivo. Lóbulos frontales y mente civilizada** Barcelona: Crítica [Spanish trans. Javier García Sanz from the English version entitled: *The Executive Brain. Frontal Lobes and the Civilized Mind.* Oxford University Press. 2001]

Goldschmidt, Gabriela and Weil, Maya (1998) **"Contents and structure in design reasoning"**. *Design Issues*, Vol. 14, No. 3, Autumn, pp. 85 -100.

Gómez de Silva, Guido (1988) **Breve diccionario etimológico de la lengua española**. Mexico: Fondo de Cultura Económica.

Gombrich, Ernst (1951)**"Meditations on a hobbie horse or the roots of artistic form"**. In E.H. Gombrich (1971) *Meditations on a hobbie horse and other essays on the theory of art.* 2nd ed. London: Phaidon, pp.1-11.

Gombrich, Ernst (1960) **"On physiognomic perception"**. In Gyorgy Kepes (ed) (1960) *The visual arts today.* Middletown, Conn.: Wesleyan University Press, pp. 232 – 245.

Gombrich, Ernst (1975) **"Descubrimiento visual a través del arte"** [Visual discovery through art]. In J. Hogg et.al. (ed) *Psicología y artes visuals.* Barcelona: GG, pp.197– 219 [Spanish trans. Justo

Beramendi from the English version entitled: *Psychology and the Visual Arts.* Middlesex: Penguin. 1969].

Gombrich, Ernst H. (1998) **Arte e ilusion**. Madrid: Debate [Spanish trans. Gabriel Ferrater from the English version entitled: *Art and Illusion.* 5th ed. London. 1977].

González, Marta; López, José and Luján, José (1996) **Ciencia, tecnología y sociedad** [Science, technology and society]. Madrid: Tecnos.

Goodman, Nelson (1976) **Languages of art**. Indianapolis: Hackett.

Goodman, Nelson (1984) **"Routes of reference"**. In Nelson Goodman (1984) *Of mind and other matters*. Cambridge: Harvard University Press, pp. 55 - 71.

Gordon, Ian E. (1997) **Theories of visual perception**. 2nd ed. Chichester, England: John Wiley & Sons.

Gordon, William (1961) **Synectics: the development of creative capacity**. New York: Harper & Row.

Gotzsch, Josiena (2005) **"Desirable product characteristics: From ergonomics to symbolic value"**. In Toni-Matti Karjalaine (ed)*Design communication* [Report and selected papers from the 3rd Nordcode Seminar and Workshop at the Technical University of Denmark, Lyngby, April 2004]. Publication series, F 30. Helsinki: University of Art and Design Helsinki, pp. 35 - 42.

Govers, Pascalle; Hekkert, Paul and Schoormans, Jan (2004) **"Happy, cute and tough: Can designers create a product personality that consumers understand?"**. In Deana McDonagh et.al. (eds) (2004) *Design and emotion: The experience of everyday things*. London: Taylor & Francis, pp. 345 – 349.

Grande, Ildefonso (2004) **Marketing cross-cultural**. Madrid: ESIC.

Green, William and Jordan, Patrick (eds) (2002) **Pleasure with products**. London: Taylor & Francis.

Gregory, Sydney (1981) **"Towards design science: Review of twenty years"**. *Design Methods and Theories*, Vol. 15, N° 2, pp. 35 - 41.

Greimas, Algirdas (1966) **"Estructura e historia"** [Structure and history]. In Barbut et.al. (1975) *Problemas del estructuralismo*. 6ª ed. Mexico: Siglo XXI, pp. 120 – 134 [Spanish trans. Julieta Campos, Gustavo Esteva and Alberto de Ezcurdia from the French version entitled: *Problemes du struturalisme*. Paris: Les temps modernes, N° 246, Nov., 1966].

Greimas, Algirdas (1968) **"The interaction of semiotic constraints"**. In Algirdas Greimas (1987) *On meaning: Selected writings in semiotic theory*. London: Frances Pinter, pp. 48 – 62.

Greimas, Algirdas (1970) **"Toward a semiotics of the natural world"**. In Algirdas Greimas (1987) *On meaning: Selected writings in semiotic theory*. London: Frances Pinter, pp. 17 – 47.

Greimas, Algirdas (1973) **Semántica estructural**. Madrid: Gredos [Spanish trans. Alfredo de la Fuente from the French version entitled: *Sémantique Structurale*. Paris: Larousse. 1966].

Greimas, Algirdas (1978) **"Sémiotique figurative et sémiotique plastique"**. *Actes Sémiotiques*, N° 60. Groupe de Recherches sémio-linguistiques. Paris: CNRS [Spanish Trans. Teresa Espar, 1984], pp.17.

Greimas, Algirdas and Courtés, Joseph (1982) **Semiótica: Diccionario razonado de la teoría del lenguaje**. Vol.1. Madrid: Gredos [Spanish trans. Enrique Ballón and Hermis Campodónico from the French version entitled: *Sémiotique. Dictionnaire raisonné de la théorie du langage*. Hachette. 1979].

Greimas, Algirdas (1983) **"Knowing and believing: A single cognitive universe"**. In Algirdas Greimas (1987) *On meaning: Selected writings in semiotic theory*. London: Frances Pinter, pp. 165 – 179.

Grillo, Paul (1960) **What is design?** Chicago: Paul Theobald and company.

Gropius, Walter (1925) **"Principios de la producción del Bauhaus"** [Principles of the Bauhaus production]. In Tomás Maldonado (ed) (2002) *Técnica y cultura*. Buenos Aires: Infinito, pp. 243 - 246.

Groot, Cristiaan de (1997) **"Experiencing the phenomenological object"**. In Nick Udall (ed) *Closing the gap between subject and object*. UK: Design Transformation Group, pp. 20 – 21.

Groot, Cristiaan de (2000) **Transforming the designer's understanding of the object**. Ph.D Thesis. Birmingham: University of Central England.

Gros, Jochen (1990) **"The design object on the age of its technical singularization-identifiability and identity under conditions of digital technology"**. In Internationales Forum für Gestaltung Ulm (1990) *Cultural identity and design* [2nd International Forum of the Hochschule für Gestaltung Ulm, Tagung, 1989]. Berlin: Ernst & Sohn, pp. 77 – 81.

Gros, Jochen (1997) **"Semantic of style: The ornament in the age of new technologies"**. *Formdiskurs*, Vol. 3, N° 11/1997, pp. 82 - 93.

Guiraud, Pierre (1976) **La semántica**. Mexico: Fondo de Cultura Económica [Spanish trans. Juan Hasler from the French version entitled: *La sémantique*. Paris: Presses Universitaires de France. 1955].

Guiraud, Pierre (1986) **El lenguaje del cuerpo**. Mexico: Fondo de Cultura Económica [Spanish trans.Beatriz Padilla from the French version entitled: *Le langage du corps*. Paris: Presses Universitaires de France. 1980].

Guiraud, Pierre (1999) **La semiología**. 24 ed. Mexico: Siglo XXI [Spanish trans. María Teresa Poyrazian from the French version entitled: *La sémiologie*. Paris: Presses Universitaires de France. 1971].

Hall, Edward T. (1973) **La dimensión oculta**. Madrid: Instituto de Estudios de Administración Local [Spanish trans. Joaquín Hernández Orozco from the English version entitled: *The hidden dimension*. New York: Doubleday. 1966].

Halton, Eugene (1992) **"Charles Morris: A brief outline of his philosophy with relation to semiotics, pragmatics and linguistics"** [Online]. Available from: http://www.nd.edu/~ehalton/Morrisbio.htm (20 Oct. 2005).

Handel, S. (1967) **The Electronic Revolution**. Middlesex, England: Penguin.

Hansen, Claus and Andreasen, Mogens (2003) **"A proposal for an enhanced design concept understanding"**. Paper presented at the International Conference on Engineering Design 2003, Stockholm, August 2003 [Online]. Available from: http://dart.stanford.edu/hm/designx.mail/att-0498/02-12891CED03FP_ til_udlevering.pdf. (14 February 2003).

Hasdoğan, Gülay (1996) **"The role of user models in product design for assessment of user needs"**. *Design Studies*, Vol. 17, pp. 19 – 33.

Hauffe, Thomas (1998) **Design: A concise history**. London: Laurence King Publishing.

Haug, Wolfgang (1989) **Publicidad y consumo: Crítica de la estética de mercancías**. Mexico: Fondo de Cultura Económica [Spanish trans. Guillermo Hirata from the German version entitled: *Warenästhetik und Kapitalistiche Massenkultur*. Berlin: Argument. 1980].

Hawkes, Terence (1977) **Structuralism and semiotics**. London: Routledge.

Hegel, Georg W.F. (1993) **Introductory lectures on aesthetics.** London: Penguin.

Herbert, Daniel M. (1988) "**Study drawings in architectural design: Their properties as a graphic medium**". *Journal of Architectural Education*, Vol. 41, No. 2, Winter, pp. 26 - 38.

Hesselgren, Sven (1969) **The language of architecture.** 2° ed. Essex: Applied Science Publishers.

Heskett, John (1980) **Industrial design.** London: Thames & Hudson.

Heskett, John (1992) "**Industrial design**". In Boris Ford (ed.) *Modern Britain: the Cambridge cultural history*, Vol. 9.Cambridge: Cambridge University Press, pp. 289 - 318.

Heskett, John (1998) "**The economic role of industrial design**". In Tevfik Balcioglu (ed) *The role of product design in post-industrial society.* Ankara: Middle East Technical University-Faculty of Architecture Press, pp.77 - 92.

Heskett, John (2002) **Toothpicks & logos: Design in everyday life.** Oxford: Oxfrod University Press.

Hillier, Bill; Musgrove, John and O'Sullivan, Pat (1972) "**Knowledge and design**". In Nigel Cross (ed) (1984) *Developments in design methodology.* Chichester: John Wiley & Sons, pp. 245 –264.

Hjelm, Sara Ilstedt (2002) **Semiotics in product design.** Report N° CID-175. Stockholm: CID / Royal Institute of Technology.

Huisman, Denis and Patrix, Georges (1971) **La estética industrial.** Barcelona: Oikos-Tau [Spanish trans. Roberto Alcaraz from the French version entitled: *L'Esthétique Industrielle.* Presses Universitaires de France. 1965]

Hurlburt, Allen (1981) **The design concept: A guide to effective graphic communication.** New York: Watson-Guptill.

Husiao, Shih-Wen and Chen, Ching-Hai (1997) "**A semantic and shape grammar based approach for product design**". *Design Studies*, Vol. 18, pp. 275 – 296.

Huxley, Aldous (1970) "**Superorganización**". In Ardrey et.al. (1970) *La crisis del homo sapiens.* Caracas: Nuevo tiempo, pp. 149 - 163 [Spanish trans. Santiago González].

Iglesias, Héctor (1986) **Ciudad, política y arquitectura.** Maracaibo, Venezuela: Universidad del Zulia.

Ingram, Jack (1980) "**Designing the user experience**". In Robin Jacques and James Powell (eds) *Design: Science: Method.* Surrey, UK: Westbury House, pp. 171 – 175.

Irigoyen-Castillo, Jaime (1998) **Filosofía y diseño: Una aproximación epistemológica** [Philosophy and design: An epistemological approach]. Mexico: Universidad Autónoma Metropolitana.

Jackendoff, Ray (1983) **Semantics and cognition.** Cambridge: The MIT Press.

Jakobson, Roman (1960) "**Linguistics and poetics**". In Thomas Sebeok (ed) *Style in langague* (Papers from the *Style in Literature Conference* held at Indiana University, 1958). Cambridge, Mass.: The MIT Press, pp. 350 – 377.

Jakobson, Roman and Halle, Morris (1971) **Fundamentals of language.** 2° ed. The Hague: Mouton.

Jencks, Charles (1981) "**The architectural sign**". In Geoffrey Broadbent, Richard Bunt and Charles Jencks (eds) *Sign, symbols and architecture.* New York: John Wiley & Sons, pp. 71 - 118.

Jiménez, Luz (2000) "**Design's own knowledge**". *Design Issues*, Volume 16, N° 1, Spring, pp. 36 – 51.

Johansen, Jørgen and Larsen, Svend (2002) **Signs in use: An introduction to semiotics.** London: Routledge.

Johne, F.A. (1985) **Industrial product innovation: organization and management.** London: Nichols Publishing Company.

Johnson, Paul-Alan (1999) **"Creativity, craft, design and design review: Ineluctable conflicts vis-à-visComputarised delivery".** *Design Methods*, Vol.33, N° 4, October – December, pp. 2890 – 2908.

Johnson-Laird, Philip N. (1980) **"Mental models in cognitive science".** *Cognitive Science*, Vol.4, pp. 71 –115.

Jones, John Christopher (1969) **"The state-of-the-art in design methods".** In Geoffrey Broadbent and Anthony Ward (eds) *Design methods in architecture.* London: Lund Humphries / The Architectural Association, pp. 193 – 197.

Jones, John Christopher (1973) **"Cómo han cambiado mis pensamientos acerca de los métodos de diseño a través de los años".** In John C. Jones (1985) *Diseñar el diseño.* Barcelona: Gustavo Gili [Spanish trans. Iris Menéndez from the English version entitled: *"How my thoughts about design methods have changed during the years".* In *Essays in design.* John Wiley & Sons].

Jones, Christopher Jones (1982) **Métodos de diseño.** 3° Spanish ed. Barcelona: GG [Spanish trans. María Luisa López from the English version entitled: *Design methods. Seed of human futures.* Chichester: John Wiley & Sons, 1981].

Jones, Owen (1856) **The grammar of ornament.** Reprint 1972. New York: Van Nostrand Reinhold.

Jones, Peter Lloyd (1987) **"The metaphor of language in design".** In Susann Vihma (ed) *Form and vision* (Papers from the International University of Industrial Arts Helsinki Conference, January 1987). Helsinki: UIAH, pp. 184 – 197.

Jones, Peter Lloyd (1991) **Taste today: The role of appreciation in consumerism and design.** Oxford: Pergamon Press.

Jordan, Patrick (1998) **An introduction to usability.** London: Taylor & Francis.

Jordan, Patrick (2000) **Designing pleasurable products: An introduction to the new human factors.** London: Taylor & Francis.

Jordan, Patrick (2002) **"The personalities of products".** In William Green and Patrick Jordan (eds) (2002) *Pleasure with products.* London: Taylor & Francis, pp. 19 – 47.

Journal of Design and Manufactures (1852) **"Which direction for Ornamental Art?".** In Christopher Harvie, Graham Martin and Aaron Scharf (eds) (1970) *Industrialisation and culture: 1830 - 1914.* London: Macmillan-The Open University, pp. 272 – 273.

Juez, Fernando (2002) **Contribuciones para una antropología del diseño** [Contributions for an anthropology of design]. Barcelona: Gedisa.

Julier, Guy (1993) **Enciclopaedia of 20th century design and designers.** London: Thames & Hudson.

Jung, Carl Gustav (1990) **Archetype and the collective unconscious.** London: Routledge.

Kant, Emmanuel (1952) **The critique of pure reason.** In Robert Hutchings (ed.) *Great Books of the Western World*, Vol. 42. Chicago: Encyclopaedia Britannica, pp. 1 – 250 [English trans. J. M. D. Meiklejohn].

Karmasin, Helene (1998) "**Cultural theory and product semantics: Design as part of social communications**". *Formdiskurs*, Vol. 4, 1/1998, pp. 12 –25.

Kavakli, Manolya and Gero, John (2001) "**Sketching as mental imagery processing**". *Design Studies*, Vol. 22, N° 4, July, pp. 347 – 364.

Kazmierczack, Elzbieta (2003) "**Design as meaning making: From making things to the design of thinking**". *Design Issues*, Vol. 19, N° 2, Spring, pp. 45 – 59.

Kearney, Richard (1988) **The wake of imagination**. London: Routledge.

Kelly, George (1955) **The psychology of mental constructs**. Vol. 1. London: Routledge.

Kenedy, Anita and Baker, Michael (1982) "**Designing for market success**". In *Design '82 Conference*. Simposium series, N° 76. Rugby, England: Institution of Chemical Engineers, pp. 41 – 52.

Kerckhove, Derrick de (1994) "**Design interactivity and the production of meaning**". In Jeremy Myerson (ed) *Design Renaissance* [Papers of the International Design Conference in Glasgow, 1993] London: Open Eye, pp. 153 - 156.

Kerckhove, Derrick de (1999) **La piel de la cultura**. Buenos Aires: Gedisa [Spanish trans. David Alemán from the English version entitled: *The skin of culture*. Toronto: Somerville House Books. 1995].

Kinross, Robin (1986) "**Semiotics and designing**". *Information Design Journal*, Vol. 4/3, pp. 190 - 198.

Kofka, Kurt (1935) **Principles of Gestalt psychology**. Reprint 1999. London: Routledge.

Köhler, Wolfgang (1967) **Psicología de la configuración**. Madrid: Morata [Spanish trans. Alfredo Guerra Miralles from the English version entitled: *Gestalt Psychology*. New York: Liveright].

Kosslyn, Stephen (1988) "**Aspects of cognitive neuroscience of mental imagery**". *Science*. Vol. 240, June, pp. 1621 – 1626.

Kosslyn, Stephen and Shin, Lisa (1991) "**Visual mental images in the brain**". *Proceedings of the American Philosophical Society*, Vol. 135, N° 4. December, pp. 524 - 532.

Kotler, Philip and Armstrong, Gary (1990) **Marketing: An introduction**. 2° ed., New Jersey: Prentice-Hall.

Krampen, Martin (1979a) "**Survey of current work in the semiology of architecture**". In S. Chatman, U. Eco and J. Klinkenberg (eds) *A semiotic landscape* [Proceedings of the First Conference of the International Association for Semiotic Studies, Milan, June 1974]. The Hague: Mouton, pp. 196 – 194.

Krampen, Martin (1979b) "**Survey of current work on the semiology of objects**". In S. Chatman, U. Eco and J. Klinkenberg (eds) *A semiotic landscape* [Proceedings of the First Conference of the International Association for Semiotic Studies, Milan, June 1974]. The Hague: Mouton, pp.158 - 168.

Krampen, Martin (1989) "**Semiotics in architecture and industrial / product design**". *Design Issues* (Special Edition), Vol. 5, Part 2, Spring, pp. 124 - 140.

Krauss, Richard and Myer, John (1970) "**Design: A case history**". In Gary T. Moore (ed) *Emerging methods in environmental design and planning* [Proceedings of the *Design Methods Group First International Conference*, Cambridge, Mass., 1968]. Cambridge, Mass.: The MIT Press, pp. 11 – 20.

Krippendorff, Klaus (1989) "**On the essential context of artifacts or on the proposition that design is making sense (of things)**". *Design Issues*. Special ed. Vol.2, pp. 9 - 39.

Krippendorff, Klaus (1990) **"Product Semantics: A triangulation and four design theories"**. In Seppo Väkevä (ed) *Product Semantics '89* [Papers from the 1989 Product Semantics conference in Helsinki,] Helsinki: University of Industrial Arts, pp. a3 - a7.

Krippendorff, Klaus (1992) **"Transcending semiotics: Towards understanding design for understanding"**. In Susann Vihma (ed) *Objects and images: Studies in design and advertising.* Helsinki: University of Industrial Arts, pp. 24 – 47.

Krippendorff, Klaus and Butter, Reinhart (1993) **"Where meanings escape functions"**. *Design Management Journal*, Spring, pp. 29 - 33.

Krippendorff, Klaus (1998) **"When I see a chair –must I see a sign of it?"**. *Formdiskurs*, Vol.5, N° 11, pp. 98 -107.

Kristeva, Julia (1981) **Semiótica.** Vol. 1. 2° ed. Madrid: Fundamentos [Spanish trans. José Martin Arancibia from the French version entitled: *Σημειωτικη. Recherches pour une sémanalyse.* Editions du Seil.1969].

Krohn, Lisa and McCoy, Michael (1989) **"Beyond beige: Interpretative Design for the post-industrial age"**. *Design Issues*, Vol. 5, N° 2, Spring, pp. 112 – 123.

Kuhn, Thomas (1977) **"Second thoughts on paradigms"**. In Frederick Suppe (ed) *The structure of scientific theories.* Urbana: University of Illinois Press, pp. 459 - 482.

Labov, William (1973) **"The boundaries of words and their meanings"**. In Charles-James Bailey and Roger Shuy (eds) (1973) *New ways of analyzing variations in English.* Washington: Georgetown University Press, pp. 340 – 373.

La Barre, Weston (1964) **"Paralingüística, cinésica y antropología cultural"** [Paralinguistics, kinetics and cultural anthropology]. In Thomas Sebeok, Alfred Hayes and Mary Bateson (eds) (1978) *Semiótica aplicada.* Buenos Aires: Nueva Visión, pp. 251 - 289 [Spanish trans. María Cristina Davolio from the English version entitled: *Approaches to semiotics.* The Hague: Mouton & Co. 1964].

Lacruz-Rengel, Rafael (1997) **The symbolic equation in product design: An approach to the aesthetic characterisation of products along their life cycle.** Master of Arts thesis. Birmingham, UK: University of Central England.

Lacruz-Rengel, Rafael (1998) **"Intellectual dimensions of form"**. Lecture delivered the 30 of June 1998 as part of the 2° Annual Course on Theory of Form at the School of Industrial Design, University of Los Andes, Venezuela.

Lacruz-Rengel, Rafael (2001b) **"Desmitificando la noción de arquetipo en diseño"** [Demystifying the notion of archetype in design]. *Edificar* [Journal of the Faculty of Architecture and Art, University of Los Andes, Venezuela] No.8, pp. 10 - 15.

Lacruz-Rengel, Rafael (2002a) **La referencia correal como aporte semiótico a la estética del diseño industrial** [The co-real reference: A semiotic contribution to the aesthetics of industrial design]. Paper read at the *III Venezuelan Conference of Semiotics.* University of Zulia, Maracaibo, Venezuela.

Lacruz-Rengel, Rafael (2002b) **"Implicaciones del desarrollo tecnológico en la estética de nuestros objetos cotidianos"** [Implications of technological development in the aesthetics of our everyday objects]. *Estética* [Journal of Aesthetics published by University of Los Andes, Venezuela], No.6, November, pp. 333 - 340.

Lacruz-Rengel, Rafael (2003a) **Notas para un concepto de función en el diseño** [Notes for a concept of function in design]. Lecture delivered the 22nd of February 2003 as part of a *Series of Lectures* organised by the Student's Union, Faculty of Architecture and Art, Universidad de Los Andes, Merida, Venezuela.

Lacruz-Rengel, Rafael (2003b) **La dimensión social de las funciones en el diseño de productos** [The social dimension of functions in product design]. Paper read at the *2° Venezuelan Design Conference: Design and society*, 04 – 06 of December 2003, Faculty of Architecture and Design, University of Zulia, Maracaibo, Venezuela.

Lacruz-Rengel, Rafael (2003c) **"Obliteration versus re-semantization of references in electrical appliances"**. *Visio* [Journal of the International Association for Visual Semiotics], Vol. 8, N° 3 - 4, Autumn-Winter, pp. 265 - 274.

Lacruz-Rengel, Rafael (2004) **"Visual literacy and culture conscious design"**. Lecture delivered the 08 of December 2004 as part of the 6° annual course on theory of form at the School of Industrial Design, University of Los Andes, Venezuela.

Lakoff, George & Johnson, Mark (1980) **Metaphors we live by**. Chicago: University of Chicago Press.

Lambert, Susan (1993) **Form follows function?** London: Victoria & Albert Museum.

Landry, Roch (1990) **"Product Semantics: Convergence of design research and design discipline"**. In Vihma, Susann (ed) *Semantic visions in design* [Proceedings from the Symposium on Design Research and Semiotics, 1989, University of Industrial Arts, Helsinki]. Helsinki: UIAH, pp. k1 – k8.

Langer, Susanne K. (1957) **Philosophy in a new key: Study in the symbolism of reason, rite and art.** 3rd ed. Cambridge, Mass: Harvard University Press.

Langer, Susanne K. (1966) **Los problemas del arte**. Buenos Aires: Infinito [Spanish trans. Luis Enrique Revol form the English version entitled: *Problems of Art.* New York: Charles Scribner's Sons.1957].

Lango, Clemens (1999) **"Interaction design: Between hardware and software"**. *Formdiskurs*, Vol.6, N° 1/1999, pp. 63 – 71.

Lannoch, Helga and Lannoch, Hans-Jürgen (1989) **"Toward a semantic notion of space"**. *Design Issues*, Vol.V, N° 2, Spring, pp. 40 – 50.

Lannoch, Hans-Jürgen (1990) **"Towards a semantic notation of space"**. In Seppo Väkevä (ed) *Products Semantics '89* [Papers of the Product Semantics '89 Conference in Helsinki]. Helsinki: University of Industrial Arts, pp. c1 - c11.

La Puerta, José María de (1997) **El croquis, proyecto y arquitectura**. Madrid: Celeste.

Lawson, Bryan (1979) **"Cognitive strategies in architectural design"**. *Ergonomics*, Vol. 22, N°1, pp. 59 - 68.

