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### Form and Movement in Domestic Networked Systems

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You may cite this version as: Kerridge, Tobie, Boucher, Andy, Law, Andy and Gaver, William, 2007. 'Form and Movement in Domestic Networked Systems'. In: UNSPECIFIED., School of Design at Northumbria University, United Kingdom, December 12th and 13th 2007. [Conference or Workshop Item]: Goldsmiths Research Online.

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Loe Feijs, Steven Kyffin, Bob Young

# Design and semantics of form and movement

DeSForM 2007



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# Design and semantics of form and movement

DeSForM 2007



## Foreword

# DeSForM 2007 : Reading the Object

Welcome to DeSForM 2007, the third DeSForM conference. Previously we have hosted DeSForM in buildings with a rich cultural heritage; in 2005 we met in the Baltic Centre for Contemporary Art in Gateshead, Newcastle Upon Tyne in the UK, a building symbolising the driving cultural change from a birthplace of traditional heavy industry in the North East of England to a modern knowledge based economy that is both aware of its industrial heritage but comfortable with the challenges of our omnipresent global society. In 2006 we met in the iconic Evoluon Building in Eindhoven, which symbolises the optimism for science and technology at the time of its development in the 1960s in The Netherlands. Now, in December 2007, we meet in another iconic building, the newly opened School of Design at Northumbria University's City Campus East, which connects the east of the city of Newcastle, including the riverside area of Gateshead Quays, the Baltic and the Sage Music Centre, with its universities and learning heartland.

This being the third DeSForM Conference, marked by a return to Newcastle, it gives us the opportunity to do a brief retrospection of the journeys our research and debates have already covered. We have concerned ourselves with the design of products, systems and services and their focus on; the meanings of products, how designers communicate and mediate information functions and ideas, and their perceptions by people in their everyday lives.

Previously we have considered the changing relationship of design from a process fixated with generating physical cultural icons that give meaning to our lives, to concerns for representing and defining interactions within an ambient world that is becoming dematerialised and evanescent, brought about by ubiquitous digital technology. Of course there is growing competition between micro, photonic and nano technologies in terms of the principal solutions driving our realisation of tomorrow and our keynotes and researches have explored, experimented and analysed these opportunities. The pervading approach has been one of optimistic curiosity and deriving new knowledge through practice. This has led to many different observations about the methods, processes and techniques required by designers working to create new empathic interfaces and behaviours in and between people, products and operating systems.



A strong theme that has emerged in our previous two conferences in the importance of narrative to the process of generating, developing and communicating new modalities of interaction between people, things and environments. Our researches have identified aspects of importance in the design and have begun to establish orders of, priority of approach and representation for these aspects as components of interaction. We have begun to grapple with the growth in the complexity of the interaction design process for truly 'animated' functionality in products, especially where this manifests itself as apparent behavioural characteristics resident in or portrayed by products. The findings and experience of researchers is that this increase in complexity is likely to be exponential compared to the rigours relating to the resolution of static physical product configuration or even system operated product with screen based interfaces. The emerging sense is that narrative in the process is essential to bring meaning and to 'touch' our humanity or connect with human experience. 'The science of the artificial in conversation with the poetics of human experience'!

Through this conference we will once again engage in presentations, debate and demonstrations on these issues. In this respect we, the conference co-chairs, have sought to bring together researchers from academia, industry and professional design practice and related disciplines connected with interactive product service and system development to share our latest thinking in the field, to assess its outcomes and to identify further research questions, opportunities and territories for future investigation and exploration.

We trust you will be invigorated and provoked by this event and will return to Offenbach am Main in 2008 to participate in DeSForM4 there. Meanwhile, we offer the DeSForM3 proceedings, initiated by the School of Design at the University of Northumbria at Newcastle upon Tyne, Philips Design, and The Department of Industrial Design at the Technical University Eindhoven, under auspices of; IFIP, Design Research Society, 'Interactions' in the HCI Group of the British Computer Society, with sponsorship and support from Philips Design, TU/e and Northumbria University, for your information and enjoyment.