Lawson, Bryan (1990) **How designers think**. Oxford: Butterworth Architecture.

Le Bon, Gustave (1983) **Psicología de las masas**. Madrid: Morata [Spanish trans. Alfredo Guera from the French version entitled: *Psycholgie des foules*. Paris: Presses Universitaires de France. 1981].

Le Corbusier (1964) **Hacia una arquitectura**. Buenos Aires: Poseidón [Spanish trans. Josefina Martínez Alinari from the French version entitled: *Vers une Architecture*. Crès. 1926].

Le Doux, Joseph (1994) **"Emotion, memory and the brain"**. *Scientific American*, Vol. 270, N° 6, June, pp. 32 – 39.

Lee, Sue-Ann (1984) **"Models of men in psychology and design: A review and discussion of the implications for man-environment education"**. In R. Langdon and P. Purcell (eds) *Design theory* *and practice* [Proceedings of the International Conference on Design Policy, Royal College of Art, 1982], Vol. 2, London: Design Council, pp. 29 – 32.

Leiser, Bob (1992) **"The presence phenomenon and other problems of applying mental models to user interface design and evaluation"**. In Y. Rogers, A. Rutherford and P. Bibby (eds) *Models in the mind: Theory, perspective and application.* London: Academic Press, pp. 267 - 281.

Lenau, Torben and Boelskifte, Per (2005) **"Product search through the use of semantic properties"**. In Toni-Matti Karjalainen (ed) *Design communication* [Selected papers from the 3rd Nordcode Seminar & Workshop at the Technical University of Denmark, Lyngby, April 2004]. Publication series, F 30. Helsinki: University of Art and Design Helsinki, pp. 11 – 20.

Leon-Trujillo, Ivan (2004) **"Interfases gráficas digitales en páginas web: Una aproximación morrisiana en pro de la optimización de su diseño"**. Paper read at the *8° Conference of Visual Semiotics*. Lyon 2 University, Lyon, France, 07 – 12 July 2004, pp. 21.

Leroi-Gourhan, André (1993) **Gesture and speech**. Cambridge: The MIT Press.

Levinson, Paul (1977) **"Toy, mirror and art: the metamorphosis of technological culture"**. *Etcetera*, June, pp. 151 - 167.

Lieb, Hans-Heinrich (1979) **"On relating pragmatics, linguistic, and non-semiotic disciplines: A summary view"**. In S. Chatman, U. Eco and J. Klinkenberg (eds) *A semiotic landscape* [Proceedings of the First Conference of the International Association for Semiotic Studies, Milan, June 1974]. The Hague: Mouton, pp. 309 - 312.

Liddament, Terry (1994) **"Technological literacy: The construction of meaning"**. *Design Studies*, Vol.15, N° 2, pp. 198 - 213.

Lidwell, William; Holden, Kritina & Butler, Jill (2003) **Universal principles of design.** Gloucester, Mass.: Rockport.

Lindsay, Robert (1988) **"Images and inference"**. *Cognition*, Vol. 29, pp. 229 - 250.

Lippmann, Walter (1922) **"Stereotypes"**. In J. Corner and J. Hawthorn (ed)(1993) *Communication studies: An introductory reader.* 4° ed. London: Hodder & Stoughton, pp. 133 – 139.

Llorens, Tomás (1979) **"Notes for a definition of aesthetic semiosis"**. In S. Chatman, U. Eco and J. Klinkenberg (eds) *A semiotic landscape* [Proceedings of the First Conference of the International Association for Semiotic Studies, Milan, June 1974]. The Hague: Mouton, pp. 313 – 317.

Llovet, Jordi (1979) **Ideología y metodología del diseño** [Ideology and methodology of design]. Barcelona: Gustavo Gili.

Löbach, Bernd (1981) **Diseño industrial: bases para la configuración de productos industriales.** Barcelona: GG [Spanish trans. Jordi Utgès i Pascual from the German version entitled: *Industrial Design. Grundlangen der Industrieproduktgestaltung.* Munich: Karl Thieming. 1976].

Loos, Adolf (1908) **"Ornamento y delito"**. In (1971) *Ornamento y delito y otros escritos.* Barcelona: Gustavo Gili [Spanish trans. Lourdes Cirlot and Pau Pérez from the German version entitled: *Adolf Loos: Sämtliche Schriften.* Wien: Herold. 1971].

Loewy, Raymond (1951) **Never leave well enough alone.** New York: Simon & Schuster.

Lotman, Juri (1970) **"Two models of communication"**. In Daniel Lucid (1977) *Soviet semiotics: An anthology.* Baltimore: The John Hopkins University Press, pp. 99 – 101.

Lotman, Juri (1974) **"Primary and secondary communication-modelling systems"**. In Daniel Lucid (1977) *Soviet semiotics: An anthology.* Baltimore: The John Hopkins University Press, pp. 95 – 98.

Lotman, Juri (1982) **Estructura del texto artístico** [Structure of the artistic text]. 2° ed. Madrid: Istmo [Spanish trans. Victoriano Imbert].

Lotman, Juri (1984) **"Acerca de la semiosfera"** [About the semiosphere]. In Yuri Lotman (1996) *La Semiosfera I: Semiótica de la cultura y el texto.* Madrid: Cátedra [Spanish trans. Desiderio Navarro].

Luh, Ding-Bang (1994) **"The development of psychological indexes for product design and the concepts for product phases"**. *Design Management Journal*, Vol.5, No.1, pp. 30 - 39.

Luria, Alexander (1976) **Cognitive development: Its cultural and social foundations.** Cambridge: Harvard University Press.

Luria, Alexander (1982) **"El papel del lenguaje en la formación de los procesos mentales"** [The role of language in the formation of mental processes]. In *El papel del lenguaje en el desarrollo de la conducta.* Mexico: Cártago, pp. 7– 33 [Spanish trans. from the Russian version Carlos Wilderg].

Macdonald, Alastair (1993) **"Developing a qualitative sense"**. In *Coloquium on Aesthetics in Design.* [London 29 June 1993]. Digest N° 1993/153, London: Institution of Electrical Engineers, pp. 5/1 – 5/4.

Macdonald, Alastair (1998) **"Developing a qualitative sense"**. In Neville Stanton (ed) (1998) *Human factors in consumer products.* London: Taylor & Francis, pp.175 – 191.

Macdonald, Alastair (2002) **"The scenario of sensory encounter: Cultural factors in sensory-aesthetic experience"**. In William Green and Patrick Jordan (eds) *Pleasure with products.* London: Taylor & Francis, pp. 113 – 123.

Mackay, Hugh (1997) **"Consuming communication technologies at home"**. In Hugh Mackay (ed) *Consumption and everyday life.* London: Sage / The Open University, pp. 259 – 297.

Maldonado, Tomás (1959) **"Comunicación y semiótica"** [Communication and semiotics]. In Tomás Maldonado (1977) *Vanguardia y racionalidad.* Barcelona: Gustavo Gili, pp. 81 - 88 [Spanish trans. Francesc Serra i Cantarell from the Italian version entitled: *Avanguardia e razionalità. Articoli, saggi, pamphlets: 1946-1974.* Turin: Enaudi. 1974].

Maldonado, Tomás (1960) **"New developments in industry and the training of designers"**. *Architect's Yearbook*, pp. 173 - 180.

Maldonado, Tomás (1961a) **"Glossary of semiotics"**. *Uppercase*, N° 5, pp. 44 - 62.

Maldonado, Tomás (1961b) **"Notes on communication"**. *Uppercase*, N° 5, pp. 5 – 10.

Maldonado, Tomás (1972) **Ambiente humano e ideología** [Human ambience and ideology]. Buenos Aires: Nueva Visión [Spanish trans. Hernán Cuevas from the Italian version entitled: *La speranza progettuale. Ambiente e società.* Torino: Giuli Enaudi. 1970].

Maldonado, Tomás (1974) **"Apuntes sobre la iconicidad"** [Notes on iconicity]. In Tomás Maldonado (1977) *Vanguardia y racionalidad.* Barcelona: Gustavo Gili, pp. 229 - 264 [Spanish trans. Francesc Serra i Cantarell from the Italian version entitled: *Avanguardia e razionalità. Articoli, saggi, pamphlets: 1946-1974.* Turin: Enaudi. 1974].

Maldonado, Tomás (1979) **"Does the icon have a cognitive value?"**. In S. Chatman, U. Eco and J.M. Klinkenberg (eds) *A semiotic landscape* [Proceedings of the First Conference of the International Association for Semiotic Studies, Milan, June 1974]. The Hague: Mouton, pp. 774 – 776.

Maldonado, Tomás (1987) **"Looking back at Ulm"**. In Herbert Lindinger (ed) *Ulm Design: The morality of objects.* Cambridge, Mass.: The MIT Press, pp. 222 - 224.

Maldonado, Tomás (1993) **"Presupuestos históricos del diseño industrial"** [Historical pressupositions about industrial design]. In Tomás Maldonado (1993) *El diseño industrial* *reconsiderado.* Barcelona: GG, pp. 19 - 26 [Spanish trans. Francesc Serra i Cantarell from the Italian version entitled: *Disegno industriale: Un riesame.* Milan: Feltrinelli. 1991].

Malhotra, A.; Thomas, J. and Carroll, J. (1978) **Cognitive process in design.** *IBM Research Report,* RC-7082, New York, pp. 39.

Malmberg, Bertil (1967) **Structural linguistics and human communication: an introduction into the mechanism of language and the methodology of linguistics.** 2nd ed. Berlin: Springer.

Malrieu, Philippe (1971) **La construction de lo imaginario.** Madrid: Guadarrama [Spanish trans. Luis Alberto Martín from the French version entitled: *La construction de l'imaginaire.* Brussels: Charles Dessart. 1967].

Maltese, Corrado (1972) **Semiología del mensaje objetual.** Madrid: Alberto Corazón [Spanish trans. César Suárez from the Italian version entitled: *Semiologia del messaggio oggettuale.* Milan: Mursia. 1970].

Mangieri, Rocco (1998a) **"El lenguaje de los objetos: Objetos cotidianos y significación"** [The language of objects: Everyday objects and signification]. In Rocco Mangieri (1998) *El objeto cultural y sus sentidos.* Mérida: Consejo de Publicaciones de la Universidad de Los Andes, pp. 104 – 113.

Mangieri, Rocco (1998b) **Signos e interfases** [Signs and interfases]. Cuadernos de investigación y documentación, No.10, Merida: Universidad de Los Andes.

Manzini, Ezio (1994a) **"Design environment and social quality: From existenzminimun to quality maximum".** *Design Issues,* Vo. 10, N° 1 , Spring, pp. 37 – 43.

Manzini, Ezio (1994b) **"Design, environment and social quality".** In Jeremy Myerson (ed) *Design Renaissance* [Papers of the International Design Conference in Glasgow, 1993] London: Open Eye, pp. 35 – 40.

Manzini, Ezio (1998) **"Products in a period of transition: Products, services and interactions for a sustainable society".** In Tevfik Balcioglu (ed) *The role of product design in post-industrial society.* Ankara: Middle East technical University / Faculty of Architecture Press, pp.43 – 58.

Maquet, Jacques (1999) **La experiencia estética.** Madrid: Celeste [Spanish Trans. Javier García Bresó from the English version entitled: *The Aesthetic Experience. An anthropologist looks at the Visual Arts.* Yale University Press. 1986].

Marchán Fiz, Simón (1981) **El universo del arte** [The universe of art]. Temas Claves series, N° 25. Barcelona: Salvat.

Marcus, George (1995) **Functionalist design.** Munich: Prestel.

Marcuse, Herbert (1979) **The aesthetic dimension.** London: Macmillan Education.

Marías, Julián (1993) **La estructura social** [The social structure]. Madrid: Alianza.

Margolin, Victor (2005) **Las políticas de lo artificial.** Mexico: Designio [Spanish trans. Gabriela Ubaldini from the English version entitled: *The politics of the artificial.* Chicago: The University of Chicago Press. 2002].

Marina, José Antonio (1996) **Teoría de la inteligencia creadora** [Theory of the creative intelligence]. Barcelona: Anagrama.

Martin, W. Mike (1982) **"The act of design and its relationship to cognitive abilities and cognitive style".** *Design Methods and Theories,* Vol. 16, N° 1, pp. 8 – 22.

Maslow, Abraham (1987) **Motivation and personality.** 3rd ed. New York: Harper Collins.

Maser, Siegfried (1987a) **"Design education"**. In Susann Vihma (ed) *Form and vision* [Writings from the International UIAH'87 Conference at Helsinki]. Helsinki: The University of Industrial Arts, pp. 206 – 208.

Maser, Siegfried (1987b) **"Design as science"**. In Susann Vihma (ed) *Form and vision* [Writings from the International UIAH'87 Conference at Helsinki]. Helsinki: The University of Industrial Arts, pp. 90 – 99.

Maslow, Abraham (1987) **Motivation and personality.** 3° ed. New York: Harper Collins.

Maturana, Humberto and Varela, Francisco (1996) **El árbol del conocimiento** [The tree of knowledge]. Santiago of Chile: Editorial Universitaria.

Maurer, C.; Overbeeke, C.J. and Smets, G. (1992) **"The semantics of street furniture"**. In Susann Vihma (ed) *Objects and images: Studies in Design and Advertising.* Helsinki: UIAH, pp. 86 - 93.

Mautner, Thomas (1997) **The Penguin dictionary of philosophy**. London: Penguin Books.

Mazlish, Bruce (1978) **"La cuarta discontinuidad"** [The fourth discontinuity]. In Melvin Kranzberg and William Davenport (eds) *Tecnología y cultura.* Barcelona: GG, pp. 177 -191 [Spanish trans. Esteve Riambau from the English version entitled: *Technology and culture. An anthology.* Society for the History of Technology. 1972].

McDermott, Catherine (1994) **Essential design.** London: Bloomsbury.

McDonagh-Philp, Deana and Lebbon, Cherie (2000) **"The emotional domain in product design".** *The Design Journal,* Vol. 3, Issue 1, pp. 31 - 43.

McLuhan, Marshall (1966) **"The emperor's old clothes"**. In Gyorgy Kepes (ed) *The man-made object.* London: Studio Vista, pp. 90 - 95.

McLuhan, Marshall (1987) **Understanding Media: the extensions of man**. London: Routledge and Kegan.

McLuhan, Marshall and Powers, Bruce (1989) **The global village**. New York: Oxford University Press.

Mead, George Herbert (1934) **Mind, self and society**. 1967 Paperback reprint. Chicago: Chicago University Press.

Medin, Douglas and Smith, Edward (1984) **"Concepts and concept formation"**. *Annual Review of Psychology,* N° 35, pp. 113 - 138.

Mendini, Alessandro (1996) **"Los objetos del mañana"**. *Diseño Interior,* N° 53, p. 48.

Menéndez, José (1968) **La metodología científica y su aplicación al diseño arquitectónico.** Caracas: UCV.

Merrel, Floyd (1998) **Introducción a la semiótica de C. S. Peirce.** [Introduction to the semiotics of Charles S. Peirce]. Maracaibo, Venezuela: Universidad del Zulia - Asociación Venezolana de Semiótica.

Mervis, Carolyn and Rosch, Eleanor (1981) **"Categorization of natural objects"**. *Annual Review of Psychology,* Vol. 32, pp. 89 – 115.

Michl, Jan (1990) **"A review of two product semantics conference proceedings"** [Online]. Available from: http://geocities.com/athens/2360/jm.homepage.html (10 May 2005)

Michl, Jan (1995) **"Form follows what? The modernist notion of function as a *carte blanche*"** [Online]. Available from: http://geocities.com/athens/2360/jm-eng.fff-hai.html (12 June 1998)

Michl, Jan (2002) **"On seeing design as redesign: An exploration of a neglected problem in design education"** [Online]. Available from: http://www.designaddict.com/essais/michl.html (14 May 2006)

Miller, J. Abbott (1994) **"La Bauhaus y la teoría del diseño"**. In Ellen Lupton and Abbott Miller (eds) *El ABC de▽□O: La Bauhaus y la teoría del diseño*. Barcelona: GG, pp. 2 – 21 [English version entitled: *The ABC's of ▽□O: The Bauhaus and the design theory*. London: Thames & Hudson. 1993].

Miller, George (1956) **"The magical number seven, plus or minus two: Some limits on our capacity for processing information"**. *The Psychological Review*, Vol. 63, N° 2, March 1956, pp. 81 – 97.

Miller, George (1970) **Introducción a la psicología**. 2° ed. Madrid: Alianza [Spanish trans. Carlos Ramírez from the English version entitled: *Psychology. The science of mental life*. New York: Harper & Row].

Miller, George (1973) **Psicología de la comunicación**. Buenos Aires: Piados [Spanish trans. María Ines Dates from the English versión entitled: *The psychology of communication*. New York: Basic Books].

Mitchell, C. Thomas (1996) **New thinking in design: Conversations on theory and practice**. New York: Van Nostrand Reinhold.

Moles, Abraham (1966) **Information theory and aesthetic perception**. Urbana: University of Illinois Press.

Moles, Abraham (1971) **"Objeto y comunicación"** [Object and communication]. In Abraham Moles et.al. (1974) *Los objetos*. Buenos Aires: Tiempo Contemporáneo, pp. 9 – 35 [Spanish trans. Silvia Delpy from the French version entitled: *Les objets*. Communications (Journal), N° 13. Éditions du Seuil. 1969].

Moles, Abraham (1973) **"Integración y percepción"** [Integration and perception]. In Abraham Moles et.al. (1975) *La comunicación y los mass media*. Bilbao: Ediciones mensajero [Spanish trans. Juan José Ferrero], pp. 378 – 397.

Moles, Abraham and Zeltmann, Claude (1973) **"Los canales de la comunicación"** [The communication channels]. In Abraham Moles et.al. (1975) *La comunicación y los mass media*. Bilbao: Ediciones mensajero [Spanish trans. Juan José Ferrero], pp. 54 - 79.

Moles, Abraham (1975) **Teoría de los objetos**. Barcelona: GG [Spanish trans. Laura Pla Blacín from the French version entitled: *Théorie des objets*. Paris: Editions Universitaires. 1972].

Moles, Abraham (1995) **"Design and inmateriality: What of it in a postindustrial society?"**. In Victor Margolin and Richard Buchanan (eds.) *The idea of design: a Design Issues reader*. Cambridge: The MIT Press, p. 268 - 274.

Moloney, Karen (1981) **"Notes on concept analysis and art education"**. *Journal of Aesthetic Education*,Vol. 15, N° 3, July, pp. 111 -115 [Special Issue on the Aesthetic Education Conference, Roehampton Institute, Southlands College.1980].

Monö, Rune (1992) **"Design semiotics in practical use"**. In Susann Vihma (ed) *Objects and images: Studies in design and advertising*. Helsinki: University of Industrial Arts Helsinki, pp. 118-123.

Moore, Charles (1976) **"Shape"**. In Charles Moore and Gerald Allen (eds) *Dimensions: Space, shape and scale in architecture*. New York: Architectural Records Books, pp. 11 – 15.

Morin, Edgar (1994) **El método: El conocimiento del conocimiento**. Madrid: Cátedra [Spanish trans. Ana Sánchez from the French version entitled: *La Méthode III: La connaissance de la connaissance*. Paris: Editions du Seuil. 1986].

Morin, Edgar (1998) **El método: Las ideas.** Madrid: Cátedra [Spanish trans. Ana Sánchez from the French version entitled: *Le Méthode IV: Les idées*. Paris: Editions du Seuil. 1991].

Morin, Edgar (2003) **El método: La humanidad de la humanidad.** Madrid: Cátedra [Spanish trans. Ana Sánchez from the French version entitled: *Le Méthode 5. L'Humanité de l'humanité. L'Identité humaine*. Paris: Editions du Seuil. 2001].

Morgantini, Maurizio (1983) **"Man confronted by the third technological generation"**. In Victor Margolin (ed) (1989) *Design discourse: history, theory, criticism*. Chicago: The University of Chicago Press, pp. 43 - 37.

Morris, Charles W. (1939a) **"Aesthetics and the theory of signs"**. *Erkenninis* [Journal of Unified Science], Vol.8, pp.131 - 150.

Morris, Charles W. (1939b) **"Science, art and technology"**. *Kenyon Review*, Vol.1, Fall, pp. 409 - 423.

Morris, Charles W. (1946) **Sign, language and behavior.** New York: George Braziller.

Morris, Charles W. (1974) **La significación y lo significativo.** Serie B – Comunicación. Madrid: Alberto Corazón [Spanish trans. Jesús Antonio Cid from the English version entitled: *Signification and significance.* Cambridge, Mass.: The MIT Press. 1964].

Morris, Charles W. (1985) **Fundamentos de la teoría de los signos.** Barcelona: Paidós [Spanish trans. Rafael Grasa from the English version entitled: *Foundations for a theory of signs*. The Hague: Mouton. 1971].

Mosterín, Jesús (1981) **Grandes temas de la filosofía actual** [Great themes of present philosophy]. Temas claves series, N° 56. Barcelona: Salvat.

Mosterín, Jesús (1993) **Filosofía de la cultura** [Philosophy of culture]. Madrid: Alianza.

Mountford, Joy (1990) **"Tools and techniques for creative design"**. In Brenda Laurel (ed) *The art of human-computer interface design.* Reading: Addison-Wesley, pp. 17 - 30.

Mucchielli, Roger (1969) **Introducción a la psicología estructural.** Barcelona: Anagrama [Spanish trans. Ramón García López from the French version entitled: *Introduction à la psycholgie structurale.* Brussels: Charles Dessart. 1968].

Mukařovský, Jan (1942) **"El lugar de la función estética entre las demás funciones"** [The place of the aesthetic among others functions]. In (1977) *Escritos de estética y semiótica del arte.* Barcelona: Gustavo Gili, pp.122-138 [Spanish trans. Anna Anthony-Višová from the Czech version entitled: *Mukařovský studie z estetiky.* Prague: Odeon. 1966].

Munari, Bruno (1991) **El arte como oficio** [Design as art]. Barcelona: Labor [Spanish trans. Juan-Eduardo Cirlot from the Italian version entitled: *Arte como mestiere.* Bari: Gius, Laterza & Figli. 1968].

Myerson, Jeremy (1998) **"Things to enjoy: Reassessing craft and design objects in an age of technology"**. In Tevfik Balcioglu (ed.) *The role of product design in post-industrial society.* Ankara: Middle East Technical University - Faculty of Architecture Press), pp. 59 - 76.

Nadin, Mihai (1981) **"Aesthetic sign processes"** [Online]. Available from: http://www.code.uni-wuppertal.de/uk/computational_design/who/nadin/publications/articles_in_books/signproc.html (12 December 2005).

Nagel, Ernest (1972) **Simbolismo y ciencia.** Buenos Aires: Nueva Visión [Spanish trans. Horacio Crespo from the English version entitled: *"Symbolism and science"*. In L. Bryson et.al. (1954) *Symbolism and values.* New York: Harper & Brothers].

Negrin, Chel and Fornari, Tulio (1992) **Semiótica del producto** [Semiotics of products]. Mexico: Universidad Autónoma Metropolitana.

Negroponte, Nicholas (1975) **"Sketching: A computational paradigm for personalized searching"**. *Journal of Architectural Education (JAE),* Vol. 29, N° 2, November, pp. 26 - 29.

Neisser, Ulric (1976) **Cognition and reality**. San Francisco: W.H. Freeman and Co.

Nilson, Torsten (1992) **Value-added marketing**. London: McGraw Hill.

Norberg-Schulz, Christian (1965) **Intentions in architecture**. Cambridge, Mass.: The MIT Press.

Norman, Donald and Rumelhart, David (1975a) **"Reference and comprehension"**. In D.Norman and D. Rumelhart (eds) *Explorations in cognition.* San Francisco: W.H.Freeman, pp. 65 - 87.

Norman, Donald and Rumelhart, David (1975b) **"Memory and knowledge"**. In D.Norman and D. Rumelhart (eds) *Explorations in cognition.* San Francisco: W.H.Freeman, pp.3 - 32.

Norman, Donald (1988) **The psychology of everyday things**. New York: Basic Books.

Norman, Donald (1992) **Turn signals are the facial expressions of automobiles**. Reading, Mass: Addison-Wesley.

Norman, Donald (1999) **"The invisible computer: The move from technology-centered to human-centered products"**. *Formdiskurs,* Vol. 6, N° 1 /1999, pp. 29 – 37.

Norman, Donald (2004) **Emotional design**. New York: Basic Books.

Novaes, María (1973) **Psicología de la aptitud creadora** [Psychology of the creative aptitude]. Buenos Aires: Kapelusz.

Ockerse, Thomas (1984) **"De-Sign / Super-Sign"**. *Semiotica,* N° 52, Vol. 3/4, pp. 247 – 272.

O'Doherty, E. F. (1963) **"Psychological aspects of the creative act"**. In J. Christopher Jones and D.G. Thornley (eds) *Conference on design methods* [Papers presented at the Conference on Systematic and Intuitive Methods in Engineering, Industrial Design, Architecture and Communications; London, September 1962]. Oxford: Pergamon Press, pp. 197 – 203.

Oehlke, Horst (1990) **"In search of the semantics of design objects"**. In Susann Vihma (ed) *Semantic visions in design* [Proceedings from the Symposium on Design Research and Semiotics at the University of Industrial Arts Helsinki, 1989]. Helsinki: UIAH, pp. e1 – e12.

Ogden, Charles and Richards, Ivor (1923) **The meaning of meaning**. London: Kegan, Trench, Trubner and Co.

Ohnuki-Tierney, Emiko (1981) **"Phases in human perception / conception / symbolization processes: Cognitive Anthropology and Symbolic Classification"**. *American Etnologist* (Special Issue), Vol. 8/3, pp. 451 – 467.

Olea, Oscar and González, Carlos (1988) **Metodología para el diseño.** 2nd Reprint. Mexico: Trillas.

Olivé, León (1991) **Cómo acercarse a la filosofía**. México: Limusa.

Olver, Elizabeth (2003) **El arte del diseño de joyería**. Barcelona: Acanto [Spanish Trans. Ana Herrera from the English version entitled: *The Art of Jewellery Design.* Quarto Publishing. 2002].

Ortega y Gasset, José (1984) **¿Qué es el conocimiento?** [What is knowledge?]. Madrid: Alianza.

Ortega y Gasset, José (1986) **Ideas y creencias** [Ideas and beliefs]. Madrid: Alianza.

Ortiz, Georgina (2004) **Usos, aplicaciones y creencias acerca del color** [Usages, applications and beliefs about colour]. Mexico: Trillas.

Osborne, Harold (1970) **The art of appreciation**. London: Oxford University Press.

Osgood, Charles; Suci, George & Tannenbaum, Percy (1957a) **The measurement of meaning.** Urbana: University of Illinois Press.

Osgood, Charles; Suci, George & Tannenbaum, Percy (1957b) **"A report on experiments in esthetic communication by W.T.Tucker"**. In James Hogg (ed) (1969) *Psychology and the visual arts.* Middlesex: Penguin, pp. 323 – 330.

O'Sullivan, Tim et.al. (1994) **Key concepts in communication and cultural studies.** 2nd ed. London: Routledge.

Ou, Li-Chen and Luo, Ming (2004) **"Colour preference and colour emotion"**. In Deanna McDonagh et.al. (eds) (2004) *Design and emotion: The experience of everyday things.* London: Taylor & Francis, pp. 185 – 189.

Oxman, Rivka (1997) **"Design by representation: A model of visual reasoning in design"**. *Design Studies,* Vol. 18, N°4, October, pp. 329 – 347.

Packard, Vance (1992) **Las formas ocultas de propaganda.** Buenos Aires: Sudamericana [Spanish trans. Martha Mercader de Sánchez from the English version entitled: *The Hidden Persuaders.* 1981].

Paivio, Allan (1971) **Imagery and verbal processing.** New York: Holt, Rinehart and Winston.

Palmer, Stephen (1975a) **"Visual perception and world knowledge: Notes on a model of sensory-cognitive interaction"**. In D. Norman and D. Rummelhart (eds) *Explorations in cognition.* San Francisco: W.H. Freeman and Co., pp. 179 – 307.

Palmer, Stephen (1975b) **"The effect of contextual scenes on the identification of objects".** *Memory & Cognition,* Vol. 3, N° 5, pp. 519 – 526.

Pantzar, Mika (1997) **"Domestication of everyday life technology: Dynamic views on the social histories of artefacts"**. *Design Issues,* Vol. 13, N° 3, Autumn, pp. 52 – 65.

Pantzar, Mika (2000) **"Consumption as work, play and art: Representation of the consumer in future scenarios"**. *Design Issues,* Vol. 16, N° 3, Autumn, pp. 3 – 18.

Papanek, Victor and Hennessey, James (1977) **How things don't work.** New York: Pantheon Books.

Papanek, Victor (1984) **Design for the real world.** London: Thames & Hudson.

Papanek, Victor (1994) **"The coming of a new aesthetics: eco-logic, etho-logic, bio-logic".** In Jeremy Myerson (ed) *Design Renaissance* [Papers of the International Design Conference in Glasgow, 1993] London: Open Eye, pp.29-34.

Papanek, Victor (1995) **The green imperative.** London: Thames & Hudson.

Pasman, G. and Muller, W. (1995) **"Using precedents in the form-creation phase of the industrial design process: A typological approach"**. In Rachel Cooper (ed.) *Design Interfaces* [Proceedings of the Inaugural Conference of the European Academy of Design, University of Salford, UK, April 1995]. Vol.1, Salford: European Academy of Design, pp. 6 [No page is numbered].

Pastor, Elida and Echegaray, Mario (1997) **Identi-kit del diseño industrial.** Mendoza, Argentina: EDIUNC.

Payne, Stephen (1991) **"A descriptive study of mental models"**. *Behaviour & Information Technology*, Vol.10, N° 1, pp. 3-21.

Peirce, Charles Sanders (1897) **"Division de los signos"** [Original text in English without title]. In Charles Sanders Peirce (1974) *La ciencia de la semiótica.* Buenos Aires: Nueva Visión, pp. 21 - 43 [Spanish trans. Beatriz Bugni].

Peirce, Charles Sanders (1904) **"Carta a lady Welby del 12 de octubre de 1904"**[Letter to Lady Welby, dated 12 October 1904]. In Charles Sanders Peirce (1974) *La ciencia de la semiótica.* Buenos Aires: Nueva Visión, pp. 85 - 96 [Spanish trans. Beatriz Bugni].

Peirce, Charles Sanders (1908) **"Carta a lady Welby del 23 de diciembre de 1908"** [Letter to Lady Welby, dated 23 December 1908]. In Charles Sanders Peirce (1974) *La ciencia de la semiótica.* Buenos Aires: Nueva Visión, pp. 96 - 108 [Spanish trans. Beatriz Bugni].

Peirce, Charles Sanders (1909) **"Carta a lady Welby del 14 de marzo de 1909"** [Letter to Lady Welby, dated 14 March 1909]. In Charles Sanders Peirce (1974) *La ciencia de la semiótica.* Buenos Aires: Nueva Visión, pp. 108 - 110 [Spanish trans. Beatriz Bugni].

Peirce, Charles Sanders (1974) **"Grafos existenciales"** [Existential Graphs]. In Charles Sanders Peirce (1974) *La ciencia de la semiótica.* Buenos Aires: Nueva Visión, pp. 63 - 82 [Spanish trans. Beatriz Bugni].

Péninou, Georges (1976) **Semiótica de la publicidad** [Semiotics of advertising]. Barcelona: Gustavo Gili [Spanish trans. Justo Beramendi from the French version entitled: *Intelligence de la Publicité: Étude sémiotique.* Paris: Robert Laffont. 1972].

Pérez-Carreño, Francisca (1998) **Los placeres del parecido: Icono y representación** [The pleasures of resemblance: icon and representation]. Madrid: Visor.

Pérez de Medina, Elena (2002a) **"Charles Sanders Peirce (1839-1914): El signo y sus tricotomías"** [Charles Sanders Peirce (1839-1914): The sign and its trichotomies]. In Roberto Marafioti (Comp) *Recorridos semiológicos: Signos, enunciación y argumentación* [Semiological journeys: Signs, enunciation and argumentation]. Buenos Aires: EUDEBA, pp. 35 – 78.

Pérez de Medina, Elena (2002b) **"El ámbito de estudio de la semiología"** [Field of study of semiology]. In Roberto Marafioti (Comp) *Recorridos semiológicos: Signos, enunciación y argumentación.* Buenos Aires: EUDEBA, pp. 11 – 33.

Pettersson, Gunnel (2001) **"Products as signs: An implication of semantic and three-dimensional visual analysis in product development"** [Online]. Available from: http://design.ntnu/forskning/artikler/2001/pettersson_11.pdf (15 September 2006).

Piaget, Jean (1947) **The psychology of intelligence.** London: Routledge & Kegan.

Piaget, Jean (1971) **El estructuralismo.** 3rd ed. Buenos Aires: Proteo [Spanish trans. Floreal Mazía from the French version: *Le structuralisme.* Paris: Presses Universitaires de France. 1968].

Piaget, Jean & Inhelder, Bärbel (1969) **The psychology of the child.** New York: Basic Books.

Piaget, Jean & Inhelder, Bärbel (1971) **Mental imagery in the child: A study of the development of imaginal representation.** London: Routledge & Kegan.

Pibernat, Oriol (1996) **"Ecología y entropía sígnica del objeto"**. *Tipográfica*, Year X, N° 30, pp. 38 – 40.

Pile, John F. (1979) **Design: Purpose, form and meaning.** Amherst: The University of Massachussetts Press.

Pineda, Edgar; Sánchez, Mauricio and Amarilles, Diego (1998) **Lenguajes objetuales y posicionamiento** [Object languages and positioning]. Bogota: Fundación Universidad de Bogotá José Tadeo Lozano.

Pinker, Steven (1999) **How the mind works.** London: Penguin Books.

Plato. **The republic.** In E. Hamilton and C. Huntington (eds) (1973) *The collected dialogues of Plato.* Princenton: Princenton University Press [English trans. Paul Shorey].

Plato. **Parmenides.** In E. Hamilton and C. Huntington (eds) (1973) *The collected dialogues of Plato.* Princenton: Princenton University Press [English trans. F.M. Conford].

Pope, Jeffrey (1984) **Investigación de mercados.** Bogotá: Norma [Spanish trans. Franklin Malguashca from the English version entitled: *Practical Marketing Research.* New York: AMACOM. 1981].

Popper, Karl (1968) **The logic of scientific discovery.** New York: Harper Torchbooks.

Popper, Karl (2005) **Conocimiento objetivo.** 5° ed.Madrid: Tecnos [Spanish trans. Carlos Solís Santos from the English version entitled: *Objective knowledge.* Oxford: Clarendon Press. 1972].

Popovic, Vesna (2004) **"Expertise development in product design: Strategic and domain-specific knowledge connections".** *Design Studies,* Vol. 25, No.5, September, pp. 527 – 545.

Posner, Michael (1973) **Cognition.** Glenview, Illinois: Scott Foresman and Company.

Pouillon, Jean (1975) **"Presentación: Un ensayo de definición".** In Barbut, Marc et.al. (1975) *Problemas del estructuralismo.* 6ª ed. Mexico: Siglo XXI, pp. 1 - 24 [Spanish trans. Julieta Campos, Gustavo Esteva and Alberto de Ezcurdia from the French version entitled: *Problemes du structuralisme.* Les temps modernes, N° 246, Paris, 1966].

Prentice, Deborah (1987) **"Psychological correspondence of possessions, attitudes, and values".** *Journal of personality and Social Psychology.* Vol. 53, N° 6, pp. 993 – 1003.

Prieto, Luis J. (1971) **"Notas para una semiología de la comunicación artística"** [Notes for a semiotics of artistic communication]. In Luis J. Prieto (1978) *Estudios lingüísticos y de semiología generales.* 2° ed. Mexico: Nueva Imagen [Spanish trans. Jorge Promio from the French entitled: *Essais de linguistique et sémiologie générales.* Geneva: Librairie Droz. 1975], pp. 169 – 180.

Pross, Harry (1980) **Estructura simbólica del poder: Teoría y práctica de la comunicación pública.** Barcelona: Gustavo Gili [Spanish trans. Pedro Madrigal and Homero Alsina from the German version entitled: *Politische Symbolik: Theorie und Praxis der öffentlichen Kommunikation.* Sttutgart: W. Kohlhammer. 1974].

Pugh, Stuart (1991) **Total design: Integrated methods for successful product engineering.** Wokingham, England: Addison-Wesley.

Pye, David (1978) **The nature and aesthetics of design.** London: The Herbert Press.

Put, F.H.C. van der (1980) **"The practice of industrial design".** In P. Ramírez and A. Lazo (ed.) *Industrial design and human development* [Proceedings of the XIth Conference and Assembly of the ICSID, Mexico, 1979]. Amsterdam: Excerpta Medica, pp. 321 – 324.

Quarante, Danielle (1992) **Diseño industrial.** Vol. 1-2. Barcelona: CEAC [Spanish trans. Xavier Gispert from the French version entitled: *Eléments de Design Industrielle.* Paris: Maloine. 1984].

Quillet, Arístides (1969) **Diccionario Enciclopédico Quillet.** 7 Vols. Buenos Aires: Arístides Quillet.

Quiroga, Blanca (2001) **Léxico de diseño.** 2° ed. Mendoza, Argentina: EDIUNC.

Quirós, Luis Fernando (1998) **Diseño: Teoría, acción, sentido.** Cartago: Editorial Tecnológica de Costa Rica.

RAE [Spanish Royal Academy of Language] (1992) **Diccionario de la lengua española** [Dictionary of the Spanish language]. Madrid: Espasa.

Raman, Pattabi (1973) **"Form, models and design synthesis"**. *Proceedings of the Design Activity Conference.* Section 1: Design Morphologies. London, pp. 1/15/1 – 1/15/5.

Ramírez, Nelson (1987) **El concepto arquitectónico, su naturaleza y enseñanza** [The architectural concept, its nature and teaching]. Merida, Venezuela: University of Los Andes.

Ramos, Juan María (2005) **"Revolución industrial"**. In Marisa Javierre (ed) (2005) *Gran Enciclopedia Espasa.* Vol. 17. Bogota: Espasa-Calpe.

Rams, Dieter (1989) **"Omit the unimportant"**. In Victor Margolin (ed) (1989) *Design discourse: History, theory and criticism.* Chicago: The University of Chicago Press, pp. 111 – 113.

Rams, Dieter (1998) **"The responsibility of design in the future"**. In Tevfik Balcioglu (ed) *The role of product design in post-industrial society.* Ankara: Middle East Technical University – Faculty of Architecture Press, pp. 35 – 42.

Rapoport, Amos (1969) **"Facts and models"**. In Geoffrey Broadbent and Anthony Ward (eds) *Design methods in architecture.* London: Lund Humphries / The Architectural Association, pp. 136 – 146.

Rauterberg, Matthias; Salem, Ben and Mortel, Dirk van de (2005) **"From passive to active forms"**. In Loe Feijs, Steven Kyffin and Bob Young (eds) *Design and semantics of form and movement.* The Netherlands: Koninklijke Philips Electronics N.V., pp. 110 - 117.

Read, Herbert (1957a) **Art and industry: The principles of industrial design.** 2° ed. London: Faber & Faber.

Read, Herbert (1957b) **"La imagen vital"** [The vital image]. In Herbert Read (1957) *Imagen e idea.* Mexico: Fondo de Cultura Económica, pp.11 – 41 [Spanish trans. Horacio Flores Sánchez from the English version entitled: *Icon and Idea.* Harvard University Press. 1955].

Read, Herbert (1967) **"El sentido biológico del arte"** [The biologic sense of art]. In Herbert Read (1967) *Orígenes de la forma en el arte.* Buenos Aires: Proyección, pp. 166 – 175 [Spanish trans. Alicia Gómez from the English version entitled: *The origins of form in art.* London: Thames & Hudson. 1965].

Reber, Arthur (1995) **Dictionary of psychology.** London: Penguin Books.

Reid, Louis Arnaud (1954) **A study in aesthetics.** Wesport, Connecticut: Greenwood Press.

Reid, Louis Arnaud (1969) **Meaning in the arts.** London: Allen & Unwin.

Reid, Louis Arnaud (1982) **"The concept of aesthetic development"**. In Malcolm Ross (ed) *The development of aesthetic experience.* Oxford: Pergamon Press, pp. 2 –2 6.

Reyes, Juan; Boils, Francisco and Pérez, José (1988) **Mercadotecnia industrial** [Industrial Marketing]. Mexico: Trillas.

Ricard, André (1982) **Diseño: ¿Por qué?** [Design: Why?] Barcelona: Gustavo Gili.

Richardson, Alan (1969) **Mental imagery.** London: Routledge & Kegan.

Ricoeur, Paul (1976) **Interpretation theory.** Forth Worth: The Texas Christian University Press.

Rittel, Horst (1964) **The universe of design** [Typed paper]. Berkeley: University of California.

Rittel, Horst (1972) **Una teoría y un paradigma del diseño** [A theory and a paradigm for design]. Merida, Venezuela: University of Los Andes [Spanish trans. Enrique Vila].

Rittel, Horst (1986) **"Some principles for the design of an educational system for design".** *Design Methods and Theories,* Vol. 20, N° 1, pp. 359 – 375.

Rivera, Melesio (1978) **La comprobación científica.** 2ª ed. México: Trillas.

Robertson, Alec (1994) **"4D Design: Interaction among disciplines at a new frontier".** *Design Management Journal,* Vol. 5, N° 3, pp. 26 –30.

Rodgers, Paul; Green, Graham and McGown, Alistair (2000) **"Using concept sketches to track design progress".** *Design Studies,* Vol. 21, pp. 451 – 464.

Rodríguez-Morales, Luis Alfredo (2004) **Diseño: Estrategia y táctica.** Mexico: Siglo XXI.

Rodríguez, Gerardo (1987) **Manual de diseño industrial.** Mexico: Gustavo Gili.

Rogers, Everett (1989) **"Elements of diffusion".** In Robin Roy and David Wield (eds) *Product design and technological innovation.* Milton Keynes, England: The Open University Press, pp. 184 - 192.

Rogers, Yvonne (1992) **"Introduction".** In Y. Rogers, A. Rutherford and P. Bibby (eds) *Models in the mind: Theory, perspective and application.* London: Academy Press, pp. 1 - 7.

Roozenburg, Norbet and Eekels, J. (1995) **Product Design: Fundamentals and methods.** Chichester: John Wiley & Sons.

Rorty, Richard (1995) **La filosofía y el espejo de la naturaleza.** Madrid: Cátedra [Spanish trans. Jesús fernández Sulaica from the English version entitled: *Philosophy and the mirror of nature.* New Jersey: Princeton University Press. 1979].

Rosch, Eleanor (1975) **"Cognitive representations of semantic categories".** *Journal of Experimental Psychology,* Vol. 104 (General), N°3, pp.192 - 233.

Rosch, Eleanor et.al. (1976) **"Basic objects in natural categories".** *Cognitive Psychology.* Vol.8, pp. 383 – 439.

Ross, David (1951) **Plato's theory of ideas.** Oxford: Clarendon Press.

Rossi-Landi, Ferruccio (1975) **Linguistics and economics.** The Hague: Mouton.

Roth, Ilona and Bruce, Vicky (1995) **Perception and representation.** Buckingham: The Open University Press.

Rotte, A. C. (1993) **"Design and aesthetics: Ordo, Claritas et Consonantia".** In *Aesthetics in Design Coloquium.* Digest N° 1993/153, 29 June 1993. London: Institution of Electrical Engineers, pp. 3/1 – 3/6.

Rowe, Peter G. (1987) **Design thinking.** Cambridge, Mass.: The MIT Press.

Rykwert, Joseph (1968) **"The dark side of the Bauhaus".** In Joseph Rykwert (ed) (1982) *The necessity of artifice.* New York: Rizzoli, pp. 44 – 49.

Saffo, Paul (1992) **"The thirty year rule".** *Design World,* N° 24, pp. 16 - 23.

Sakashita, Kiyoshi (1996) **"Humanware design".** In C. Thomas Mitchell (1996) *New thinking in design: Conversations on theory and practice.* New York: Van Nostrand Reinhold, pp. 82 – 87.

Salinas, Oscar (2003) **"Historia del diseño ¿Para qué?"** [Design history ¿What for?]. In Victor Margolin et.al. (2003) *Las rutas del diseño: Estudios sobre teoría y práctica.* México: Designio, pp. 49 – 56.

Sánchez, Margarita de (1991a) **Procesos básicos del pensamiento** [Basic processes of thinking]. Mexico: Trillas.

Sánchez, Margarita de (1991b) **Creatividad** [Creativity]. Mexico: Trillas.

Sánchez, Mauricio (2001) **Morfogénesis del objeto de uso: La forma como hecho social de convivencia** [Morphogenesis of the utilitarian object]. Bogota: Fundación Universidad de Bogotá Jorge Tadeo Lozano.

Sanz, Félix and Lafargue, José (2002) **Diseño industrial: Desarrollo del producto** [Industrial Design: Product development]. Madrid: Thomson.

Sartre, Jean-Paul (1971) **Bosquejo de una teoría de las emociones.** Madrid: Alianza [Spanish trans.Mónica Acheroff from the French version entitled: *Esquisse d'une théorie des emotions.* Paris. Editions Hermann. 1965].

Saussure, Ferdinand de (1980) **Curso de lingüística general.** 20° ed. Buenos Aires: Losada [Spanish trans. Amado Alonso from the French version entitled: *Cours de linguistique générale.* 1916].

Savas, Özlem (2004) **"A perspective on the person-product relationship: Attachment and detachment".** In Deana McDonagh et.al. (eds) (2004) *Design and emotion: The experience of everyday things.* London: Taylor & Francis, pp. 317 - 321.

Schaer, Walter (1983) **"Design interaction research".** In *Design'81 Conference on Design Integration* (ICOGRADA – ICSID – IFI). Final report. Helsinki: Rakennuskirja Oy, pp. 205 – 207.

Scheuer, Winfried (1989) **"Die produktwelt der elektronik verlangt nach neuen gestaltungsansätzen".** *FORM* (Zeitschrift für Gestaltung), N° 128, p. 13.

Schifferstein, Hendrik; Mugge, Ruth and Hekkert, Paul (2004) **"Designing consumer-product attachment".** In Deana McDonagh et.al. (eds) (2004) *Design and emotion: The experience of everyday things.* London: Taylor & Francis, pp. 327 – 331.

Schön, Donald (1969) **"Design in the light of the year 2000".** *Student Technologist,* Autumn, pp. 20 – 24.

Schön, Donald (1998) **"El diseño como una conversación reflexiva con la situación"** [Design as a reflective talk with the situation]. In Donald Schön (1998) *El profesional reflexivo.* Barcelona: Paidós, pp. 79 -102 [Spanish trans. José Bayo form the English version entitled: *The Reflective Practitioner.* Basic Books. 1983].

Schutz, Alfred (1953) **"The frame of unquestioned constructs".** In Mary Douglas (ed) (1973) *Rules and meanings.* Middlesex, UK: Penguin Education, pp. 18 –20.

Scott, Robert Gillian (1974) **Fundamentos del diseño.** Buenos Aires: Victor Lerú [Spanish trans. Martha del Castillo from the English version entitled: *Design Fundamentals.* New York: McGraw-Hill. 1958].

Scrivener, Stephen; Ball, Linden and Tseng, Winger (2000) **"Uncertainty and sketching behaviour".** *Design Studies,* Vol. 21, N° 5, September, pp. 465 – 481.

Scruton, Roger (1985) **La estética de la arquitectura.** Madrid: Alianza [Spanish trans. Jesús Fernández Zulaica from the English version entitled: *The Aesthetics of Architecture.* London: Methuen & Co. 1979].

Scruton, Roger (1999) **Filosofía para personas inteligentes**. Barcelona: Península [Spanish trans. Mingus Formentor from the English version entitled: *An intelligent person's guide to philosophy.* London: Gerald Duckworth & Co. 1996].

Sebeok, Thomas (1976) **"Semiosis in nature and culture"**. In Thomas Sebeok (ed) (1979) *The signs and its masters.* Austin: University of Texas Press, pp. 3 – 26.

Sebeok, Thomas (ed) (1986) **Encyclopedic dictionary of semiotics**. 2 Vol. Berlin: Mouton de Gruyter.

Sebeok, Thomas (1996) **Signos: Una introducción a la semiótica.** Barcelona: Paidós [Spanish trans. Pilar Torres Franco from the English version entitled: *Signs: An introduction to Semiotics.* Toronto: University of Toronto Press. 1994].

Selle, Gert (1975) **Idelogía y utopía del diseño**. Barcelona: Gustavo Gili [Spanish trans. Eduardo Subirats from the German version entitled: *Ideologie und Utopie des Design: Zur gesellschaftlichen Theorie der Industriellen Formgebung.* Cologne: Du Mont Schauberg. 1973].

Selle, Gert (1995) **"Untimely opinions (an attempt to reflect on design)"**. In Victor Margolin and Richard Buchanan (eds) *The idea of design.* Cambridge: The MIT Press, pp. 238 - 247.

Senosiain, Javier (1996) **Bioarquitectura: En busca de un espacio**. Mexico: Limusa.

Serrano, Jorge (1978) **Pensamiento y concepto** [Thinking and concept]. 2nd ed. Mexico: Trillas.

Shah, Jami; Smith, Steve and Vargas-Hernandez, Noe (2003) **"Metrics for measuring ideation effectiveness"**. *Design Studies*, Vol. 24, No. 2, March, pp. 111 – 114.

Shapiro, Gary (1995) **"Georg Wilhelm Friedrich Hegel"**. In David Cooper (ed) *A companion to Aesthetics.* Oxford: Blackwell, pp. 182 – 188.

Shore, Bradd (1991) **"Twice-born, once conceived: Meaning construction and cultural cognition"**. *American Anthropologist*, Vol. 93, pp. 9 – 27.