26 October, 2006

**Prof. Steven Kyffin, Philips Design Eindhoven**

**Prof. Loe Feijs, Technische Universiteit Eindhoven**

**Prof. Bob Young, Northumbria University, Newcastle**



## Keynote speakers



### **Prof. Bernhard E. Bürdek**

Prof. Burdek, born in 1947 was one of the last students at the Ulm Design School. Since 1971 he has been working as a designer, teacher, author and consultant. At present, Burdek is a Professor at the Hochschule für Gestaltung Offenbach am Main, where he teaches a variety of Design programmes and was the Dean from 2001 - 2007.

He has also been guest lecturing across the globe including; Brasil, Mexico, Europe, Asia and USA. From 1995-2005 he was a member of the International Advisory Board to the Faculty of Industrial Design Engineering at Delft University of Technology / Netherlands. Burdek is also the author of many famous publications, for example "Design. History, Theory and Practice of Product Design" Köln 1991. This publication has been reworked in many different languages including Spanish, Dutch, Chinese and Italian. He has also contributed to many magazines in the design industry, these include; Zeitschrift für Gestaltung/The European Design Magazine /Frankfurt), designreport (Stuttgart), Experimenta – Revista par la cultura del proyecto (Madrid), i-com - Magazine for interactive and cooperative Media (München). In 1996 he was a co-founder of "formdiskurs", the famous Zeitschrift für Design und Theorie/Journal for Design and Theory.

In 1990 he was a co-founder of the Design Office Vision & Gestalt at Obertshausen/ Frankfurt a.M., which works in the field of Design + Communication. Clients include AGFA, Vodafone Group and Bosch-Telenorma and many more.

About the roots of DesForm:

# Product Language and Product Semantics

## **Abstract**

Going back to the Bauhaus and the Ulm Design School I will show the same roots of these two movements: Technology, Semiotics & Design. Due to the global challenges, Design Research has to focus new forms of technologies but also results from anthropology and ethnology.



## Keynote speakers



**Geoff Hollington**  
**Hollington, UK**

Geoff is a product designer, innovator and commentator on design. He studied Industrial Design at the Central School (now University of the Arts) in London, followed by a postgraduate degree in environmental design at the Royal College of Art.

Geoff has worked as a consultant with many big international brands and has always been an innovator, combining technical and aesthetic invention in products that often advance the state of the art. His Relay office furniture group for US giant Herman Miller was the first product to anticipate the modern organisation's need for instant flexibility and mobility in the workplace: it won a Business Week IDEA gold award. Geoff also designed Sonnet – the classic, best-selling Parker pen. In 2000 his office directed the digital interaction design and programming for a major new digital gallery at the London Science Museum. His other big-brand clients include Kodak, NCR, Sony Ericsson, Gillette, NEC and Panasonic. In 2003 Geoff formed a high-tech start-up company to develop and market an advanced, digital consumer product. This took him to China where he spent much of 2005.

# Forget Design

## Abstract

I think the verb *to design* is troublesome. It attributes an almost god-like authority to its subject – he or she who *designs*. Ask a child if she designed the Mothers' Day card she made at school and the reply will be No, I *made* it. But designers don't make things; they make the instructions for making things. So design is making instructions, not things; it's abstracted one step (at least) away from its real, concrete purpose – which is to *bring new things into the world*. Design that doesn't do this, doesn't make *things* appear, is a kind of absurdity. (Yes I know that the things in the virtual worlds of computer games, animated films and *Second Life* still have to be designed, but they arguably achieve a kind of being, acquire *thing* status, in the place where they exist, where they have a functional purpose, if only to be seen.)