Silva, Fernando (1998) **Antropología: Conceptos y nociones generales**. Lima: Fondo de Cultura Económica.

Simon, Herbert (1973) **"The structure of ill-structured problems"**. In Nigel Cross (ed) (1984) *Developments in design methodology.* Chichester: John Wiley & Sons, pp. 145 – 166.

Simon, Herbert (1992) **The sciences of the artificial.** 2nd ed. Cambridge, Mass: The MIT Press.

Singleton, W.T. (1972) **Introduction to Ergonomics**. Geneva: World Health Organization.

Sless, David (1981) **Learning and visual communication**. New York: John Wiley & Sons.

Smets, Gerda (1987) **"Form semantics: A scientific approach"**. In Susann Vihma (ed) *Form and vision* [Articles and writings from the International UIAH'87 Conference, Helsinki]. Helsinki: The University of Industrial Arts, pp. 100 –113.

Smets, Gerda (1989) **"Perceptual meaning"**, *Design Issues*, Vol.5, Part 2, Spring, pp. 86 - 99.

Smets, Gerda (1994) **"Industrial design engineering and the theory of direct perception"**. *Design Studies*, Vol. 15, No. 2, pp. 175 – 184.

Smith, Gillian Crampton (1994) **"Humanising technology: Could do better?"**. In Jeremy Myerson (ed.) *Design Renaissance* [Selected papers from the International Design Conference of Glasgow, 1993]. London: Open Eye, pp. 143 - 146.

Solomon, Odile (1992) **"Aesthetic references and cultural representations"**. In Susann Vihma (ed) *Objects and images: Studies in design and advertising.* Helsinki: University of Industrial Arts, pp. 146 – 159.

Somerville, James (1988) **"Are there aesthetic qualities?"** In Richard Woodfield (ed) *Proceedings of the XIth International Conference in Aesthetics.* Nottingham: Nottingham Polytechnic Press, pp. 207 - 211.

Sonensson, Göran (2004) **"Linguistic model fallacy"**. In *The Internet Semiotics Encyclopaedia* [Online]. Available from: http://www.arthist.lu.se/kultsem/encyclo/linguistic_model.html (15 February 2005).

Sottsass, Ettore (1973) **"Entrevista"** [Interview]. In Jordi Mañá (1973) *El diseño industrial.* Barcelona: Salvat.

Sottsass, Ettore (1986) **"Design is a metaphor"**. In Gianni Barbacetto (1987) *Design interface. How man and machine communicate: Olivetti design research by King & Miranda.* Milan: Arcadia, pp. 33 - 35.

Stanton, Neville (1998) **"Product design with people in mind"**. In Neville Stanton (ed) *Human factors in consumer products.* London: Taylor & Francis, pp. 1 – 15.

Stanton, Neville and Young, Mark (1998) **"Ergonomics methods in consumer product design and evaluation"**. In Neville Stanton (ed) *Human factors in consumer products.* London: Taylor & Francis, pp. 21 - 53.

Suwa, Masaki and Tversky, Barbara (1997) **"What do architects and students perceive in their design sketches? A protocol analysis"**. *Design Studies,* Vol. 18, N° 4, pp. 385 – 403.

Suwa, Masaki; Purcell, Terry and Gero, John (1998) **"Macroscopic analysis of design processes based on a scheme for coding designers' cognitive actions"**. *Design Studies,* Vol. 19, N°4, October, pp. 455 – 483.

Suwa, Masaki; Gero, John and Purcell, Terry (1999) **"Unexpected discoveries: How designers discover hidden features in sketches"** [Online]. Available from: www.arch.usyd.edu.au/~john/publications/1999/99SuwaGeroPurcellVR99.pdf - (22 August 2006)

Suwa, Masaki and Tversky, Barbara (2001) **"How do designers shift their focus of attention in their own sketches?"** [Online]. Available from: http://www-psych.stanford.edu/~bt/diagrams/papers/SuwaTversky.DRII.Word.doc1.pdf (22 August 2006)

Taboada, Emil and Napoli, Roberto (1977) **El diseño industrial.** Buenos Aires: Centro Editor de América Latina.

Tatarkiewicz, Wladyslaw (1976) **"La belleza: Historia de la categoría"** [Beauty: History of a category]. In W. Tatarkiewicz (1990) *Historia de seis ideas*[A History of Six Ideas]. Madrid: Tecnos, pp. 185 – 230 [Spanish trans. Francisco Rodríguez Martín from the Polish version entitled: *Dzieje szésciu pojec.* Varsow: Pánstwowe Wydawnictwo Naukowe. 1976].

Tatarkiewicz, Wladyslaw (1977) **"La creatividad: Historia del concepto"** [Creativity: History of the concept]. In W. Tatarkiewicz (1990) *Historia de seis ideas* [A History of Six Ideas]. Madrid: Tecnos, pp. 279 - 300 [Spanish trans. Francisco Rodríguez Martín from the Polish version entitled: *Dzieje szésciu pojec.* Varsow: Pánstwowe Wydawnictwo Naukowe. 1976].

Taylor, Andrew and Taylor, Valerie (2004) **"The use of social representations in product design"**. In McDonagh, Deane; Hekkert, Paul; Erp, Jeroen van and Gyi, Diane (eds) *Design and emotion: The experience of everyday things.* London: Taylor & Francis, pp. 267 – 271.

Teague, Walter Dorwin (1946) **Design this day: The technique of order in the machine age.** London: The Studio Publications.

Teigen, Karl (1987) **"Intrinsic interest and the novelty-familiarity interaction"**. *Scandinavian Journal of Psychology*, N° 28, pp. 199 - 210.

Thompson, Michael (1979) **Rubbish theory: The creation and destruction of value.** Oxford: Oxford University Press.

Thomas, John and Carroll, John (1979) **"The psychological study of design"**. *Design Studies*, Vol. 1, N°1, July, pp. 5 – 11.

Tjalve, Eskild (1979) **A short course in industrial design.** London: Newnes-Butterworths.

Toffler, Alvin (1983) **Previews and premises.** Toronto: Bantam Books.

Tomasello, Michael (1999) **The cultural origins of cognition.** Cambridge: Harvard University Press.

Tordera, Antonio (1978) **Hacia una semiótica pragmática: El signo en Charles Sanders Peirce** [Towards a Pragmatic Semiotics: The sign in Charles Sanders Peirce]. Valencia: Fernando Torres.

Tovey, Michael (1984) **"Designing with both halves of the brain"**. *Design Studies*, Vol. 5, N° 4, October, pp. 219 – 228.

Tovey, M; Porter, S. and Newman, R (2003) **"Sketching, concept development and automotive design"**. *Design Studies*, Vol. 24, N° 2, March, pp. 135 – 153.

Tuovinen, Jussi (1999) **"Cognition, perception and imagination: A Semiotic approach"**. *Opción* [Journal of human and social sciences edited by University of Zulia, Venezuela]. Year 15, N° 28, pp. 125 – 142.

Trachte, Ralf (1999) **"New objects: Forms of differentiation for the universal data culture"**. *Formdiskurs*, Vol. 6, N° 1/1999, pp. 17 – 25.

Tsow, David and Beamer, Linda (1987) **"Verbalization and visualization: A need in architecture education"**. *Journal of Architectural Education*, Vol. 40, No. 2, Jubilee Issue, Winter, pp. 80 - 81.
Tversky, Barbara (2002a) **"What do sketches say about thinking?"** [Online]. Available from: http://www-psych.stanford.edu/~bt/diagrams/papers/sketchingaaai02format.doc.pdf (22 August 2006)

Tversky, Barbara (2002b) **"Some ways that graphics communicate"** [Online]. Available from: http://www-psych.stanford.edu/~bt/diagrams/papers/imageword3.15.doc1.pdf (10 November 2006).

Tversky, B. et.al. (2003) **"Sketches for design and design of sketches"** [Online]. Available from: http://www-psych.stanford.edu/~bt/diagrams/papers/sketches-tversky-suwa-etal.pdf (22 August 2006)

Tyler, Ann C. (1992) **"Shaping belief: The role of audience in visual communication"**. *Design Issues*, Vol. IX, N° 1, Autumn, pp. 21 - 29.

Uexküll, Jakob von (1934) **"A stroll through the worlds of animal and men"**. In Claire Schiller (ed) (1957) *Instinctive behaviour*. New York: International University Press, pp. 5 – 80.

Ulrich, Karl and Eppinger, Steven (1995) **Product design and development.** New York: McGraw-Hill.

Ulusoy, Zuhal (1999) **"To design versus to understand design: The role of graphic representations and verbal expressions"**. *Design Studies*, Vol. 20, N°2, March, pp. 123 – 130.

Uspenskij, B.A. (1962) **"Semiotics of art"**. In Daniel Lucid (ed) (1977) *Soviet semiotics: An anthology.* Baltimore: The John Hopkins University Press, pp. 171 – 173.

Uzcátegui, Eli Saúl (1988) **El proceso de diseño en arquitectura** [The design process in architecture]. Mérida: Consejo de Publicaciones/ Universidad de Los Andes.

Väkevä, Seppo (1990) **"What do we need semiotics for?"** In Susann Vihma (ed) *Semantic visions in design* [Proceedings from the Symposium on Design Research and Semiotics 1989 at the University of Industrial Arts, Helsinki]. Helsinki: UIAH, pp. g1 - g9.

Vasari, Giorgio (1978) **Vidas de los más excelentes pintores, escultores y arquitectos.** 11° ed. Mexico: Cumbre [Spanish translation Julio Pyró from the Italian version entitled: *Vite de' piú celebri Pittori, Scultori ed Architetti*].

Verón, Eliseo (1996a) **"Terceridades"** [Thirdnesses]. In Eliseo Verón (1996) *La semiosis social* [Social semiosis]. Barcelona: Gedisa, pp. 99 – 110.

Verón, Eliseo (1996b) **"La clausura semiótica"** [The semiotic closure]. In Eliseo Verón (1996) *La semiosis social* [Social semiosis]. Barcelona: Gedisa, pp. 111 – 120.

Verón, Eliseo (2002) **"Signo"** [Sign]. In Carlos Altamirano (ed) *Términos críticos de la sociología de la cultura* [Critical terms of the sociology of culture]. Buenos Aires: Paidós, pp. 213 – 218.

Verstijnen, I.M.; Hennessey, J.M.; Leeuwen, van C and Hamel, R. (1998) **"Sketching and creative discovery"**. *Design Studies*, Vol. 19, N° 4, October, pp. 519 – 546.

Verstock, Mark (1987) **The genesis of form: From caos to geometry**. London: Muller, Blond & White.

Vétrov, A.A. (1973) **La semiótica y sus problemas fundamentals** [Semiotics and its basic problems]. Montevideo: Ediciones Pueblos Unidos [Spanish trans. Augusto Vidal Roget from its Russian version].

Vickers, Graham (1991) **Style in product design**. London: The Design Council.

Vihma, Susann (1987) **"Designing form in industrial design"**. In Susann Vihma (ed) (1987) *Form and vision* [Papers from The International University of Industrial Arts Conference, Helsinki, 1987] Helsinki: UIAH, pp. 176 – 180.

Vihma, Susann (1992) **"Iconicity and other signs in the form of products"**. In Susann Vihma (ed) *Objects and images. Studies in design and advertising*. Helsinki: University of Industrial Arts, pp.100 – 105.

Vihma, Susann (1995) **Products as representations: A semiotic and aesthetic study of design products**. Helsinki: UIAH.

Vihma, Susann (1997) **"Semantic qualities in design"**. *Formdiskurs*, N°3, Vol. 11, pp. 28 -41.

Virilio, Paul (1991) **The aesthetics of disappearance**. New York: Semiotext.

Visser, Willemien (1995) **"Use of episodic knowledge and information in design problem solving"**. *Design Studies*, Vol. 16, N°2, April, pp. 171 – 209.

Vitruvio, Marco Lucio (1991) **Los diez libros de arquitectura** [The ten books of architecture]. Barcelona: Iberia [Spanish trans. Agustín Blánquez].

Vygotsky, Lev (1995) **Pensamiento y lenguaje**. Barcelona: Paidós [Spanish trans. Pedro Tosaus Abadía from the English version entitled: *Thought and language*. Cambridge: The MIT Press. 1986].

Wake, Warren (2000) **Design paradigms**. New York: John Wiley & Sons.

Walker, John (1989) **Design history and the history of design**. London: Pluto Press.

Walker, Stuart (1999) **"The manifestation of meaning. A discussion of the environmental, social and spiritual aspects of product design"**. *The Design Journal,* Vol. 2, Issue 2, pp. 2 – 9.

Walker, Stuart (2006) **Sustainable by design: Explorations in theory and practice.** London: Earthscan.

Wallon, Henri (1985) **La vida mental** [The mental life]. Barcelona: Crítica [Spanish trans. Octavi Pellissa from the French version entitled: *La vie mentale.* Paris: Messidor. 1982].

Ward, A. (1984) **"Design cosmologies and brain research"**. *Design Studies,* Vol. 5, N° 4, October, pp. 229 - 238.

Warrington, Elizabeth and Taylor, Angela (1978) **"Two categorical stages of object recognition"**. *Perception,* Vol. 7, pp. 695 - 705.

White, Edward T. (1979a) **Manual de conceptos de formas arquitectónicas.** Mexico: Trillas [Spanish trans. Federico Patán López from the English version entitled: *Concepts sourcebook. A vocabulary of architectural forms.* Tucson, Arizona].

White, Edward T. (1979b) **Introducción a la programación arquitectónica.** Mexico: Trillas [Spanish trans. Federico Patán López from the English version entitled: *Introduction to architectural programming.* Tucson, Arizona].

Whiteley, Nigel (1993) **Design for society.** London: Reaktion Books.

Wiener, Norbert (1969) **Cibernética y sociedad.** Buenos Aires: Editorial Sudamericana [Spanish trans. José Novo Cerro from the English version entitled: *The human use of human beings. Cybernetics and society*].

Williams, Alma (1984) **"Consumer education and design awareness: Their role and relevance in development"**. In Richard Langton and Nigel Cross (eds) *Design and Society,* Vol. 1. [Proceedings of the International Conference on Design Policy, Royal College of Art, 1982] London: The Design Council, pp. 7 – 10.

Williams, Christopher (1984) **Los orígenes de la forma.** Barcelona: Gustavo Gili [Spanish trans. Homero Alsina Thevenet from the English version entitled: *Origins of form.* New York: Architectural Book.1981].

Williams, Linda (1986) **Aprender con todo el cerebro.** Barcelona: Martínez Roca S.A. [Spanish translation Estebán Riambau from the English version entitled: *Teaching for the two-sided mind.* New Jersey: Prentice Hall. 1983].

Witkin, H.A. (1967) **"Cognitives styles across cultures"**. In J.W. Berry and P.R. Dasen (1974) *Culture and cognition: Readings in cross-cultural psychology.* London: Methuen & Co., pp. 99 - 117.

Wittig, Susan (1979) **"Architecture about architecture: Self-reference as a type of architectural signification"**. In S. Chatman, U. Eco and J.M. Klinkenberg (eds) *A semiotic landscape* [Proceedings of the First Conference of the International Association for Semiotic Studies, Milan, June 1974]. The Hague: Mouton, pp. 970 – 978.

Wober, M. (1966) **"Sensotypes"**. In J.W. Berry and P.R. Dasen (1974) *Culture and cognition: Readings in cross-cultural psychology.* London: Methuen & Co., pp. 119 - 127.

Wolf, K.L. and Kuhn, D. (1960) **Forma y simetría** [Form and symmetry]. Buenos Aires: EUDEBA.

Wolff, Janet (1983) **Aesthetics and the sociology of art.** London: George Allen & Unwin.

Wollheim, Richard (1993) **"Representation: The philosophical contribution to psychology"**. In Richard Wollheim (1993) *The mind and its depths.* Cambridge, Mass.: Harvard University Press, pp. 159 - 170.

Wolter, James et.al. (1989) "**How designers and buyers evaluate products**". *Industrial Marketing Management*, Vol. 18, May, pp. 81 – 89.

Wong, Andrew (1974) "**Bioengineering design**". In William Spillers (ed) *Basic questions of design theory* [Papers of the *Symposium on Basic Questions of Design Theory*, Columbia University, 1974]. Amsterdam: North-Holland Publishing, pp. 431 – 450.

Wong, Wucius (1998) **Fundamentos del diseño**. Barcelona: Gustavo Gili [Spanish trans. Homero Alsina Thevenet y Eugeni Rosell i Miralles from the English version entitled: *Principles of form and design*. Van Nostrand Reinhold. 1995].

Woolley, Martin (1992) "**A comparison of design and user perceptions**". In Susann Vihma (ed) *Objects and images: Studies in design and advertising*. Helsinki: UIAH, pp. 76 – 85.

Wu, Chun Tin and Johnston, Malcolm (2005) "**The use of images and descriptive words in the development of an image database for product designers**". In Loe Feijs, Steven Kyffin and Bob Young (2005) *Design semantics of form and movement*. Konninklijke Philips Electronics N.V., pp.59 – 69.

You, Hsiao-chen and Chen, Kuohsiang (2004) "**A Comparison of affordance concepts and product semantics**" [Online]. Available from: http://www.ipo.tue.nl/homepages/mrauterb/conferences/CD_ doNotOpen/ADC/final_paper/105.pdf. (13 July 2004).

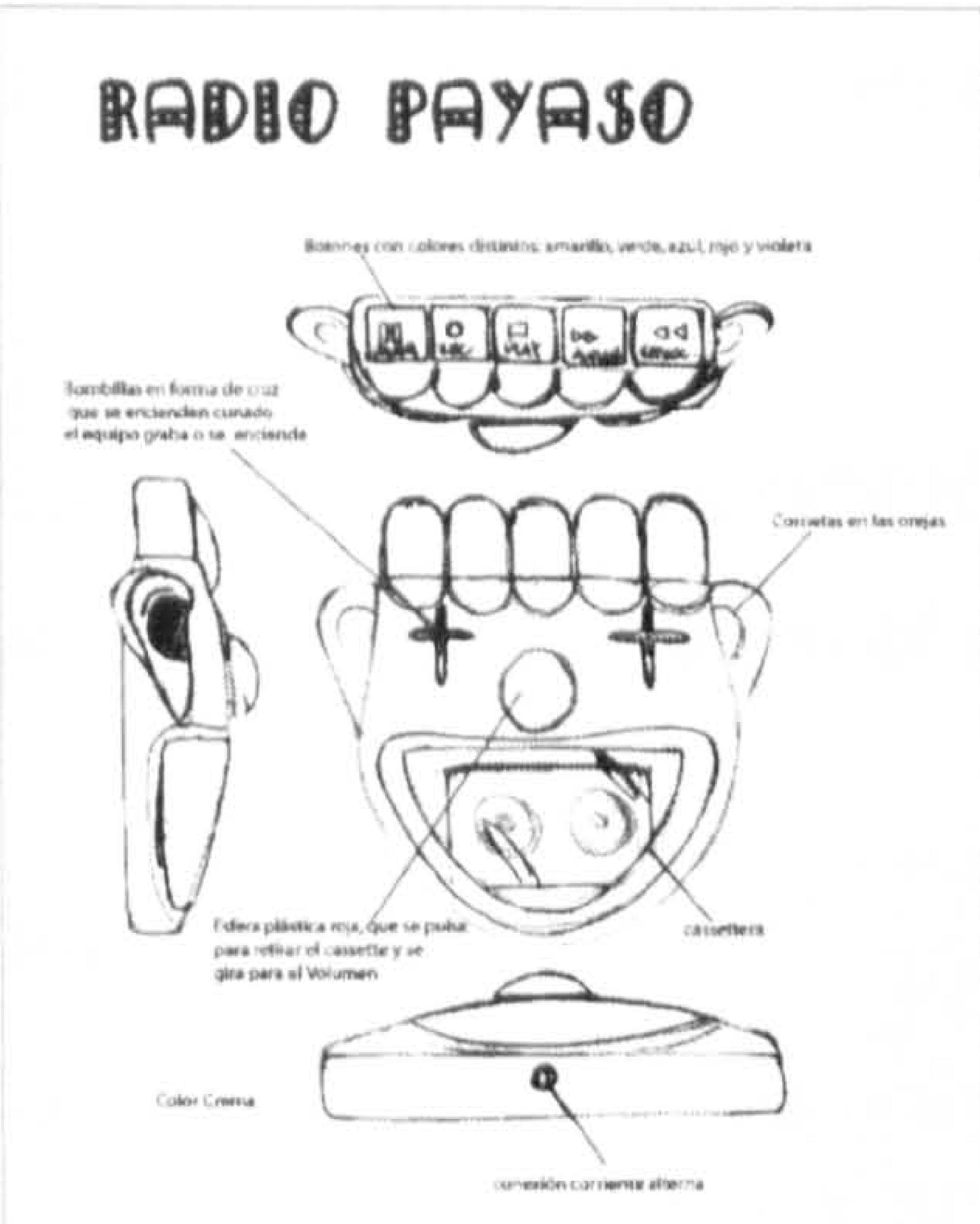
Zajonc, R.B. (1980) "**Feeling and thinking: Preferences need no inferences**". *American Psychologist*. Vol. 35, N° 2, February, pp. 151 – 175.

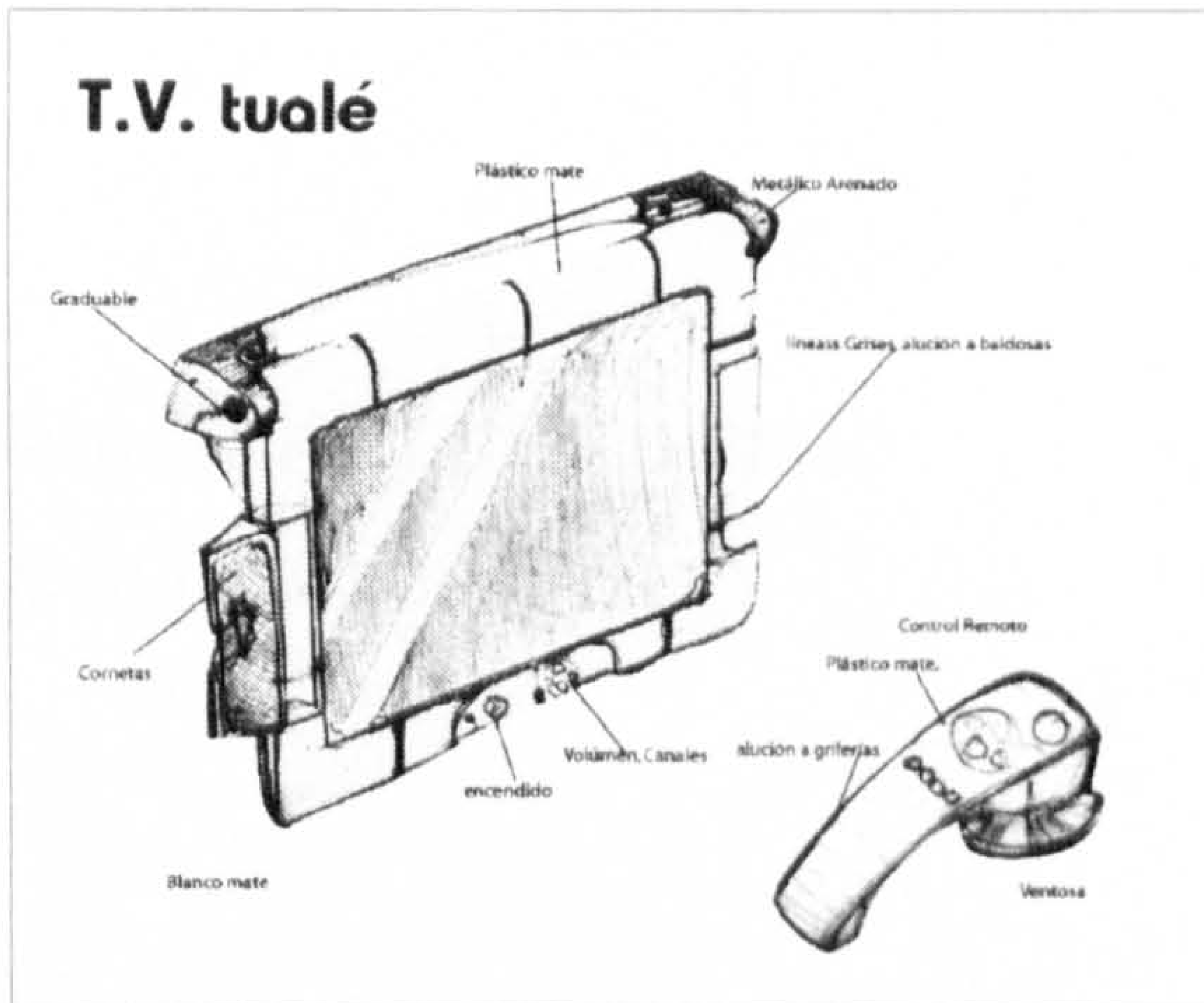
Zec, Peter (1999) **Designing success: Strategies, concepts, processes**. Essen: Design Zentrum Nordrhein Westfalen.