We worry about design, worry that the things we create are brutish and crude compared to the stuff that Nature makes. Nature is our impossible rival; it shames us, and it doesn't even design this stuff; it has other strategies that

seem far superior to ours. Our strategies are born of our scale and size, our hands and eyes, and the limited ways we can make things. Manufacturing has come a long way since our hominid ancestors made the first stone tools 2.5M years ago, but we still smash, melt, bend, chop, grind and otherwise abuse material into the shapes we want (we're getting cleverer at the margins, but that's for another discussion) and our engineering and design paradigms have grown up to reflect this. We use hard, cold, dry materials and shape them in Cartesian, Euclidian geometries and expect from them simple, Newtonian behaviours – as a rule. Nature has no truck with any of this nonsense, of course. When we try to mimic biology in the things we make, whether in form or behaviour, the results generally just highlight the limitations of our technologies and design methods.

The ideas and structures of design thought are predicated on the way humans manufacture things, with cold, hard, dry mechanics and (for the most part and until very recently) simple geometries.

Geoff is author of many technical patents and his work has won international awards and is held in museum collections. He has written about design in newspapers and magazines and is a regular columnist on the topic of automotive design. He has also given many talks to audiences around the world, particularly in the United States, and appeared on TV and radio in several countries.

In education Geoff has taught at Kingston University, University of the Arts London and the Royal College of Art, and has moderated PhDs and been external examiner for postgraduate degrees, particularly at the Royal College.

In January 2007 Geoff became a consultant to a UK government-funded materials innovation initiative and is organising conferences on and speaking about the global impact of Rapid Manufacture. He is also involved in several projects and initiatives in the fields of advanced manufacturing, biomimetics and evolutionary design. In 2007 Geoff joined forces with Linda Barron and John Gould to form a new kind of consultancy, focussed on design and innovation driven by advanced materials and processes.

Design is not neutral, nor is it a universal tool; it has structural limitations – could this be true? I believe so and, though we could try to find ways to make design less problematic, we could simply forget it. And that – forget design -- is my proposition.

We could simply say that the designer's job is to bring new things into the world, or at least help in some way to make that happen. If my job is to help make some new world-thing possible, some object or system, I know that it will inhabit the same riotous physical, sensory world as me and that it could be blindingly visible, or modestly invisible, it could be silent, cold, radiant, furry, tiny, buried, wet, inquisitive, bold, flat, sharp, very long, folded, floating, hurtful, flavoured, gentle, demanding, suspicious, sweet, breezy, momentary... I could go on, but the point is that it can be many things, about which design as we know it has little to say.

## Keynote speakers



**Peter Higgins**

**Land Design Studio, UK**

Peter trained at the Architectural Association and has worked for the BBC, in the West End Theatre, and for design consultancy Imagination. In 1992 he helped form Land Design Studio who have built a reputation in conceptual masterplanning, design and the innovative use of communication media for museums, visitor attractions and commercial environments. This holistic approach involves collaborations and cross-overs of diverse disciplines reflected in the range of present clients that include; Anschutz Entertainment Group, Eurostar; Christies, National Parks Singapore, V&A, Natural History Museum, and The Chinese Academy of Art. He is a Visiting Professor at the University of the Arts London.

# Reflection to Reflex Action

The design of interactive systems in digitally enhanced products and environments

## Abstract

It is commonly accepted that visitors to museums and science centres merely see them as a part of the fast expanding leisure market. The competition is fierce and the boundaries between entertainment and education are becoming increasingly blurred

Over many years of diverse experience and critical case studies in this field we have determined that the creation of architecture the development of narrative content and the appropriate use of communication media are all holistically linked. Unlike the luxurious nature of theatre or film these idiosyncratic museum or even branded experiences involve a non-linear rather un-controllable series of events, where participants are often usually free to build their own bespoke visitation pattern.

The point of entry to the presentation will investigate fundamentals of place making, challenge the familiar practitioners, the lack of intelligent curation, and suggest diverse protagonists that may be able to construct more meaningful and responsive narratives.