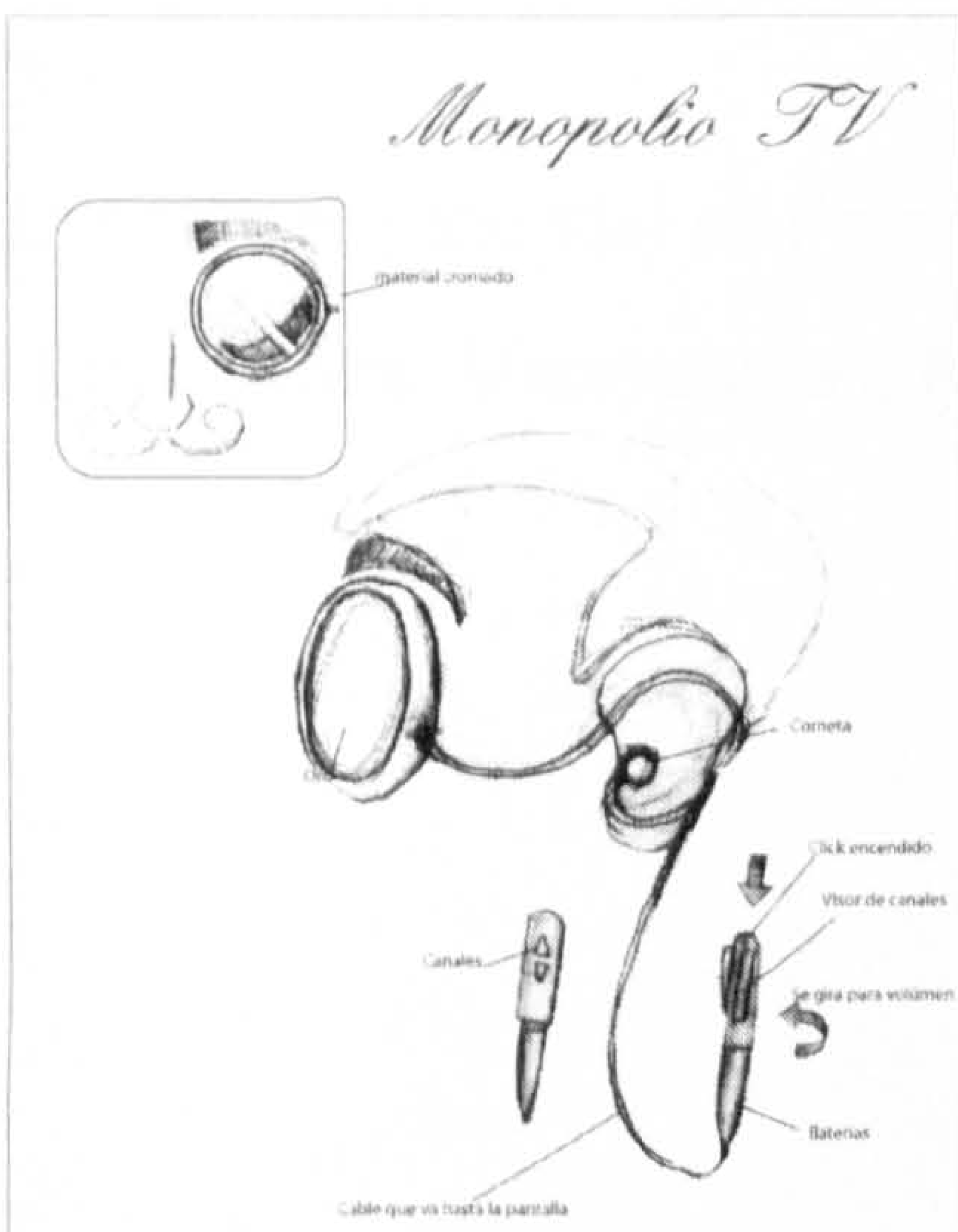
Zimmermann, Yves (1981) "**Diseño y lenguaje**" [Design and language]. In Ives Zimmerman (1998) *Del diseño*. Barcelona: GG, pp. 23 – 30.

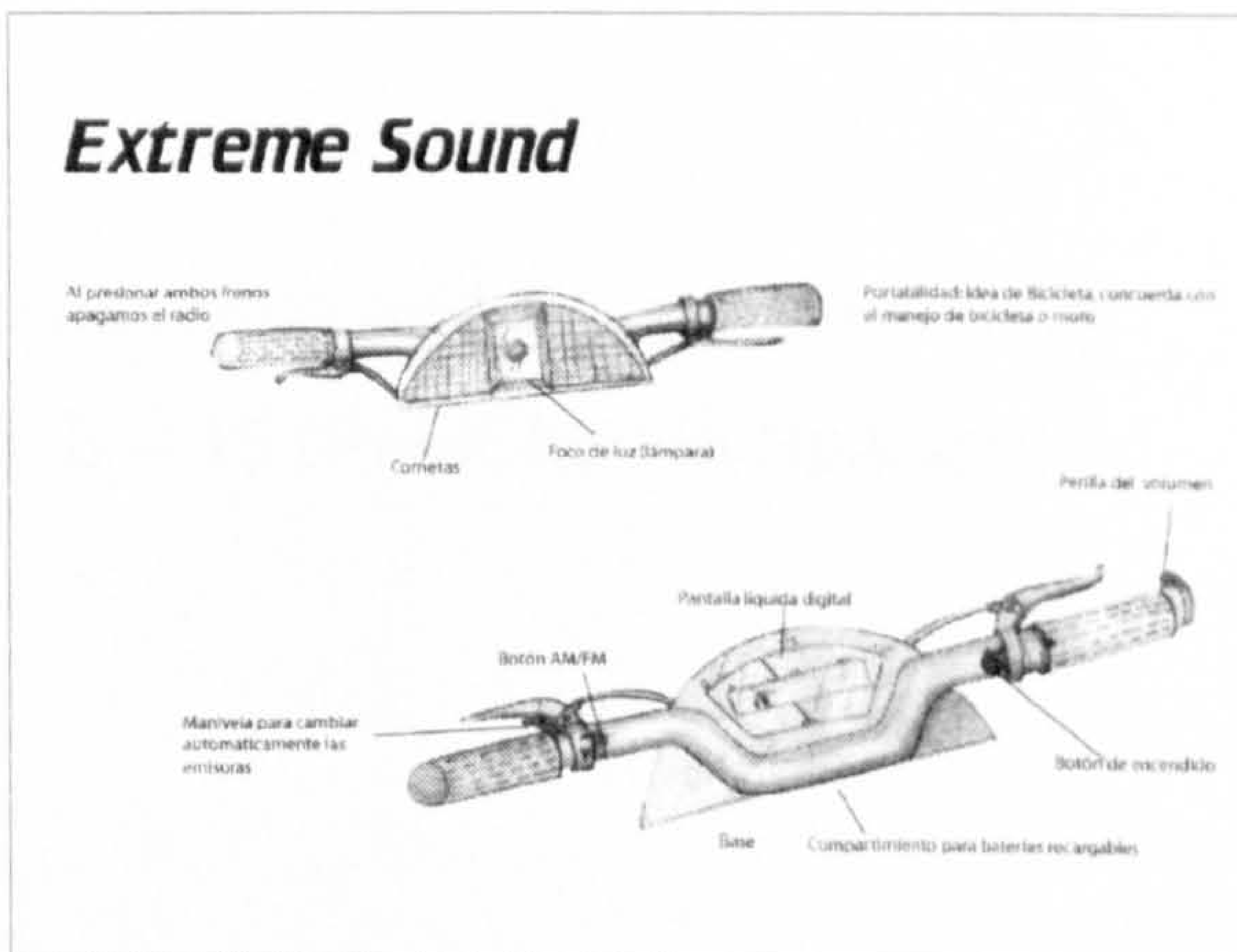
Appendix 1

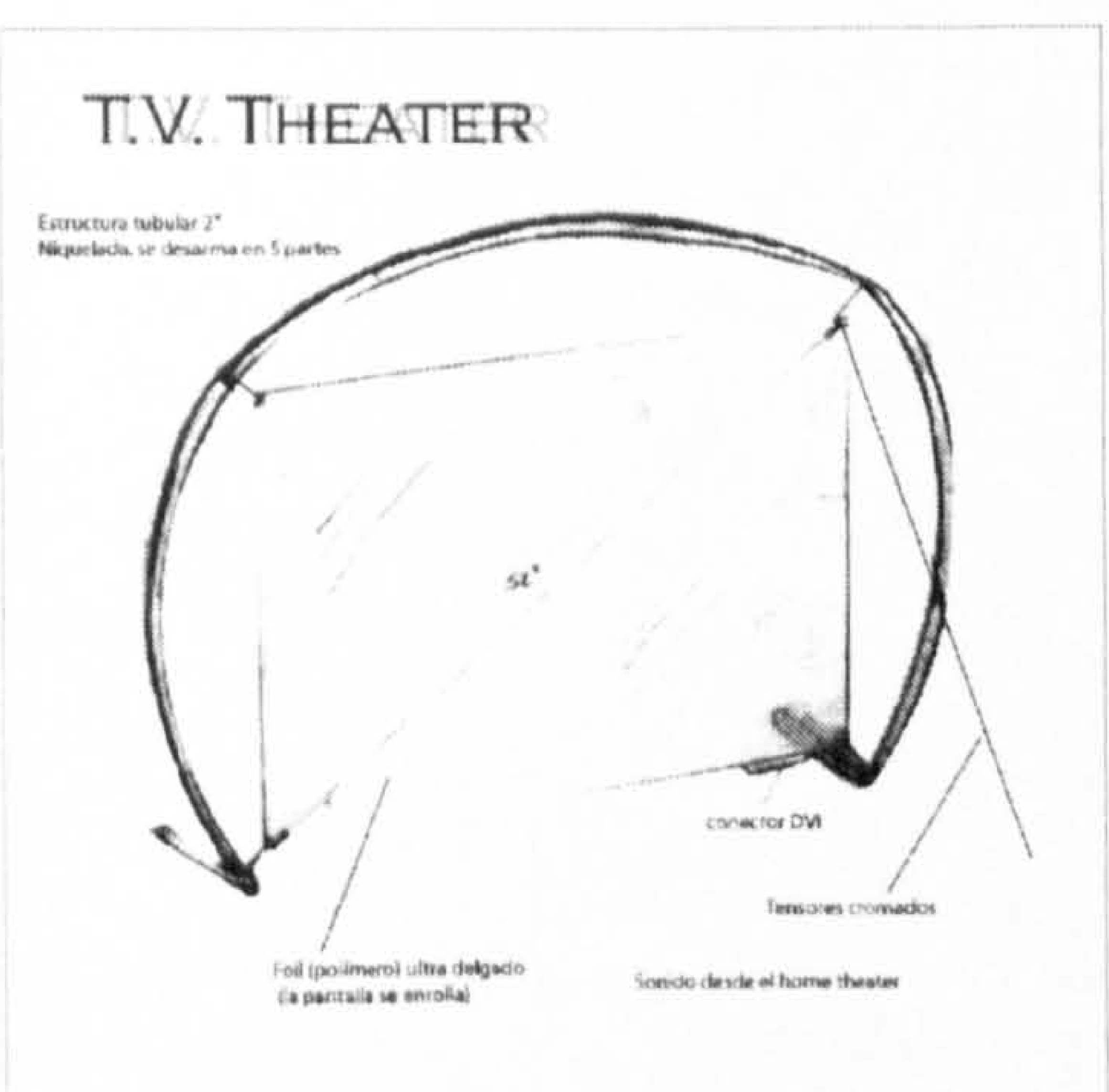
Examples of design concepts produced during the experiments presented in Chapter 5:











Appendix 2 – Publication / Article

Author:
Rafael Ignacio Lacruz-Rengel

Title:
DESMITIFICANDO LA NOCIÓN DE ARQUETIPO EN EL DISEÑO
(Demystifying the notion of Archetype in Design)

Date:

May 2001

Journal:

EDIFICAR (Journal of Faculty of Architecture and Design, University of Los Andes, Venezuela), No. 8, pp. 8 – 15 (Published in Spanish)

Demystifying the notion of archetype in design

Abstract:

The Archetype is a notion formulated many centuries ago. Plato was the first to completely outline what it stands for in his "Theory of Ideas". Design as a discipline dealing with ideas has also taken this notion as a theoretical model to explain where the work of designers starts from. Unfortunately, its conceptual complexity has risen a number of misunderstandings and misconceptions reflected in the writings and expressions of theorists and practitioners in the design field. According to the author, these misunderstandings can be catalogued as coming from the assumption of three main ideas as being true characterizations of the Archetype. The first of them equates the archetype to the essence of things. The second talks about it as if it were some sort of material achievement coming from the perseverant work of human masses. And, finally, a third one that considers the Archetype as a notion too old and therefore as a matter of no interest for design theory. Based on the writings of Plato, the author of this article shows where the misunderstandings are in an attempt to re-state what should be taken as an Archetype.

Desmiticizzando la nozione dell'archetipo nel disegno

Riassunto:

L'archetipo è una nozione formata secoli fa. Platone è stato il primo a delineare completamente ciò a che questa si riferiva attraverso la sua "teoria delle idee". Il disegno, come disciplina che tratta anche delle idee, ha preso questa nozione come modello teorico per spiegare dove inizia il lavoro dei disegnanti. Sfortunatamente, la complessità concettuale di questa nozione ha originato numerosi malintesi da parte di scrittori e praticanti del disegno. Secondo l'autore, questi malintesi provengono dell'assunzione di tre idee come vere caratterizzazioni dell'archetipo. La prima è quella che riguarda alla essenza delle cose. La seconda, quella che parla dell'archetipo come se si trattasse di un successo materiale delle masse umane. Finalmente, una terza caratterizzazione che lo vede come qualcosa troppo antico e dunque inservibile in ciò che riguarda la teoria del disegno. Prendendo come base gli scritti di Platone, l'autore di questo articolo ci mostra dove si trovano i malintesi in un intento per rivendicare ciò che deve essere capito come archetipo.

En démythifiant le concept de l'archétype dans le dessin

Résumé:

L'archétype est un concept formulé il y a des siècles. Platon a été le premier à délinéer complètement ce à quoi ce concept se référait dans sa "théorie des idées". En tant que discipline qui traite aussi des idées, le dessin a pris ce concept comme modèle théorique pour expliquer où commence le travail des dessinateurs. Malheureusement la complexité conceptuelle de cette notion a donné lieu à de nombreux malentendus de la part des écrivains et des praticiens du dessin. D'après l'auteur, ces malentendus viennent du fait d'assumer trois idées comme vraies caractérisations de l'archétype. La première est celle qui l'égale à l'essence des choses. La deuxième, celle qui parle de l'archétype comme s'ils'agissait d'un succès matériel des masses humaines. Et finalement, une troisième caractérisation qui le considère comme quelque chose de trop antique et ainsi obsolète en ce qui concerne le dessin. En prenant comme base les écrits de Platon, l'auteur de cet article nous montre où se trouvent les, dans un essai pour revendiquer ce qui doit être compris en tant qu'archétype.

Desmitificando la Noción de Arquetipo en el Diseño.

Rafael Lacruz Rengel

El desapego de las fuentes originales del conocimiento, aunado a una suerte de libertinaje especulativo, ha llevado a algunos teóricos del diseño a desvirtuar toda la riqueza conceptual presente en la noción de arquetipo. Esta noción, cuya completa formulación es atribuida en la historia de la cultura occidental a Platón, ha sido distorsionada a tal punto que en muchas ocasiones el lector sólo entra en contacto con curiosas reinvenciones de la misma, las cuales, más que ampliar su comprensión, lo que hacen es limitarla.

Una cuidadosa revisión de los planteamientos de dichos teóricos puede llevarnos sin mucho esfuerzo a la conclusión de que el *locus* de la nombrada tergiversación está vinculado a la formulación de tres mitos fundamentalmente. El primero es aquel que iguala al arquetipo con la *esencia de las cosas*[1]. El segundo, lo define como *una materialización de la suma de la experiencia de muchas personas*[2]. Y el tercero, reconociendo la antigüedad de esta idea, simplemente la descalifica por considerar que *lo "viejo" es obsoleto*. En este sentido, es importante recordar que, como lo ha apuntado Roland Barthes, la naturaleza de todo mito no consiste en ser verdadero[3], sino en hacer pasar un concepto como tal de manera intencional[4]. Es por ello que se

Fig. 1 – El Frontispicio, modelo básico de toda arquitectura, según ilustración del Essai sur l' architecure de Marc-Antoine Laugier, París 1755.

Los teóricos de la ilustración formularon ideas que podría confundirse con lo que Platón definió como modelos abstractos de todas las cosas existentes conocidos posteriormente como "arquetipo". De hecho, la naturaleza de estos modelos, considerados por Platón como objetivos en sí mismo e independientes del pensamiento humano, responden a un principio de identidad muy distinto a aquello a lo que se referían teóricos como Marc-Antoine Laugier cuando nos hablaban de la cabaña primitiva como modelo básico de toda arquitectura, a mediados del siglo XVIII.

hace necesaria una revisión de aquello a lo que realmente se refería Platón y de su significación teórico-conceptual dentro del campo del diseño.

¿Es el Arquetipo lo mismo que la Esencia de las Cosas?

Aun cuando Platón nunca usó en sus escritos el término "arquetipo"[5], bien sabemos que la idea a la que se refería es exactamente la misma: un tipo de entidad en base a la cual son hechas las cosas del mundo material. Los traductores de Platón generalmente la llaman "Forma". Los estudiosos del tema, más allá de preocuparse por darle un nombre, parten por reconocer que se trata una entelequia a la que su autor por excelencia[6] (Platón) consideraba como perfectamente objetiva, existente por sí misma y no en virtud del hecho de que la pensemos[7]. De ahí que, para poder entender lo que son los arquetipos, debamos empezar por verlos como *modelos abstractos que delinean la identidad de cada tipo de cosa existente*. De hecho, ésta es la manera como Platón nos presenta los arquetipos en su obra La República cuando nos dice:

"...Hay muchos sofás y mesas... pero, supongo, que estos utensilios sólo implican dos ideas de forma [dos arquetipos], *la de un sofá y la de una mesa".*[8]

Estas palabras podrían dar pie para pensar que los arquetipos son lo mismo que la esencia de las cosas, ya que todo indica que tanto la esencia como el arquetipo de algo están vinculados a la identidad del objeto. Sin embargo, la vinculación de cada uno de ellos a la identidad del objeto es distinta. La esencia parte de *lo mínimo que necesita el objeto para ser lo que es*, mientras que el arquetipo *abarca todo lo que el objeto puede ser sin perder su identidad*. Por otra parte, tenemos que, mientras la esencia se puede hacer totalmente presente en un objeto, el arquetipo no: trascendiendo a dicho objeto y justificando, en consecuencia, su constante búsqueda.

Estas dos observaciones se pueden ver corroboradas en los escritos del mismo Platón, particularmente cuando nos recuerda que *nada puede ser como el arquetipo, ni el arquetipo ser como cosa alguna*[9]. De igual forma cuando también nos dice que *no hay "artesano" que pueda crear al arquetipo como tal*[10].

Ambas afirmaciones dejan por sentada la idea de que la participación de las cosas materiales en los arquetipos sólo se limita al hecho de que son hechas a su imagen[11]. Razón por la cual los arquetipos difícilmente pueden verse totalmente inscritos en la materialidad de un objeto como sucede con su esencia. El que la esencia esté implícita en el arquetipo no significa necesariamente que ambos -esencia y arquetipo- sean lo mismo. Si ésta fuese la situación el arquetipo, como modelo abstracto que es, perdería su carácter holístico al no poder englobar dentro de sí todo lo que en la realidad material del mundo se agrega a la esencia de cada tipo de objeto sin afectar su identidad.

Finalmente, también es factible que otra fuente de confusión entre la esencia y el arquetipo pueda que provenga de la terminología históricamente vinculada al tema. De hecho, el mismo Platón usó alrededor de 44 términos griegos distintos para referirse a los arquetipos a lo largo de 17 escritos[12]. De estos 44 términos, los dos que hoy usamos con mayor frecuencia al hablar de los planteamientos de Platón son eidos e idea - dos palabras que se derivan del término griego ideıv, que significa "ver".

De ellas se sabe que Platón las usaba para aludir a un tipo de "forma visible"[13], donde el calificativo de "visible", más que referirse a una condición de tangibilidad, debió usarlo para reforzar la idea de presencia en este tipo de entidades. Sin embargo, lo más interesante al respecto es que el significado que Platón le da a estas dos palabras (eidos e idea) no se corresponde con el sentido que ordinariamente se les daba en la Grecia de esa época, es decir, el de "cualidad" o "característica"[14]. De ahí que el desconocimiento de esta realidad pueda llevar a muchos a asumir este último sentido como si fuese aquel que les daba Platón a estas palabras, dando pie a mal interpretaciones que definen al arquetipo como una suerte de "cualidad característica de las cosas", o lo que sería lo mismo: su esencia[15].

La discusión planteada al evaluar estas dos posibles fuentes de confusión (entre esencia y arquetipo) puede que lleve al estudioso del tema a entender los arquetipos más bien bajo una definición semejante a la dada por Carl Gustav Jung. Es decir, como "modelos hipotéticos e irrepresentables"[16], donde, si bien su carácter hipotético les confiere alguna suerte de límites, el que no puedan representarse hace que estos últimos sean difícilmente discernibles (no imposibles de discernir) y por ende difícilmente alusivos a una unidad conceptual de naturaleza tan específica como lo es una esencia.

¿Es el Arquetipo la materialización de la suma de la experiencia de muchas personas?

La interpretación quizás más peligrosa de la noción de arquetipo es aquella que busca igualarlo al resultado de la experiencia de muchas personas. Peligrosa en el sentido de que, para justificarse, esta idea termina entretejiendo un sinnumero de asociaciones aún más distorsionadoras de esta noción.

Dentro de esta línea interpretativa, Paul Grillo ha llegado a definir el arquetipo como el tipo de diseño anónimo producto de "...la suma de la ingenuidad y sabiduría de la gente", que a manera de solución grupal *"...caracteriza a una región de clima consistente y condiciones de suelo particulares"*[17].

Frente a definiciones como ésta lo primero que debemos recordar es que el arquetipo existe al margen de que lo pensemos, mientras que los diseños son precisamente productos del pensamiento. Razón por la cual es errado tomar a los arquetipos como diseños o viceversa. Aunado a esto, no hay que olvidar que la palabra arquetipo proviene del griego "Arkhétupon" que literalmente significa "lo primero que ha sido moldeado" (arkhein = primero + tupos = molde o tipo)[18], lo cual deja sentada de antemano la idea de que los arquetipos existen antes que las cosas hechas a su imagen (entre estas, los diseños).

La segunda observación que debemos hacer sobre lo expresado por Grillo es que el arquetipo como típico producto del **argumento unilineal** característico de los griegos[19], no puede ser entelequia y materialidad a la vez. De manera que es del todo errado interpretarlo como una suerte de "solución"[20], menos aún vincularlo a condiciones geográficas particulares. Con esto último incurriríamos en un error aún mayor: limitar el carácter trascendente que originalmente le otorga Platón a los arquetipos. En otras palabras, esto equivale a contradecir la idea de que sólo hay un arquetipo de vivienda, para erradamente aceptar, como lo hace Grillo, que puede haber un arquetipo de vivienda asiática y otro de vivienda europea, por ejemplo.

En tercer lugar, hay que resaltar que el carácter holístico propio de los arquetipos no nace del hecho de ser una suerte de sumatoria de ideas y esfuerzos de muchos. Todo lo contrario, el arquetipo es una entelequia cuyo locus se encuentra más allá de cualquier individuo o grupo de estos. En este sentido la interpretación que Carl Gustav Jung hace de los arquetipos arroja importantes luces sobre una manera de explicarlo.

Para Jung un arquetipo es una suerte de "contenido psíquico que no ha sido sometido aún a elaboración consciente"[21]. De ahí que el carácter universal de los arquetipos nos remita a la idea de que éstos sólo pueden entenderse como algo que los seres humanos comparten en su inconsciente, es decir, un **inconsciente colectivo**[22].

El mismo Platón nos dice en El Sofista, que *todo arte productor* [acto creativo] *consiste en hacer reales las cosas que anteriormente no lo eran*[23]. Afirmación con la que difícilmente tendremos problemas si aceptamos a la *conciencia* como el medio por excelencia para ver y entender como reales las cosas que nos rodean; o como lo diría Ortega y Gasset, el mundo existe porque uno lo piensa[24].

De hecho, bajo la perspectiva platónica, el acto de creación de objetos es presentado en términos semejantes a lo que hoy llamaríamos un acto de concientización de partes de una suerte de ideal, que es continuamente perseguido sin poder ser alcanzado. Esta es una posición tácitamente compartida por varios escritores sobre el tema, aun cuando ellos no se remitan directamente a Platón.