Emerging principles that evolve from the consideration of the urban condition enable us to focus on the above mentioned building types, demonstrating that architectural space may be mediated in response to an entirely new set of principles. External form, movement systems, sequence of events, natural light, engineering and many other

features may be best determined when they respond to narrative threads and carefully constructed media experiences. Borrowing a phrase from the world of Dutch football, we may argue that the built form simply becomes part of the 'Total Media' process.

Response to this forum and the contemporary mantra for interactivity defines a distinctive activity that we now expect to find in such informal learning environments. The valued concept of 'memory learning' involves the understanding of objects or phenomena through direct control of input/output feedback, where cognitive exploration, initiative and experiment are rewarded through emotional engagement. Our source material provides fascinating opportunities; we may investigate data archives, information timelines, the navigation of mapped space, unlock real protected objects and voyeuristically enter the world of living personalities. It is the recently developed technologies that have enabled us to process this data/material in a rapid responsive and sensory way. Interfaces or reactive space may now be intuitive and unlike anything that our visitors have seen before, Single user or multi user interfaces create very interesting dynamics as does the concept of 'passive' interactivity where reluctant participants may encourage the involvement of other in order to progress the interactive mechanisms.

## Keynote speakers



### **Kevin McCullagh**

#### **CEO Plan Design, London, UK**

Kevin is a director of Plan, a product strategy consultancy based in London. While at Plan and in his previous position was Director of Foresight at the product design consultancy Seymour Powell, he has consulted to design, marketing and corporate strategy departments of brands including: Ford, HP, Nokia, Orange, Samsung, Shell, Strategos, Unilever and Yamaha. Kevin also writes, speaks and broadcasts on design, technology and society. His background spans design, marketing, engineering and academia. Before taking a first class degree in product design at Newcastle, he studied mechanical engineering, sponsored by Rolls Royce. He also spent time in academia researching and teaching the social, cultural, technological and business dimensions of design. Kevin also writes, speaks and broadcasts on design, technology and society.

Product experience strategy:

# equity, aesthetics and interactions

## **Abstract**

The concept of the experience economy is now a decade old, and experience design has been talked about for nearly as long. However, there is little of practical or theoretical substance behind the bluster. This is starting to change as brands demand a more rigorous approach.

As fragmenting media channels make conventional brand communications less effective, product experiences that drive positive word of mouth recommendations are the new focus. Brands must express themselves as eloquently through products, interfaces and packaging as they do through communications. In a crowded market full of me too products, the brands that prevail speak with a distinctive, clear and attractive voice across all experience touch points.

From an experience design perspective, designers have traditionally focused on brand touch-points, whether that is product, UI, graphics, interiors etc. Clients now demand a joined up approach to the consumer experience, which tends to cut cross these touch points.

Can experiences be designed? What are the dimensions of a product experience? How can strategists and designers best intervene?

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# An exploration into aesthetic Association of product form

## **Abstract**

Creating a relevant and pleasing design aesthetic is a fundamental aim designers endeavour to achieve. Perception of aesthetics takes place both during the design process when the designer creates a form, and later, through the users' interpretation of the form. Within the perception process, association plays a significant role. This paper addresses the stage research results of our exploration into the associative meanings of a product. By analysing the evaluation of a series of top award winning designs, it was found that some associative meanings (represented by descriptive words) are correlated, such as 'pure-architectural-geometrical', 'delicate-curvaceous-organic' etc. By conducting a series of workshops, both in the UK and China, we have been able to explore the extent to which young designers are able to manipulate form, style and create an overall perception of a positive aesthetic. One of the main outputs during the workshops was to design a MP3 player with speaker units, styled in line with three topics of aesthetic association: topic 1 – pure, architectural, geometrical and technical; topic 2 – curvaceous, organic, and fun; topic 3 – graceful, cheerful, and powerful. Three non-correlated associative descriptors were deliberately used in topic 3. Results suggest that young designers tend to differ in their ability and success of manipulating form to match different aesthetic targets. When the descriptive words in one aesthetic topic are correlated, student designers seem to find it easier to manipulate the form matching the topic. Comparative

analysis between the results from the workshops in the UK (Southampton Solent University) and in China (Tsinghua University) is also presented in the paper.

## **Key words**

Form, aesthetics, association, MP3 design, UK, China.

This project has been set up to explore the extent to which young designers are able to manipulate form, style and create an overall perception of a positive aesthetic. At the same time, we aim to explore, on a practical basis, the relationship between the formal aesthetic aspects and the associative meanings of a design expressed by verbal description. This will hopefully contribute to the development of product language system. This system will differ from the traditional 'semiotics' or 'semantics', and although it will include these aspects, it will probe deeper into the elements of formal aesthetics such as the shape, colour, material, texture, proportion, dimensions, space, etc. This language system will be a combination of both formal/ external presentation and the representative/embedded meanings of a physical product. It will enable more effective communication between the various people involved in the product development processes and in particular, the relationship between designers and consumers. We have conducted a series of practice-based design workshops for undergraduate design students both in the UK (Southampton Solent University) and China (Tsinghua

University). This paper will showcase the stage results from this workshop.

### **1. Aesthetic experience and association**

Ugly things are hard to sell. Aesthetic designs are often perceived as easier to use. What makes a product aesthetically appealing? This is an old topic but always triggers new debates in the design field. Aesthetics is usually defined as the branch of philosophy that deals with questions of beauty and artistic taste [1]. It has been recognised since antiquity and has continually evolved over time. The word beauty is commonly applied to things that are pleasing to the senses, imagination and/or understanding. It is often what an artist or a designer endeavours to achieve in their works, either for personal or mass interest and pleasure.

Aesthetics might have different connotations if envisaged from different perspectives, such as sensory aesthetics, functional aesthetics, technological aesthetics, formal aesthetics, psychological and cultural aesthetics etc [2]. Though, an aesthetic design may not have or not be perceived to have all these connotations at the same time. However, it is widely agreed by scholars that sensory perception plays an intrinsic role in aesthetic experience [3, 4, 5]. In other words, aesthetic experience starts from pleasing the senses in the first instance. It has even been argued that aesthetic experience is restricted to the pleasure/displeasure that results from sensory perception [5]. We can perhaps say that every experience starts from our senses, as our sensory organs serve as the windows through which human beings are able to know and feel the external world, but not all experiences can be attributed to aesthetic experience. This implies that sensation does not represent the whole aesthetic experience, although representing the dominant element contributing to aesthetics; Individual isolated stimuli, either a colour, a sound, or a smell, can elicit physiological response (e.g., comfort or excitement) such as represented by the change of pulse, blood pressure. However, this cannot equal aesthetic response unless it evokes our emotions.

You might say that you find a particular curve, line or a colour to be beautiful, even when separated from any context. However, there will be something underlying your instinctive response to these stimuli that will share an association with an image or meaning you will have stored in your memory, no matter how vague the recollection.

For example, the colour of green might remind you of freshness, purity, hope, or the curvaceous lines resemble organic lives or the form of a beautiful etc. This can be termed as 'association'.

Exploring the aesthetic association with designed products is one of the purposes of this research, as association plays a significant role in the process of aesthetic experience, and is connected with the formal aspect of an artwork or designed product. Fundamental forms are given meaning through association with previous knowledge of the world stored in long-term memory [6]. With certain associations, meanings and emotions added to the primary sensory experience, the overall aesthetic experience could be enriched to a greater extent.