Entre estos autores encontramos a Erich Kahler, Herbert Read y Charles Moore. El primero ve la creación artística como una conquista de lo que hasta el momento nadie ha "tocado, aprisionado o revelado"; ubicando las raíces últimas de esta búsqueda en el inconsciente[25]. El segundo, Read, define el acto creador del artista como la toma de posesión de un segmento de lo que existe, donde el artista, al igual que los niños, no expresa lo que es capaz de ver sino lo que sabe (aquello de lo que es consciente), es decir, algo generalmente inexacto e incompleto[26]. Finalmente tenemos a Moore, quien ve los intentos de los diseñadores por alcanzar armonías eternas como una suerte de acercamiento a los arquetipos[27].

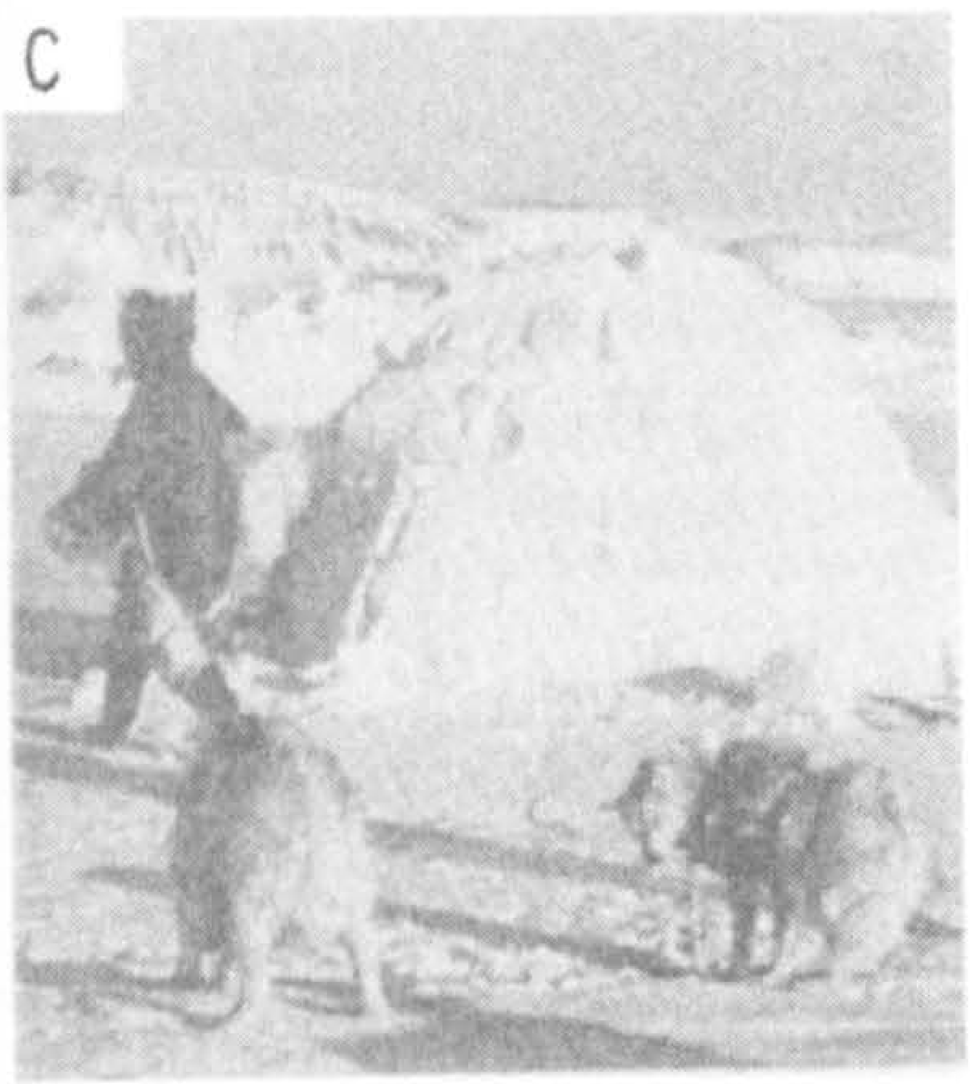
De ahí que parte del **carácter universal** de los arquetipos radique esencialmente en el hecho de que están más allá de nuestro alcance y no, como se cree, en el hecho de alcanzarlos aunando esfuerzos individuales. Pensar en lo contrario, nos llevaría a caer en una suerte de círculo vicioso que anularía la **condición de primeridad** propia del arquetipo, ya que en dicho caso, tal como lo expresa Platón:

"Una segunda forma [arquetipo] siempre se hará presente después de la primera, dando pie de la misma manera a una tercera. Y no habrá fin para el surgimiento de nuevas formas, si ésta sigue basándose en aquella de la cual proviene."[28]

A

B

C



D

A. Tepee de los pieles rojas.
C. Iglú de los habitantes del polo Norte.
B. Viviendas pareadas en Birmingham, Inglaterra.
C. Edificios multifamiliares de la ciudad de Pittsburg, U.S.A.

Existe una marcada tendencia a confundir lo que es el arquetipo de vivienda con materializaciones geográficamente localizadas de él. Todos estos modelos de vivienda pueden entenderse como resultados de esfuerzos mancomunados de distintas sociedades humanas, más no como arquetipos. El arquetipo de vivienda pertenece a un "inconsciente colectivo". Estos modelos, en cambio, son manifestaciones de una conciencia colectiva.

¿Es la Noción del Arquetipo completamente obsoleta Hoy en día?

Se ha dicho que la humanidad está pasando por una etapa centrada en una suerte de incredulidad frente a "explicaciones metanarrativas" (ideas como la del arquetipo). Que el síntoma más evidente de esto se manifiesta en el surgimiento de una supuesta independencia por parte de las ciencias respecto de los **metadiscursos**[29] que anteriormente se usaban como medios para legitimarlas[30]. Sin embargo, ¿qué puede ser mas trascendente a lo físico que la revolución de la información en la cual nos vemos cada vez más inmersos?

Estamos entrando, como lo ha afirmado Abraham Moles, en una Era de Telepre**sencias** donde nuestra proximidad a los objetos (a lo tangible) se está haciendo cada vez mas irrelevante en la construcción de nuestra conciencia de las cosas[31]. Mas aún, ¿hasta que punto podemos afirmar que nuestro conocimiento de las cosas no sigue viéndose mediado por modelos y nociones que la ciencia y la tecnología aún no han podido corroborar?

La misma idea de una realidad existente más allá de las apariencias no puede decirse que ha perdido vigencia. Mucho menos nociones como la de arquetipo, que aun cuando nadie la nombra, muchas veces es asumida tácitamente en nuestro discurrir. De hecho, hablar de temas como el arquetipo es hablar de lo que en filosofía griega se conoce como el Apeiron, es decir, la posibilidad de pensar la realidad como parte de un continuum infinito -intangible- y por ende caracterizado por interminables transformaciones[32].

Desde esta perspectiva, los artistas y diseñadores lo que hacen en sus creaciones es aproximarse a arquetipos. Ya sea que se entienda esta aproximación como la búsqueda de una *correcta expresión*, de una *adecuada interpretación* o de una *óptima configuración* de la realidad. Nos referimos así a una dinámica donde los "creativos" pueden ser vistos como "lectores" de la realidad y donde "leer" debe entenderse como un acto de "comprensión razonada, paciente y reflexiva"[33] de una realidad que como "libro abierto" está allí para aquellos que son capaces de leerla (parafraseando un decir de Goldoni).

Ahora bien, lo más interesante de todo esto radica en darse cuenta de que, tal como lo ha afirmado Umberto Eco, "el verdadero lector [creador] es aquel que entiende que el secreto del texto [en este caso la realidad] está en su vacío"[34]. En otras palabras, que el verdadero creativo es aquel que entiende que su obra nunca satisfará todo lo que debe. Razón que lo mantiene en una constante búsqueda que le da sentido a su vida, a través de la "objetivación" de partes de aquello que llega a conocer o entender sobre ella. De aquí que afirmar que nociones como la del arquetipo son obsoletas, equivalga a decir que tanto el arte como el diseño han perdido la razon que les da vida, y que son, por ende, actividades también obsoletas.

notas...

1 Lancelot Whyte ha llegado a afirmar que el arquetipo o idea de forma ha sido reconocido como la esencia misma de las cosas - tanto en el campo filosofico como en el científico - Cfr. Whyte, Lancelot. "Introduction" en *Aspects of Form* (Londres: Lund Humphries). 1968. p.7. Los profesores Pineda, Sánchez y Amarilles de la Universidad de Bogota "José Tadeo Lozano", en una reciente publicacion han llegado a definirlo también como atributo o cualidad esencial de todo objeto - Cfr. Pineda, Edgar, Mauricio Sánchez y Diego Amarilles. *Lenguajes objetuales y posicionamiento.* Cuadernos de Diseño Industrial (Santa Fé de Bogotá: Fundación Universidad de Bogotá), 1998. p.17.

2 Cfr. Grillo, Paul. *What is design?* (Chicago: Paul Theobald and company). 1960. p.16.

3 Barthes, Roland. *Mitologías* (México: Siglo XXI), 1980, p.215.

4 *Ibid.* p.222.

5 En este sentido, Carl Gustav Jung nos recuerda que la palabra "arquetipo" es sólo una paráfrasis explicativa usada por otros para referirse a la idea de forma delineada por Platón (Jung, Carl Gustav. *Archetype and the collective unconscious.* Londres: Routledge, 1990.p. 4).

6 No debemos olvidar que Platón no es el único autor en abordar el tema de los arquetipos. Este tema se encuentra plasmado en obras no sólo de corte filosofico sino tambien religioso, las cuales cuentan entre sus autores más representativos a Filón de Alejandría y San Agustín (Cfr. Jung, *op.cit.*).

7 Ross, David. *Plato's theory of ideas* (Oxford: Clarendon Press). p.15. 1951.

8 Platon, La Republica. X.596b en Hamilton, E. y C. Huntington (eds.) *The collected dialogues of Plato.* (Princenton: Princenton University Press). 1973, traducción al ingles de Paul Shorey.

9 Este es un parafraseo de lo expresado por Platón en Parménides, 133a en Hamilton, E. y C. Huntington (eds.) *The collected dialogues of Plato* (Princenton: Princenton University Press), 1973. traduccion al inglés de F.M. Cornford.

10 Cfr. Platón, *La República,* X.596b en Hamilton y Huntington, op.cit.

11 Platón, *Parménides*, 132d en Hamilton y Huntington, op.cit.

12 David Ross, un estudioso de la teoría de las ideas de Platón, nos ofrece en su libro sobre este tema esta lista de 44 términos griegos. Cfr. Ross, *op.cit.*

13 *Ibid*, p.13.

14 *Ibid*, p.14.

15 Una idea semejante ha sido sugerida por el catedrático norteamericano Charles Moore al referirse a la forma en su ensayo titulado "Shape". Cfr. Moore, Charles y Gerald Allen. *Dimensions: Space, shape and scale in architecture* (New York: Architectural Records), 1976, pp.11-13.

16 Jung, Carl Gustav. *Archetype and the collective unconscious* (Londres: Routledge), 1990, p.5.

17 Grillo, *op.cit.*, p.18-19.

18 Ayto, John. *Dictionary of words origin* (Londres: Bloomsbury), 1990. p.33-34.

19 Modo de argumentacion para la sustentación de lo que son las cosas basado en tres principios: de identidad, de la no contradicción y de exclusion de puntos medios (*non datur tertium*).

20 Recuerdese que la idea de "solución" en diseño nos remite a una respuesta material que, aun cuando todavía no esté plasmada ni siquiera en dibujos, ya contempla las características físicas que la definen.

21 Jung, *op.cit.*, p5.

22 *Ibid*, p.43.

23 Platón, *El Sofista*, 265 en Hutchins, Robert M. (ed) *Plato-Great Books of Western World*, Vol.7 (Chicago: Encyclopaedia Britanica), traducción al inglés de Benjamin Jowett. 1982, pp. 577-578.

24 Ortega y Gasset, José. *¿Qué es conocimiento?* (Madrid: Alianza),1984, p.32.

25 Kahler, Erich. *La desintegración de la forma en las artes* (Mexico: Siglo XXI), 1978. pp.28 y 56.

26 Read, Herbert. "La imagen vital" en *Imagen e idea: la función del arte en el desarrollo de la conciencia humana* (México: Fondo de Cultura Económica), 1957.

27 Moore, *op.cit.*, p.6.

28 Platón, *Parmenides*, 133a en Hamilton y Huntington, op.cit.

29 Las metanarrativas o metadiscursos pueden definirse como formas de explicar las cosas que buscan ir más allá del análisis mecánico o físico de la realidad. Cfr. Lyotard, Jean-François. *The Postmodern Condition: a report on knowledge* (Manchester: Manchester University Press), 1984.

30 *Ibid*, p.XXIV.

31 Moles, Abraham. "Design and immateriality: what of it in a post industrial society?" en Margolin V. y Buchanan R. (eds.) *The Idea of Design: a Design Issues reader* (Cambridge: the MIT Press), 1995, p.268.

32 Eco, Umberto. "Interpretation and history" en Collini, Stefan (ed.) *Interpretation and overinterpretation* (Cambridge: Cambridge University Press), 1992, p.27-29.

33 Aguirre, Manuel Agustín. "El arte de leer para cultivarse" (Loja: Casa de la Cultura Ecuatoriana), 1993, p.8.

34 Eco, *op.cit.*, p.40.

Appendix 3 – Publication / Article

Author:
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IMPLICACIONES DEL DESARROLLO TECNOLÓGICO EN LA ESTÉTICA DE NUESTROS OBJETOS COTIDIANOS

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Implicaciones del Desarrollo Tecnológico en la Estética de nuestros Objetos Cotidianos

Rafael La Cruz

La experiencia estética de nuestros objetos cotidianos*

Hablar de lo estético en la tecnología pudiese parecer a primera vista un intento forzado por vincular dos cosas que habitualmente vemos como aisladas. El que tengamos esta impresión no denota otra cosa sino el predominio de una aproximación de corte tradicionalista que nos remite a una visión de lo estético referida únicamente a la búsqueda o apreciación de aquello que suele verse como bello en el arte. Sin embargo, hoy en día esta aproximación ha cambiado y tal como lo ha expresado Omar Calabrese: lo estético "...ya no es más el territorio de lo bello... es el territorio de la ***aisthesis***, como la entendían los griegos, es decir, la percepción del mundo."[1]

En este sentido resulta muy útil recordar la manera en que el crítico mexicano Juan Acha diferencia lo artístico de lo estético al acotar que en la copia de una obra de arte lo único que se pierde es el valor artístico ya que el valor estético permanece.[2] Esta es una idea que Acha complementa al supeditar **lo estético** *al conjunto de preferencias y aversiones mediante las cuales entablamos relaciones diarias e inmediatas con la realidad.*[3] Según esta definición, hablar de estética no es hablar de arte, ni hablar solamente de lo que se considera como bello, sino más bien una forma de vincularnos al mundo que se puede dar en cualquier momento y sin la necesidad de vernos involucrados en experiencias altamente elaboradas.

Habiendo dejado por sentada esta posición en torno a lo que denominaremos como estético, la otra labor que obviamente se nos presenta consiste en revisar los términos o parámetros mediante los cuales vamos a abordar la **estética de nuestros objetos cotidianos.**

John Hospers, ha llegado a decir que la forma estética de contemplar el mundo es generalmente contrapuesta a la actitud práctica o aquella que sólo se interesa por la utilidad del objeto en cuestión.[4] Apre-ciación con la que no podemos estar totalmente de acuerdo, dado que si algo es verdaderamente difícil de determinar es el punto a partir del cual el receptor del fenómeno estético se desvincula totalmente de lo útil para entrar en una dinámica centrada en lo que Hospers define como el "saborear la experiencia de percibir" en sí misma.

Ahora bien, si evaluamos el planteamiento de Hospers desde la perspectiva que ofrece la etimología del término estética -es decir, desde su definición como "aquello que es perceptible a través de los sentidos"- encontraremos que si bien es cierto que el **placer estético** es inmediato, también es cierto que como resultante de un acto de **percepción**, se ve mediado por procesos de selección, ordenamiento e **interpretación** del tipo de información que propicia esa forma de placer. De ahí que podamos referirnos a ese placer como a una **experiencia significativa**, donde el **objeto estético** (es decir, la razón de ser de ese placer) no debe estar necesariamente desvinculada de lo útil del objeto. De hecho, el diseño de un objeto tan cotidiano como una batidora manual, por ejemplo, puede generar ese tipo de placer al elevar el acto funcional que lo define a una suerte de poesía de lo que es batir. De ahí que **lo estético del objeto cotidiano pueda definirse como aquello que lo convierte en "metáfora de la actividad que ejecuta".**

Pero ¿qué implicaciones tiene esto sobre la concepción de la razón estética del objeto cotidiano? En principio, la visualización de la configuración de sus rasgos físicos de manera semejante a las palabras de un poema, es decir, como rasgos estéticamente elaborados para suscitar significados más allá de la simple expresión de la función a la que aluden.[5] En otras palabras, no es la función o utilidad del objeto lo que aquí interesa sino las asociaciones mentales que éste suscita en torno a esa función. En segundo lugar, que la interpretación o "lectura" de esos rasgos viene a darse de manera *subjetiva y* por ende mediada por el **interés selectivo** de quien percibe o capta el objeto.[6] Es por esto precisamente que –al hablar de la estética de los objetos cotidianos- no podemos desvinculamos de la experiencia a través de la cual se presentan,[7] ya que sólo a través de ella podemos saber con certeza a que se refiere.

Esta es una faceta de la estética del objeto cotidiano que ya ha encontrado comprobación científica a través de investigaciones como las desarrolladas por el psicólogo Mihaly Csikszentmihalyi, durante los años ochenta en los Estados Unidos. En ellas se evidenció que la preferencia estética en este tipo de objetos está marcadamente determinada por la **postura emocional** que frente a ellos tiene su propietario.[8] Aunado a esto, el teórico alemán Wolfgang Haug nos recuerda que en la apreciación estética de cualquier objeto utilitario se generan dos tipos de "promesas" en la mente del propietario. Una objetiva, determinada por las características físicas del objeto y otra subjetiva, proveniente de una lectura *personalizada* y en consecuencia *selectiva*, centrada en lo que esos rasgos físicos del objeto pueden representar en la vida de quien los posee.[9] De ahí que un objeto de uso cotidiano no solo sea adquirido para cumplir una función física, sino también para simbolizar las aspiraciones que tiene su propietario más allá de lo físico.[10]

De manera que **difícilmente podemos decir que al apreciar** (estéticamente) **objetos cotidianos nos desvinculamos totalmente de su uso o función.** Esta es una idea también defendida por James Somerville pero en el campo del arte. Según él, en nuestras **"descripciones estéticas"** la información en torno a cómo son las cosas está mediada por la información en torno al tipo de cosas que son;[11] aduciendo que las descripciones estéticas sólo son posibles si tomamos como base el hecho de que tanto aquel que la emite (un crítico, por ejemplo) como el que la escucha saben de antemano el tipo de objeto al que se refieren.[12]

Abraham Moles nos aclara al respecto que la estética de un objeto cotidiano se construye sobre "las variaciones que puede sufrir el mensaje objetual sin alterar notablemente su significación funcional básica".[13] En otras palabras, que **lo estético del objeto cotidiano se erige alrededor de su función.** Esto es precisamente lo que caracteriza el sentido metafórico antes mencionado, ya que a través del objeto cotidiano se "objetiva" no sólo una función sino también a una forma de verla realizada; exponiéndonos no sólo a un objeto sino también una manera de sentirnos frente a esa función.[14] Esto nos lleva a entender al diseñador de objetos cotidianos en términos semejantes a como el pintor Pablo Picasso describía su trabajo al decirnos: "cuando pinto lo que quiero es mostrar qué he encontrado, no que buscaba".[15]

En este sentido cabe recordar la manera en que Monroe Beardsley define lo que es una **experiencia estética.** Para él, se trata de un tipo de experiencia de cierta intensidad que se devela ante su espectador de manera continua, coherente e inconclusa, interrelacionando los componentes del "objeto" en torno al cual se construye.[16] Desde mi punto de vista, esta definición se corresponde perfectamente con lo que hasta ahora hemos esbozado, llevándonos a cuatro conclusiones fundamentales en relación a la experiencia estética de los objetos cotidianos:

1) **La experiencia estética de quien crea el objeto no es la misma de aquel que lo contempla o usa**, aun cuando en las experiencias de ambos exista un sentido de descubrimiento que parezca unificarlas.

2) **Todas estas experiencias estéticas están mediadas por un acto de reconocimiento de la función del objeto** que a manera de identificación primaria o *estructura profunda* -como diría el lingüista Chomsky- evita que estas se vean malogradas o desvirtuadas. Esto es precisamente lo que define cuales de nuestros sentidos son los que deben intervenir en cada tipo de experiencia; definiendo ésta como una actividad mental que, por su naturaleza casi automática, se da en gran parte inconscientemente.[17]

3) **Toda experiencia estética** -como acto perceptivo que es- **depende de las vivencias acumuladas** (conocimiento) **y de la postura emocional que frente al objeto** (y lo que éste representa) **tiene la persona involucrada**. Esto se da al punto de que dicha postura puede terminar favoreciendo el énfasis o atención que ponemos sobre determinados aspectos del objeto, condicionando a su vez aquello que vivenciamos como parte de esa experiencia.[18]

4) Finalmente cabe referirnos al tipo de **sensibilidades**[19] que nos habilitan para vivenciar estéticamente nuestros objetos cotidianos. En este sentido debemos tener claro que la dinámica expresiva de estos objetos está dirigida a la sensibilidad diaria del hombre común. Situación que además de no estar delineada por un conocimiento de naturaleza altamente especializado, tampoco hace necesario el hecho de que tenga que darse en lugares y tiempos especiales, como sucede con el arte.[20]

La tecnología del futuro y su rol en la estética en nuestros objetos cotidianos

Alrededor 1.830 el mundo occidental comenzó a presenciar como la producción en masa invadía la esfera de los objetos cotidianos. Dichos cambios se veían entonces con muy buenos ojos, ya que todo parecía indicar que finalmente se iba a superar la incapacidad de la producción artesanal imperante para hacer que estos objetos pudiesen llegar a satisfacer las necesidades de una población que crecía a una velocidad antes desconocida. Sin embargo, lo que realmente estaba sucediendo era **la instauración definitiva de una nueva forma de entender y apreciar nuestros objetos cotidianos**, ya que con la producción en masa lo que solapadamente se estaba implantando era una barrera comunicacional entre el productor o creador de objetos y su destinatario, o lo que es lo mismo: la erradicación definitiva de aquella dinámica que imperó en los albores de la humanidad y mediante la cual el hombre creaba sus objetos a su gusto y medida. Esto trajo consigo un cambio significativo en nuestra forma de apreciar los objetos cotidianos y junto a ésta **un irremediable anhelo de restituir el vínculo perdido entre el objeto y su usuario.**[1]

De aquí que hoy en día, **lo que el diseño y los sistemas productivos están tratando de propiciar es la restauración de ese vínculo**. Para ello, tanto los nuevos creadores de objetos (los diseñadores industriales) como la infraestructura productiva de nuestras sociedades, se han dado a la tarea de desmontar paulatinamente la rigidez que ha caracterizado a la producción en masa por casi dos siglos. La sociedad de hoy exige cambios y el diseño y la industria trabajan incesantemente en las posibles soluciones.

Un factor determinante en esta búsqueda ha sido la tecnología. Su papel dentro del proceso de reconstrucción del vínculo hombre-objeto se ha enrrumbado en dos direcciones principalmente. La primera, aportando nuevas posibilidades para flexibilizar la labor del diseño –creando nuevos materiales, nuevas técnicas productivas y avances tecnológicos que mejoran la manera de ejecutar viejas funciones o de realizar otras nuevas. La segunda, forzando tanto a la industria como al diseño, a resolver otro tipo de problemas que en su devenir la tecnología ha generado, tanto a nivel de los usuarios como en el sistema productivo. Se trata de situaciones que la misma tecnología no ha podido resolver dado que, en la mayoría de los casos, escapan de su radio de acción. Este diagnóstico se ve corroborado por los planteamientos que al respecto han hecho estudiosos y profesionales vinculados al problema.

Para el profesor Thierry Chaput de la Universidad de París, por ejemplo, la forma que presentan hoy en día nuestros objetos cotidianos es el síntoma de una carrera innovadora que afecta cada vez más nuestra aprehensión estética de lo que nos rodea, ya que quebranta con increíble regularidad la **imagen del continuun tecnológico** a la que estamos acostumbrados.[2] Situación cuyas raíces se encuentran, según Uri Friedländer, en la aparición de partes electrónicas para sustituir los viejos elementos o sistemas mecánicos que existían en muchos productos. Esto, dice Friedländer, hizo que empezaran a desaparecer las empresas especializadas (o aquellas dedicadas a productos que requieren de mecanismos especiales); trayendo tres consecuencias: el aumento del número de productores compitiendo por un mismo mercado, una baja en los precios de los productos y una competencia centrada en dos renglones fundamentalmente: la calidad del producto y su aspecto, empaque y publicidad,[3] dejando de lado el carácter auto-explicativo que en estos objetos debía imperar.

Al respecto, Jean Baudrillard también ha advertido que fenómenos como la automatización nos están llevando a presenciar una suerte de **"antropomorfización del objeto"**, ya que sin darnos cuenta estamos borrando la presencia del hombre en los artefactos, al sustituir elementos mecánicos visualmente perceptibles por elementos electrónicos externamente invisibles. [4] Lo cual, según Baudrillard, termina otorgándole al artefacto un status o autonomía similar a la del hombre, destruyendo a su paso la dinámica mediante la cual el objeto estaba al servicio de este último. La misma situación ha sido vislumbrada en Italia por Gillo Dorfles quien la ha catalogado como la **instauración de una tecnología inmotivada**, es decir, una tecnología carente de toda pista o señal que nos hable de su funcionamiento o propósito.[5]

Klaus Krippendorff y Reinhart Butter, dos promotores de ideas de avanzada en la concepción del diseño industrial contemporáneo, ya han manifestado su preocupación por los efectos que nuevos materiales y fenómenos como la miniaturización están teniendo en la estética de nuestros objetos cotidianos.[6] Otros como Winfried Scheuer en cambio, centran su preocupación en la marcada tendencia que existe a trasladar problemas de hardware (productos duros) a software (productos blandos), como si no existiesen soluciones que pudiesen concretarse a través de la materialidad del objeto; llevándolo a promover un necesario retorno al ámbito del hardware.[7]

Hablamos así de una dinámica que, según palabras de Paul Virilio, nos está llevando a confrontar con increíble regularidad una "realidad infra-ordinaria", donde las **búsquedas estéticas** han sido suplantadas por una **estética de búsqueda** que exige de nosotros el desarrollo de sensibilidades distintas a aquellas a las que estamos habituados.[8] Todo esto al punto de que estudiosos del problema como Abraham Moles ya han bautizado la presente época como una **Era de Telepresencias**, donde nuestra proximidad a lo tangible se está haciendo cada vez más irrelevante en la construcción de nuestra realidad.[9]

Ante un conjunto de visiones tan alarmantes, **¿dónde quedará la experiencia estética de nuestros objetos cotidianos si la percepción de su uso se está desvaneciendo paulatinamente y la sensibilidad del usuario se ve cada vez más mediada por un conocimiento que tiende a especializarse?** ¿Qué podemos hacer frente a esta carrera innovadora donde de antemano sabemos que los bits se mueven mucho más rápido que los átomos? y en la cual, como lo afirma Froilán Fernández, [10] cada vez nos sentimos más tentados a transformar átomos en bits.

Muchos son las propuestas al respecto. La mayoría de estas tratan de resolver el problema estableciendo parámetros para su conceptualización. Esto con la esperanza de poder aportar esquemas de pensamiento que desemboquen en modos de actuar que garanticen que el proceso de tecnificación de lo cotidiano sea menos brusco. Otras propuestas, por su parte, se concentran en detalles tan minuciosos que a la larga no terminamos de saber si lo que ellas plantean pueda tomarse como una solución definitiva.

En el primer grupo encontramos un conjunto de interesantes planteamientos que tienden a caracterizar el tipo de elaboración estética que debe prevalecer en el objeto cotidiano. Allí cabe aclarar que existen precedentes teóricos que, sin partir de lo tecnológico, sientan las bases para las teorizaciones que sí lo hacen. De estos los más importantes para nuestra discusión son los provenientes de Jean Baudrillard y Abraham Moles. El primero de éstos publica en 1966 su visión de la "genesis ideológica" de nuestras necesidades; ensayo donde esboza los diferentes niveles de "lectura" que se pueden dar en un objeto cotidiano y la manera en que nuestro sistema capitalista está contribuyendo a borrar la percepción de su funcionamiento.[11] Esta es una idea que Baudrillard mantiene y reelabora 14 años después con matices aún más dramáticos que vaticinan **la inexorable aniquilación del valor referencial del objeto** (de la lectura de su función o uso) en favor de un valor netamente comercial en nuestras sociedades.[12] Sobre este particular, ya en 1975 Abraham Moles había insistido, señalando que la principal razón del desgaste o pronta caducidad de estos objetos no se encontraba en la tecnología sino en el mismo sistema de valores bajo el cual vivimos.[13]

Estos trabajos han abierto un área de teorización que ha desembocado directamente en planteamientos sobre cómo apreciamos objetos cotidianos matizados por innovaciones tecnológicas. Un trabajo seminal en este sentido es el de Paul Levison, el cual se publica en 1.977 y se refiere a artefactos de comunicación de masas.[14] Según este estudio artefactos como el televisor y el radio han sido objeto de una **metamorfosis** que los ha llevado a ser vistos en principio como JUGUETES (dado que sus potencialidades son pobremente entendidas), luego como ESPEJOS (objetos que forman parte de nuestra rutina) y finalmente como ARTE (cuando más allá de contarnos la realidad nos empiezan a hacerla ver de otra manera).[15] De corte similar pero con un énfasis más mercadotécnico, es el trabajo del profesor Chino Ding-Bang Luh publicado en 1994.

En él el nombrado profesor nos ofrece una serie de **índices psicológicos** que a su entender definen la percepción que los usuarios tienen de un producto a lo largo de su ciclo de vida.[16] Estos índices abordan tres aspectos que su autor ve como distintivos en el producto (la función, la manera de operar y su apariencia); definiendo a su vez cuatro maneras distintas de percibirlo: como "nueva herramienta" (al momento de ser introducido al mercado), como "equipo estándar" (en su fase de crecimiento), como "reflector de status" (en su fase de madurez) y como "entretenimiento" (en su fase de declive).[17] Dentro de este punto de vista, yo mismo me di la tarea (en 1997) de formular una propuesta para definir la secuencia que, a nivel de manipulación de significado, debería prevalecer en los productos a lo largo de su ciclo de vida.[18] Sin embargo, debo admitir con toda seriedad que la mayoría de las **secuencias estético-perceptivas** antes planteadas (incluyendo la mía), se limitan a explicar la realidad de tan sólo algunos productos, requiriendo de estudios más detallados que permitan extender su aplicación a un universo objetual más amplio.

Entre los estudios que se han abocado a los aspectos particulares del problema, cabe mencionar el trabajo del profesor Uday Athavankar, del Instituto Indio de Tecnología en Bombay, quien entre otras cosas ha llegado a sugerir que el diseño de **la apariencia del objeto** debe considerarse **como una cuidadosa construcción de vínculos visuales culturalmente arraigados** para que el usuario pueda decodificarlo; llamando nuestra atención sobre el hecho de que dichos vínculos deben tener la suficiente fuerza y claridad para evocar las conexiones correctas.[19] Otro interesante trabajo es el de Angela Dumas, del Centro para la Administración del Diseño de la London Business School. Ella sugiere como solución para los productos innovadores, la construcción de una **estética basada en metáforas referidas al contexto** para el cual están destinados.[20]

Estos dos últimos trabajos son especialmente significativos si entendemos que **la tecnología no puede verse como un problema de artefactos aislados.** Allí, por el contrario, debe prevalecer una visión ecológica de los artefactos (es decir, que objetos se parecen o pertenecen a "x" contexto) que sea capaz de involucrar dentro de su concepción el nivel de conocimiento tecnológico que tienen sus destinatarios humanos.[21] En este último sentido, **quizás sea necesario re-pensar las vías para sensibilizar al usuario ante las nuevas tecnologías.** Es decir, dejar de ver esta sensibilización como un problema que solo debe recaer en los individuos o como un proceso supeditado al azar, ya que como Paul Saffo - investigador del Instituto para el Futuro (Estados Unidos)- lo ha afirmado **lo normal es**

que nos tome un lapso de 30 años para asimilar cada nueva tecnología.[22] Ante esta situación, quizás nos resulte muy útil la propuesta del profesor Terry Liddament de la Universidad de Londres, quien plantea entender el problema como una cuestión de **alfabetización tecnológica.**[23]

Finalmente, cabe reseñar otros esfuerzos que no entran en ninguna de las categorías anteriormente tratadas. Me refiero a la creciente conciencia que en torno al problema de las nuevas tecnologías se está desarrollando dentro de la disciplina del diseño industrial. Allí, por ejemplo, Derrick de Kerckhove, director del Programa McLuhan de la Universidad de Toronto, aboga por hacer de los productos **entes interactivos** que le permitan a los usuarios moldearlos a su gusto.[24] Gillian Crampton Smith, profesora del Royal College of Art de Londres, nos insta en cambio a crear productos que enmarquen a las nuevas tecnología dentro de **"narrativas coherentes"**, capaces de expresar lo que es el producto y la forma como trabaja.[25]

Este último aspecto en particular ha llegado ha cobrar vida dentro un nuevo paradigma, que busca transformar el acto de diseñar objetos cotidianos en una actividad orientada a lograr que estos **"hagan sentido de sí mismos"**. Me refiero en particular a lo que se conoce como el **paradigma semántico**, un planteamiento que entre sus puntos contempla la concepción del producto como interfase diseñada para acomodar los modelos cognoscitivos de los usuarios y la visualización de la interacción hombre-objeto bajo una perspectiva auto-motivante (donde el usuario descubre el uso del objeto sin necesidad de leer sus instrucciones).[26] Al respecto es importante mencionar que Victor Papanek ya ha vislumbrado el desarrollo de dos tendencias en el diseño venidero: una centrada en el diseño de objetos fáciles de armar y desarmar por sus usuarios **(design for disassembly)** y la otra en un diseño tendiente a facilitar el mantenimiento y reparación de la tecnología propia de cada objeto por parte de su usuario **(the rediscovery of repairability).**[27]

Todos estos planteamientos delinean algunos de los retos más importantes para el diseño industrial en el próximo siglo y nos hablan de un panorama estéticamente prometedor que muchos esperamos poder llegar a ver. Quizás la enseñanza más importante que esta visión panorámica nos deja, sea el entender que no hay renovación estética profunda que no esté basada en un sistema de valores.[28]

NOTAS Y REFERENCIAS:

[1] Omar Calabrese, **La estética a finales del milenio**, entrevista en *Forma*, Nº 4/1, Talleres Gráficos Universitarios de la U.L.A., Mérida, 1999, p.12.
[2] Juan Acha, **Introducción a la teoría de los diseños**, Trillas, México, 1990, p.22.
[3] Ibidem.
[4] Monroe Beardsley y John Hospers, **Estética: Historia y fundamentos**, Cátedra, Madrid, 1997, p.99.
[5] Cfr. Lucius Garvin, **"The paradox of aesthetic meaning"** en Susanne Langer (ed.) *Reflections on art: a source book of writing by artists, critics and philosophers*, Oxford University Press, Londres, 1968.
[6] Ibid, p.
[7] Cfr. Roger Scruton, **"Aesthetic experience and culture"** en Richard Woodfield (ed.) *Papeles del XI Congreso Internacional de Estética*, Nottingham-Inglaterra, 1988, p.176.
[8] Cfr. Mihaly Csikszentmihalyi, **"Design and order in everyday life"** en V.Margolin y R. Buchanan (ed.) *The idea of design: A design issues reader*, The MIT Press, Cambridge, 1995, pp.118-126.
[9] Wolfgang Haug, **Publicidad y consumo: Crítica de la estética de mercancías**, Fondo de Cultura Económica, México, 1989.
[10] Cfr. Vance Packard, **"Imágenes de sí mismo para cada cual"** en *Las formas ocultas de propaganda*, Sudamericana, Buenos Aires, 1992.
[11] James Somerville, **"Are there aesthetic qualities?"** en Richard Woodfield (ed.) *Papeles del XI Congreso Internacional de Estética*, Nottingham-Inglaterra, 1988, p.208.
[12] Ibid, p.209.
[13] Abraham Moles, **Teoría de los objetos**, Gustavo Gili, Barcelona, 1975, p.50.
[14] Cfr. Richard Buchanan, **"Declaration by design: Rhetoric, argument, and demonstration in design practice"** en Victor Margolin (ed.) *Design discourse: History, theory, criticism*, the University of Chicago Press, Chicago, 1989, p.103.
[15] Picasso citado en Erich Kalher, **La desintegración de las formas en las artes**, Siglo XXI, México, 1978, p.56.
[16] Monroe Beardsley, **Aesthetics: Problems in the philosophy of criticism**, Harcourt/ Brace & World, New York, 1958, pp.527-529.
[17] E.H. Gombrich, **"Visual discovery through art"** en J. Hogg et.al. (eds.) *Psicología y artes visuales*, Gustavo Gili, Barcelona, 1975, p.200 y 210.
[18] Cfr. Gombrich, op.cit., p.213.
[19] Entiéndase por **sensibilidad** la receptividad o capacidad de sentir que todo el tiempo funciona en nosotros (no sólo frente a obras de arte) y que, además de buscar el placer, nos enfrenta al disgusto [Acaha, op.cit., p.23].
[20] Cfr. Acha, op.cit., p.23.
[21] Rafael Lacruz Rengel, **The symbolic equation in product design: An approach to the aesthetic characterisation of products along their life cycle**. Tesis de Maestría, University of Central England, Inglaterra, 1997.
[22] Thierry Chaput, **"From Socrates to Intel: The caos of micro-aesthetics"** en JohnThackara (ed.) *Design after modernism: Beyond the object*, Thames & Hudson, Londres, 1988, pp.183-186.
[23] Uri Friedländer, **"Produkt-Semantik und Steinzeit"** en *FORM* (Zeitschrift für Gestaltung), #128, 1989, pp.13-14.
[24] Cfr, Jean Baudrillard, **El sistema de los objetos**, Siglo XXI, Bogotá.
[25] Gillo Dorfles, **"Sociological and semiological aspects of design"** en Terry Bishop (ed.) *Design history: Pass, process and product*, Design Council, Londres, 1979, p.11.
[26] Klaus Krippendorff y Reinhart Butter, **"Where meanings escape functions"** en *Design Management Journal*, Boston, Spring 1993, pp.29-33.
[27] Winfried Scheuer, **"Die Produktwelt der Elektronik verlangt nach neuen**

Gestaltungsansätzen" en *FORM* (Zeitschrift für Gestaltung), #128, 1989, p.13.
[28] Cfr. Paul Virilio, **The aesthetics of disappearance.** Semiotex, New York, 1991.
[29] Abraham Moles, **"Design and inmateriality: What of it in a Postindustrial Society?"** en V. Margolin y R. Buchanan (eds.) *The idea of design: a Design Issues reader*, the MIT Press, Cambridge, 1995, p.268.
[30] Froilán Fernández, **"Versión preliminar de un futuro inalámbrico"**, Encartado Especial titulado 2000: El futuro es hoy, *El Nacional*, domingo 03 de octubre de 1999, p.8.
[31] Cfr. Jean Baudrillard, **"Génesis ideológica de las necesidades"** en *Crítica de la economía política del signo*, Siglo XXI, México, 1997.
[32] Jean Baudrillard, **"El fin de la producción"** en *El intercambio simbólico y la muerte*, Monte Ávila, Caracas, 1992, pp.11-15.
[33] Moles, 1975, op.cit., p.102.
[34] Paul Levison, **"Toy, mirror, and art: The metamorphosis of technological culture"**, en *Et cetera*, Junio, 1977, pp.151-167.
[35] Levison en Mika Pantzar, **"Domestication of everyday life technology: Dynamic views on the social histories of artifacts"** en *Design Issues*, Vol.13, # 3, Otoño de 1997, p.53.
[36] Ding-Bang Luh, **"The development of psychological indexes for product design and the concepts for product phases"** en *Design Management Journal*, Vol.5, #1, , Boston, Invierno de 1994, pp.30-39.
[37] Ibid, p.34.
[38] Lacruz Rengel, op.cit.
[39] Uday Athavankar, **"Cultural identity and design"** en *Formdiskurs*, 3/11, 1997, p.71.
[40] Angela Dumas, **"Building totems: Metaphor making in product development"** en *Design Management Journal*, Vol.5, # 1, Boston, Invierno 1994, pp.71-82.
[41] Cfr. El planteamiento de los sociólogos de la tecnología, Donald Mackenzie y Judy Wacjman (1985) en Hugh Mackay, **"Consuming communication technologies at home"** en *Consumption and everyday life*, Sage /The Open University, Londres, 1997, p.265.
[42] Paul Saffo, **"The thirty year rule"** en *Design World*, # 24, 1992, p.18.
[43] Terry Liddament, **"Technological literacy: The construction of meaning"** en *Design Studies*, Vol.15, # 2, 1994, pp.198-213.
[44] Derrick De Kerckhove, **"Design interactivity and the production of meaning"** en Jeremy Myerson (ed.) *Design Renaissance* (Papeles del Congreso Internacional de Diseño de Glasgow, 1993), Open Eye, Londres, 1994, pp.153-156.
[45] Gillian Crampton Smith, **"Humanising technology: Could do better?"** en Jeremy Myerson (ed.) *Design Renaissance* (Papeles del Congreso Internacional de Diseño de Glasgow, 1993), Open Eye, Londres, 1994, pp.143-146.
[46] Klaus Krippendorff, **"Product Semantics: A triangulation and four design theories"** en Seppo Väkevä (ed.) *Product Semantics '89* (Papeles de la Conferencia de Semántica de los Productos realizada en Helsinki en 1.989), University of Industrial Arts, Helsinki, p.a7.
[47] Victor Papanek, **"The coming of a new aesthetics: eco-logic, etho-logic, bio-logic"** en Jeremy Myerson (ed.) *Design Renaissance* (Papeles del Congreso Internacional de Diseño de Glasgow, 1993), Open Eye, Londres, 1994, pp.29-34.
[48] Parafraseo al profesor italiano Ezio Manzini quien ya ha expresado esta idea en **"Design, environment and social quality"** en Jeremy Myerson (ed.) *Design Renaissance* (Papeles del Congreso Internacional de Diseño de Glasgow, 1993), Open Eye, Londres, 1994, p.40.

Appendix 4 – Publication / Article

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Title:

OBLITERATION VERSUS RE-SEMANTIZATION OF REFERENCES IN ELECTRICAL APPLIANCES

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OBLITERATION *VERSUS* RESEMANTIZATION OF REFERENCES IN ELECTRICAL APPLIANCES

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Since signs are used to name or indicate objects and events, it is difficult to see how a theory of meaning can succeed without giving a central role to the concept of *Reference*. This is a concept that has provided semioticians with a basic source of inspiration for the study of content and the search for theories of sign production. However, it can hardly be said that there is a single definition of reference in semiotic studies.

For the German logician Gottlob Frege, for instance, *reference* is a synonym of that object a sign designates in a certain manner or *sense*; where reference is "neither a concept nor a relation but a particular object" (Frege 1892: 51). Differently, Ogden and Richards name *reference* something closer to Frege's *sense*. Indeed, they define *reference* as that "thought" which is registered in a *symbol* in order to express an object or *referent* (1923). Other authors, such as Nelson Goodman, prefer to treat *reference* as a more general term to talk about "all sorts of symbolization, all cases of standing for…" (Goodman 1984: 55).

Therefore, it should be noted that the present study will use Nelson Goodman's approach. There are two reasons for this. On the one hand, because the reference of electrical appliances, as cultural objects, is not necessarily subjected to objects in particular — as Frege suggests (Eco 1976). As a matter of fact, within the theory of codes, signs can also be explained by signs without the intervention of objects. On the other hand, because serious flaws have been found in Ogden and Richards' model during the referential analysis of design objects. Umberto Eco, in particular, has realized that a search for the *reference* of design products using such a model can only lead to the indeterminacy of its *referent* or the replacement of this *reference* (Eco 1980).

Thus, we will look at *reference as covering all cases of standing for*. Under such a definition, we must realize that almost anything may stand for almost anything else because this approach implies that resemblance is not necessary for reference (Goodman 1976). This way of defining reference will rest on two assumptions: a set of *conditions* and a set of *relations*. By *a set of conditions* we understand the presence of certain communicative abilities, attitudes, knowledge, and a common socio-

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cultural system between encoders and decoders (Berlo 1960). In other words, the idea that encoders and decoders share a common knowledge about the referential potentials of signs as well as about particular sign-types (Thrane 1980). By *a set of relations*, conversely, we refer to the existence of discontinuities in the plane of our perceptions. That is to say, the discrimination of semantic differences and the discernment of relations capable of articulating such differences (Greimas 1973).

Now, as the subject of this paper are electrical appliances, it is important to clarify the type of reference we are talking about. In this respect we should start by saying that *electrical appliances are utilitarian objects*. As such they have to fulfill a *function*. They have to display their capacity to serve a particular purpose in a certain manner. In the second place, we should acknowledge that *electrical appliances are cultural objects*. Indeed, they become part of *culture* when the function primarily assigned to them is recognized by a group of people and associated to a characteristic physical configuration (Barthes 1964; Moles 1975; Eco 1976; Lacruz-Rengel 1997). Therefore, *when we study electrical appliances the reference is inevitably of a functional nature*. It does not mean that other types of a references cannot take place in such objects. This only suggests that all those other types of references are built on top of these objects' functional references (Moles 1975).

POSITIONS ABOUT THE OBLITERATION OF FUNCTIONAL REFERENCES

Studies on material culture such as those by Jean Baudrillard, Michael Thompson, and Gillo Dorfles, explicitly state that in utilitarian objects functional references are or have been obliterated in order to give place to references of a different nature. Amongst all these authors, Jean Baudrillard is the one who has devoted more time to this subject. Indeed, his ideas about it have been presented in a variety of ways:

- In 1969, Baudrillard explains how the logic of functionality or the *use value in utilitarian objects can be progressively decontextualized* and left behind in order to impose other logics capable of leading them to their status of consumption. In this sense he asserts that "an object is not an object of consumption until it is released from... its functional determinations as an instrument..." (Baudrillard 1969: 67).
- In 1976, Baudrillard visualizes *the death of the reference* as a result of the revolution of value that characterizes our economical systems. That is to say, a revolution where the structural dimension of objects — or that determining the nature of their exchange value — becomes autonomous by excluding their referential dimension — or that built around their functionality (Baudrillard 1993).
- In 1978, Baudrillard foresees the instauration of an "age of simulation" that, beginning with the liquidation of all references, will pursue the substitu-tion of "...signs of the real for the real itself" (Baudrillard 1983: 4).
- In 1983, Baudrillard suggests that a total obliteration of all those references traditionally linked to our objects may lead us to a sort of commercial alienation that will transform our objects into fetishes, that is, objects without a function (Baudrillard 1997).

Another position tacitly supporting the obliteration of the reference is that outlined in Michael Thompson's so-called *"Rubbish Theory"*. This theory studies the social control of value standing on the fact that "rubbish is socially defined" (Thompson 1979: 11). According to Thompson, people in Western culture place objects either in a category he calls "transient" or in another he labels "durable". Objects in the *transient category* decrease in value over time and have finite lifespans, whereas those in the *durable category* increase in value over time and have infinite lifespans. Consequently, a used car falls into the transient category and an antique piece of furniture into the durable one. Objects that do not fit into any of these two categories, that is those of zero value, comprise the *rubbish category*.

Based on this conceptual framework, Thompson suggests that *transient objects* gradually decline in value and in expected lifespan, sliding across into the *rubbish category*. A category where they remain as if they were in a timeless and valueless limbo until they are rediscovered by someone who assigns them a totally different value to that they originally had. In other words, it implies that mechanisms such as the dilapidation, *obsolescence, and change of fashions, can cause a value decline in util-*

itarian objects to the extent of obliterating their use value (or functional reference) and even replace such a value with a totally different one within a matter of time.

Finally, we find a less holistic but no less important position in the writings of Gillo Dorfles (1979). The latter instead of relating the obliteration of the functional references to economic or social mechanisms links this problem to the directions followed by technological development. In this sense Dorfles have asserted that we are witnessing today the establishment of an *unmotivated technology*, where the function of objects is being wiped out from their appearance without any conscious purpose.

This is a position that coincides to a degree with the role bestowed on automation by Baudrillard. Indeed, to Baudrillard automation confers objects a similar status to that of their users: eradicating the traces of their presence from objects and, therefore, dissociating the functional "readings" traditionally assigned to many objects (Baudrillard 1994).

POSITIONS ABOUT THE RESEMANTIZATION OF FUNCTIONAL REFERENCES

Since the viewpoints regarding utilitarian objects in terms of re-semantization cannot be summarized through the study of a few authors, we will try to group and present them chronologically. Our review will start from the 1960s onward because it was only at the end of this decade that the "semiotics of objects" was cohesively appraised (Krampen 1979).

The most popular approach to the functional reference of utilitarian objects is that where they are seen as extensions of man (McLuhan 1964; Dorfles 1966; Morgantini 1983; McLuhan 1989; De Kerchove 1995; De Groot 2000). Aristotle has been regarded as the creator of such a thesis (Dorfles 1972) and the French anthropologist Leroi-Gourhan as its best known detractor (Leroi-Gourhan 1993). But the most important thing is that such an approach defines a curious case of functional references of an anthropocentric nature.

Maurizio Morgantini (1983) has divided this type of functional references into three interesting generations: 1) PROSTHESES OF THE LIMBS — e.g. knives, spades, bows and arrows —, 2) PROSTHESES OF THE SENSES — e.g. telephones, television sets and machines to reproduce images and sounds —, and 3) PROSTHESES OF THE MIND — e.g. computers, holography and virtual reality —. This idea of generations gradually replaced by new and more effective ones (Dorfles 1972; Virilio 1991), outlines a process of resemantization where the traditional materiality associated to certain functions is ignored a number of times in order to manipulate reality in more flexible ways (Toffler 1983; Mangieri 1998; De Kerchove 1999).

Another interesting contribution also from the 1960s is that of Roland Barthes. His work corresponds to that stage of general semiotics focused on cultural systems (Gandelsonas 1974). Consequently, Barthes owns up to the task of approximating the semantics of objects as cultural manifestations whose understanding follows a process comprising three phases (Barthes 1964). A first one, where the object presents itself as a functional one, that is, as "a mediator between humanity and the world" (Barthes 1964: 189). A second phase, where the object enters the semantic field of equivalences (or other meanings), struggling between "the activity of its function and the inactivity of its signification" (Barthes 1964: 189). And finally a third phase, where the object describes a sort of return movement from the world of secondary references to that of its functional reference. That is to say, a return from sign to function, describing a trajectory where functional references become the recurrent theme in spite of those contingencies the object may confront.

In 1973, Juan Pablo Bonta presented a process of re-semantization for architecture which can also be applied to the resemantization of functional references. Stemming from the semiotic writings of Eric Buyssens and Luis Prieto, he argued that the information conveyed by design objects could assume three distinctive roles: as INDICATORS (or pieces of information where the relationship between form and meaning is natural or factual), as SIGNALS (or pieces of information where the relationship between form and meaning is conventional), and as INTENTIONAL INDICATORS (or indicators purposely created and used to communicate as signals do). Thus, according to Bonta, the production of meaning in design objects begins when an INDICATOR is transformed into an

INTENTIONAL INDICATOR, which ends up as a SIGNAL after being used repeatedly. This primary semantization is subsequently followed by several resemantizations due to the obsolescence achieved by signals within time. Then obsolete signals are taken as intentional indicators to restart the process all over.

In the late 1970s, the outbreak of critical controversies about the mass media and popular culture provided new grounds for semantic theorizations. The most representative work of this period is perhaps that of Paul Levison (1977) about mass media technology. Levison, a professor of communication, focused his research on the changing usages and perceptions of film since its first appearance. From such a study he elaborated three principles that, according to him, could be extrapolated to define the development of any new technology as well as our perceptions about them. These principles take place chronologically, bearing some interesting resemblances with well-known models of human development such as Piaget's sensorimotor, concrete, and formal (abstract) stages of intellectual growth (Levison 1977).

The first of Levison's principles puts forward the idea that all new technologies are initially visualized by people as TOYS, because their potentialities are poorly understood. This is a principle that characterizes a stage in the life of technological objects based on the projection of their own identity, where the content of the object is the object itself. Once the new technology is socially accepted and its nature recognized, a second principle named MIRROR takes place. Such a principle corresponds to a stage where the object's content becomes life, transforming the technological object into a surrogate of reality. Finally, when the technology stops being a mature transcriber of reality, a third principle comes to light. Summarized under the name of ART, this principle represents the moment when the passive copy of reality is replaced by a refashioning of it, where the triumph of form over content closes the technological dialectics of prereality, reality, and postreality.

Differently from studies such as this, the 1980s experienced an important conceptual shift in the theorization of utilitarian objects. Indeed, during that decade a semantic paradigm opposed the existing functionalism (Krippendorff 1990) and the role of context was updated in terms of its contribution to the production of meaning (cf. Krampen 1989; Krippendorff 1989). Nevertheless no remarkable propositions were made in terms of semantic processes, besides the one already suggested by Morgantini (1983).

During the 1990s, on the contrary, similar ideas to those of Levison were brought back in discussion but under a different methodology. As a matter of fact, historical accounts were replaced by propositions stemming from psychology and the sociology of knowledge. Thus, based on the writings about human needs by K. S. Young and Abraham Maslow, Ding-Bang Luh (1994) outlined a group of psychological indexes to typify the different stages of an object (product) along its life cycle. This is a work that ends up defining four different conceptual phases for our understanding of mass-produced utilitarian objects. Within these phases, we first perceive the object as a NEW TOOL, second as a piece of STANDARD EQUIPMENT, third as a means for STATUS-REFLECTION and, finally, as a SOURCE OF ENTERTAINMENT.

Likewise, in 1997, I proposed a model to explain the mechanisms underlying resemantization in products along their life cycle (Lacruz-Rengel 1997). In my approach resemantization was seen as the result of a social process comprising three stages:

- *Externalization* or the expression of the designer's ideas through the creation of objects.
- *Objectivization* or the stage where the designer's creations are submitted to social scrutiny so as to be accepted or rejected by its potential consumers. Here, social mechanisms will typify and justify the physical configuration given to such an object once it is accepted.
- *Internalization* or the stage of apprehension and understanding of what an object and its configuration are about.

Such a process suggests that, in order to be successful, mass-produced utilitarian objects should be manipulated by designers first as SYMBOLS (or something whose function should be taught in order to be understood), then as ICONS (or objects that having their functional recognition granted, present features that highlight or expand their functional understanding), and finally as INDEXES (or products that having their functional references clearly outlined, increase their semantic dimension through the incorporation of non-functional meanings to their physical configuration).

Finally, we find the work of the Italian sociologist Fabrizio Carli, published in 2000. Based on a methodology that combines history, psychology and aesthetics, his study is particularly devoted to the resematization of electrical appliances. According to Carli, throughout history, this type of utilitarian objects has subsequently repeated a process comprised of five phases:

- INDIFFERENCE or the allocation of these objects into existent aesthetic canons.
- GESTATION or the visualization of the object's physical configuration as being characteristic of certain aesthetic or technological periods of time.
- SEMANTIC DEVIATION and PREFIGURATION, where objects suggest ideas technologically too advanced for their time. Therefore, this phase is characterized by an intense formal experimentation that reflects people's future expectations.
- HORIZON OF EVENTS and EPISTEMIC FRACTURE or the breaking of tradition to shake the beholder's perception. In this phase, objects are deformed and regenerated by a slow sedimentation.
- REVISIONISM or the phase where previous designs to the epistemic fracture are taken over again and reinterpreted.

A CRITICAL APPROACH TO TRANSFORMATIONS OF REFERENCE IN UTILITARIAN OBJECTS

Having presented the positions that support or deny *the death of the functional reference* in mass-produced utilitarian objects (products), it is important to acknowledge:

1. The supposed obliteration of functional references expressed in the writings of authors such as Baudrillard, Thompson, and Dorfles, can only be considered for people alienated by the economical or technological system where they live. In other words, *the idea that "some people", at a certain stage of an object's life, may cease to perceive its functional reference cannot be taken to mean that such a type of reference has been convincingly wiped out from the object.* The best proofs of this are the functional "readings" that still happen in people belonging to less advanced economical or technological cultures.

2. *The idea that the functional reference of "all" utilitarian objects can be obliterated because of a lack of shared or cultural knowledge cannot be generalized.* Research developed by well-known psychologists such as Kurt Kofka (1935), Jean Piaget (1947), Rudolf Arnheim (1947), James Jerome Gibson (1979), and Donald Norman (1988), show the existence of a sort of non-cultural or intuitive meaning that helps people infer what an object is without being told about it. As a matter of fact, intuitive meaning played an important role in the creation of early tools. Unfortunately it does not work for all utilitarian objects; its of little assistance in the recognition of box-shaped appliances.
3. In relation to Michael Thompson's theory, *it is hard to support the idea that any utilitarian object can loose its functional identity due to a lack of use.* Indeed, a radio, for instance, will not stop from being a radio just because one does not turn it on.
4. The important point about all of these positions in favor of the idea of resemantization is that, in all of them, the *general function will be part of the object's perception while changes concentrate at levels such as the reconfiguration of interfaces* (when they are seen as extensions of man), *subjective appreciations* (in Barthes' and Luh's propositions) *and the addition of secondary contents to the object's function* (like in Levison's case).
5. Despite the fact that every process of production of meaning is indeed a recognition act, *rules of meaning recognition cannot be directly and linearly inferred from a "grammar" of meaning production* (Verón 1997). In this respect propositions such as that of Pablo Bonta (1973) and Ding-Bang Luh (1994) must be discretely considered.
6. One should not forget that any semiotic "text" can have multiple and simultaneous "readings" by different people (Verón 1997). Therefore, *the sequence proposed in most of the resemantization processes presented here may change according to the background and accumulated knowledge of each beholder or user.* Indeed, the difference between a virtuous "reader" and a less capable one is obviously significant (Chartier 1991). The important thing then is to acknowledge that resemantization takes place beyond any particular kind of sequence.

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The above theoretical propositions and observations should make us realize that *signification is an active psuchic process* (Guiraud 1976) where *reference* is not restricted to physical objects but rather to concepts and ideas within a person's memory (Norman & Rumelhart 1975). This is why *the understanding of any functional reference as a unique true value is impossible to substantiate*. In fact, the idea that every object or sign-vehicle refers to something does not imply that all signs *refer* to existing things (Morris 1985). Therefore, the production of meaning does not necessarily stand on true things, neither does signification always pursue the production of truth (Eco 1976).

This is why considering the world as an "ensemble of references opened up by the text" (Ricoeur 1976: 36) has given semiotics the task of revealing not the "real" world in itself but the alternative models that circumscribe the things we get to such an about it (Sebeok 1994). This happens to such an extent that authors such as Ray Jackendoff (1983) have taken *reference* as a sort of projection of our awareness of reality rather than as a projection of reality in itself.

Having clarified some key points about the mechanisms of resemantization in utilitarian objects, I now want to suggest the use of a different type of model for this kind of study. For this purpose I will first take Fiske and Hartley's idea of "signification orders" (Fiske & Hartley 1978). Then I will add a fourth order to the three already acknowledged by those authors. I will call this order *Sub-Notation*.

A notation is a system of conventional signs. A subnotation refers instead to a signification order that works similarly to a notation but in an automatic, non-arbitrary way, where meanings appear naturally without the mediation of agreement. In the arena of utilitarian objects this subsystem is comprised of *dynamic characters* (Koffka 1935), *perceptual concepts* (Arnheim 1947), and *affordances* (Gibson 1979). By *dynamic characters* we refer to Koffka's *demand character* (or that related to our needs), *physiognomic character* (that linked to the appearance of things), and *functional characters* (those alluding to our activities). By *perceptual concepts* we talk about general perceptions such as roundness and heaviness which are different from more precise *intellectual concepts* such as "circle" or "weight". Finally, by *affordances*, we understand some kind of meaningful properties, neither objective nor subjective but both, that work as physical and geographical invariants perceived in objects by everyone, no matter the cultural background or the education of the beholder.

Thus the model proposed here can be represented by the following figure:

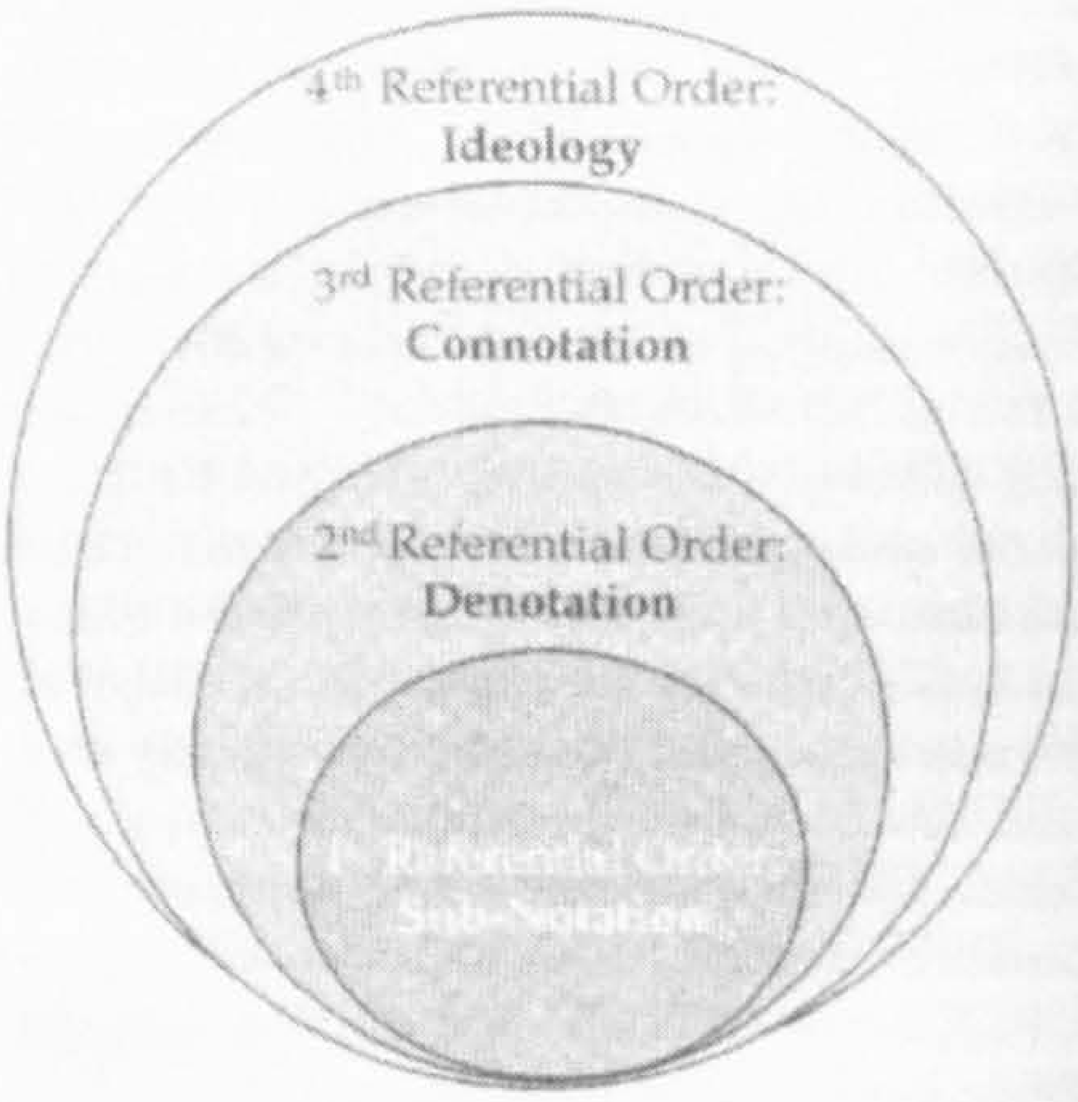

FIGURE 1 PROPOSED MODEL FOR THE STUDY OF THE RESEMANTIZATION OF REFERENCES IN UTILITARIAN OBJECTS.

Such a model does not attempt to suggest a beginning or an end to any process of resemantization. Instead this model focuses on the idea that whatever the reading of the object is (intuitive, denotative, connotative or ideological), it will always be backed-up by an inferior order of signification and therefore, also, by an inferior referential order.

OBJECT RECOGNITION AND REFERENCE IN ELECTRICAL APPLIANCES

Designers have been the professionals in charge of creating the visibility of technology in objects such as electrical appliances. In order to do this they have had to interpret what the potential consumer or user may expect. One way historically devised to achieved this has been the establishment of visual links with existing objects. This is a perfectly valid strategy if we consider that electrical appliances are products of mass-consumption and if we consider also the fact that masses think in analogical terms (Le Bon 2000).

Particularly in the case of Western societies, such a situation has defined the imagination of masses as being focused on matters of appearance, where visual associations are based on *resemblance and continuity* (Le Bon 2000). On the other hand, we should not forget that social convictions have a "religious" sense (Le Bon 2000). This is the reason why some contemporary authors handle the communication problems of masses in terms of "beliefs" (Buchanan 1989; Tyler 1992). The interesting thing however is that a belief reflects a kind of certainty about something which is taken for real without knowing how and where it comes from (Ortega y Gasset 1997).

Taking into account *the masses' analogical way of reasoning*, we can thus perfectly understand why some early electrical heaters were shaped like sunflowers, sailing yachts, or resembled Egyptian pyramids (Gordon 1984). We also understand why early refrigerators looked like wooden cabinets, electrical frying pans like saucepans, and kettles like tea-pots (Sparke 1987). In all of these early examples one can hardly say that the form given to objects has followed a "lineal" process of semantization similar to those described by most of the models already reviewed. These cases show that the starting point for semantizations in electrical appliances does not necessarily stand on a "general" conception of their function, but rather on the way such a function has been encapsulated in similar objects or in free associations different to function. This dynamic process defines patterns of semantic elaboration that jump between the different referential orders of the model I am proposing in this paper.

Only in the history of electrical appliances that are without real formal precedents (such as toasters, radios, television sets, and vacuum cleaners), can we find a semantic effort that follows a sequence starting at the first referential order of models such as mine, and climbing later into the other three orders. In this particular case, appliances only became really popular after several simplifications and thematic resemantizations of their originally complex appearances. Curiously, semantic resemantizations in these appliances tend to follow fashion trends instead of a rational sequence such as the one suggested by Carli (2000).

The other important aspect that must be mentioned about electrical appliances is related to the *religious sense of social convictions*. Indeed, throughout the history of electrical appliances, we can see how many unquestioned myths defined their appearance in different periods. This aspect refers to perceptual associations such as that of "streamlining" with progress, "cleaning" with hygiene, and "black and white square looks" with modernity (Sparke 1987). This shows that sometimes "beliefs", that is to say, the realm of ideology has played a major role in the resemantization of appliances, demystifying the presence of any rational sequence.

Consequently, we have to admit that there is a resemantization instead of an obliteration of references in the life cycle of electrical appliances. What we cannot substantiate is that such a resemantization happens within a totally rational sequence.

REFERENCES

ARNHEIM, R. ([1947] 1966). "Perceptual abstraction and art", in *Toward a Psychology of Art*, Berkeley, CA, University of California Press, 27-50.

BARTHES, R. ([1964] 1994). "Semantics of the object", in *The Semiotic Challenge*, Berkeley, CA, University of California Press, 179-190.

BAUDRILLARD, J. ([1969] 1981). "The ideological genesis of need", in *For a Critique of the Political Economy of the Sign*, St.-Louis, Telos Press;
(1983). *Simulations*, New York, Semiotext;
(1993). *Symbolic Exchange and Death*, London, Sage;
(1994). *El sistema de los objetos*, México, Siglo XXI;
(1997). *Las estrategias fatales*, Barcelona, Anagrama.

BONTA, J. P. ([1973] 1980) "Notes for a theory of meaning in design", in BROADBENT, G., BUNT, R. and JENCKS, C. (eds), *Signs, Symbols and Architecture*, New York, John Wiley & Sons, 275-310.

BERLO, D. (1969). *El proceso de comunicación*, Buenos Aires, Ateneo.

BUCHANAN, R. (1989). "Declaration by design", in MARGOLIN, V. (edit.), *Design Discourse: History, Theory and Criticism*, Chicago, ILL, The University of Chicago Press, 91-109.

CARLI, Fabrizio (2000). *Elettrodomestici Spaziale*, Roma, Castelvecchi.

CHARTIER, R. (1991). *El mundo como representacion*, Barcelona, Gedisa.

DE GROOT, C. (2000). *Transforming the Designer's Understanding of the Object*, Ph.D. Thesis, Birmingham, UK, University of Central England.

DE KERCHOVE, D. (1999). *La piel de la cultura*, Barcelona, Gedisa.

DORFLES, G. (1966). "The man-made object", in KEPES, G. (edit.), *The Man-Made Object*, London, Studio Vista, 1-8;
(1972). *Naturaleza y artificio*, Barcelona, Lumen;
(1979). "Sociological and semiological aspects of design", in BISHOP, T. (edit.). *Design History. Pass, Process, Product*, London, Design Council, 11-13.

ECO, U. (1976). *A Theory of Semiotics*, London, The Macmillan Press;
(1980). "Function and sign: the semiotics of architecture", in BROADBEENT, G., BUNT, R. and JENCKS, C. (eds), *Signs, Symbols and Architecture*, New York, John Wiley & Sons, 11-69.

FISKE, J. and HARTLEY, J. (1978). *Reading Television*, London, Methuen & Co.

FREGE, G. ([1892] 1973). "Sobre sentido y referencia", in *Estudios sobre semántica*, Barcelona, Ariel.

GANDELSONAS, M. (1974). "Linguistic and semiotic models in architecture", in SPILLERS, William (edit.), *Basic Questions of Design Theory*, Amsterdam, North-Holland Publishing Company, 39-54.

GIBSON, J. J. (1979). "The theory of affordances", in *The Ecological Approach to Visual Perception*, Boston, Houghton Mufflin.

GOODMAN, N. (1976). *Languages of Art*, Indianapolis, Hackett;
(1984). "Routes of reference", in *Of Mind and Other Matters*, Cambridge, MASS, Harvard University Press, 55-71.

GORDON, B. (1984). *Early Electrical Appliances*, Princes Risborough, England, Shire Publications.

GUIRAUD, P. (1976). *La semántica*, Mexico, Fondo de Cultura Economica.

GREIMAS, A. J. (1966). *Semántica estructural*, Madrid, Gredos.

JACKENDOF, R. (1983). *Semantics and Cognition*, Cambridge, MASS, The MIT Press.

KOFKA, K. (1935). *Principles of Gestalt Psychology*, London, Routledge.

KRAMPEN, M. (1979). "Survey of current work on the semiology of objects", in CHATMAN, S., ECO, U. and KLINKENBERG, J.-M. (eds), *A Semiotic Landscape*, The Hague, Mouton, 158-168;
(1989). "Semiotics in architecture and industrial/product design", *Design Issues*, Special Ed., 5, part 2, 124-140.

KRIPPENDORFF, K. (1989). "On the essential context of artifacts or on the proposition that design is making sense (of things)", *Design Issues*, Special Ed., 2, 9-39;
(1990) "Product semantics: A triangulation and four design theories", in VÄKEVÄ, S. (edit.), *Product Semantics '89*, Helsinki, UIAH, a2-a23.

LACRUZ-RENGEL, R. (1997). *The Symbolic Equation in Product Design*, Master of Arts thesis, Birmingham, UK, University of Central England.

LE BON, Gustave (2000). *Psicología de las masas*, Madrid, Morata.

LEVISON, P. (1977). "Toy, mirror and art: the metamorphosis of technological culture", *Et Cetera*, June, 151-167.

LEROI-GOURHAN, A. (1993). *Gesture and Speech*, Cambridge, MASS, The MIT Press.

LUH, D. (1994). "The development of psychological indexes for product design and the concepts for product phases", *Design Management Journal*, 5, 1, 30-39.

MANGIERI, Rocco (1998). "Signos e interfases", in *Cuadernos de investigación y documentación*, No. 10, Mérida, Universidad de Los Andes.

McLUHAN, M. (1964). *Understanding Media: the Extensions of Man*, London, Routledge and Kegan.

McLUHAN, M. and POWERS, B. (1989). *The Global Village*, New York, Oxford University Press.

MOLES, A. (1975). *Teoría de los objetos*, Barcelona, Gustavo Gili.

MORRIS, C. (1985). *Fundamentos de la teoría de los signos*, Barcelona, Paidós.

MORGANTINI, M. ([1983] 1989). "Man confronted by the third technological generation", in MARGOLIN, V. (edit.), *Design Discourse: History, Theory, Criticism*, Chicago, ILL, The University of Chicago Press, 43-37.

NORMAN, D. and RUMELHART, D. (1975). "Reference and comprehension", in NORMAN, D. and RUMELHART, D. (eds), *Explorations in Cognition*, San Francisco, W. H. Freeman, 65-87;
(1988). *The Psychology of Everyday Objects*, New York, Basic Books.

OGDEN, C. and RICHARDS, I. (1923). *The Meaning of Meaning*, London, Kegan, Trench, Trubner and Co.

ORTEGA Y GASSET, J. (1997). *Ideas y creencias*, Madrid, Alianza.

PIAGET, J. (1947). *The Psychology of Intelligence*, London, Routledge & Kegan.

ICOEUR, P (1976). *Interpretation Theory*, Forth Worth, TX, The Texas Christian University Press.

EBEOK, T. (1994). *Signs: An introduction to Semiotics*, Toronto, University of Toronto Press.

PARKE, P. (1987). *Electrical Appliances*, London, Unwin Hyman.

HRANE, T. (1980). *Referential-Semantic Analysis*, Cambridge, UK, Cambridge University Press.

HOMPSON, M. (1979). *Rubbish Theory: The Creation and Destruction of Value*, Oxford, UK, Oxford University Press.

OFFLER, A. (1983). *Previews and Premises*, Toronto, Bantam Books.

YLER, A. (1992). "Shaping belief: The role of audience in visual communication", *Design Issues*, IX, 1, Fall, 21-29.

ERÓN, E. (1997). *Semiosis de lo ideológico y del poder, Courses and Lectures*, Buenos Aires, Universidad de Buenos Aires, 11-37.

IRILIO, P. (1991). *The Aesthetics of Disappearance*, New York, Semiotext.