### **2. Product language**

In order to effectively express and communicate the perception of product aesthetics between people involved in the process of product design and development, we need to use and develop a vocabulary – product language system. Scholars in design and psychology have been trying to develop the theoretical framework of product language since 1970s. Gros Jochen [7, 8] and Richard Fischer [9] from the Academy of Art and Design Offenbach (Germany) proposed the fundamental concept & theory of product language, so-called Offenbach Theory. Gros subdivided the specific object of product language into formal aesthetic functions and the semantic functions. The latter is then divided into two constituents: indication function and symbolic function. Based on this, it is obvious that the concept of product language covers a wider range of information about a product than the concept of merely product semantic. A product can deliver and express the information per se about its own functions, forms, style, aesthetics, value, culture, personality, etc. However, most of the succeeded research in this area focuses more on the semantic aspect. The term 'semantics' derives from the linguistics, deals with the study of meanings [10]. Another similar term also deriving from linguistics is semiotics, which deals with the study of signs and symbols [11], not the signs as we normally think of signs, but signs in a much broader context that includes anything capable of standing for or representing a separate meaning [12]. The difference between these two terms lies in that semantics focuses on what words mean while semiotics is concerned with how signs mean. Nevertheless designers talk about



them without too much differentiation due to that they have a common concern, i.e., both product semiotics and product semantics deals with the signs and meanings of the product. However, product semiotics and semantics might not always speak of aesthetics [13, P151], although there is a connection. For example, they share some commonality when addressing the symbolic /representative meanings or associations of the product.

Based on Offenbach theory of product language, the framework of product language theory is under some development. For instance, Dagmar Steffen identified 11 principles of order and complexity with regard to the formal aesthetic functions of a product [14, 15]. However, compared to semantic or semiotic features, the formal aesthetics features of design still need further exploration, with relation to the semantics/semiotics. There is little evidence to suggest that detailed vocabularies according to particular contexts (product types, subject types, etc) that describe different constituents of product language have been fully explored, including the correlations between them. Although designers are proficient when using the formal elements such as colour, shape, materials, textures and so on, it remains ambiguous about how these elements, when applied in a particular design, be correlated with the signs and meanings, for example, the associations between a product form and aesthetic experience? How do these correlations differ when across different product categories and contexts? We are looking to formulate the details of product language system and develop a methodology for design practitioners. There is the potential for combining product semiotics and formal aesthetic features in order to establish a more complete and meaningful product language system [16].

Therefore, in this research, our second aim is to explore the ‘product language’ on a practical basis. Initial research was conducted to see if there is any common vocabulary used by people to describe a product’s aesthetics. Also of importance are the associations the product would carry, and the possible correlation between the formal elements and the associations. This could helpfully contribute to establish a sort of formal DNA for a product or group of products. DNA (Deoxyribonucleic acid) is a nucleic acid that contains the genetic instructions used in the development and functioning of all known living organisms [17]. The DNA segments that carry the genetic information are called genes. The study of DNA, as the

basis of the study of genetics, results in the cracking of the biochemical code of life. Here, we borrow the concept of DNA, as a metaphor, to imply something that can represent generative codes of an inanimate object – product form. These codes may hopefully serve as the constructive units and reference point for the design and development of any new member to the same family of products. A topology of different product types and/or different contexts will need to be established.

The next step would be to envisage how aesthetic experience and product language will be influenced by cultural background, and to further develop and compare the product vocabulary by conducting similar research under a series of differing contexts.

### 3. Preliminary study of aesthetic description

The method for a pilot study was to ask people to give their verbal description about the aesthetic for a range of products. At this stage, we are not going to distinguish which descriptors can be attributed to the aspect of formal aesthetics or the semiotic aspect of a product. We will try to look at this division and a possible correlation between these two aspects at a later stage. We used 10 top products that had already been selected by an international panel of judges, representing those products that were worthy of an international design award and having strong aesthetic appeal – Hannover, 2005 International Forum (IF) Design awards (see Figure 1). These products represented different product areas such as medical, domestic, technological, industrial etc and were selected as the products that would be used for product description. 113 completed questionnaires were collected from design students at Southampton Solent University. We presented students with a list of pre-selected vocabulary for their reference (see Table 1). However, participants were also encouraged to use their own descriptive words.

**Table 1 Vocabulary for product aesthetics description**

CLASSICAL	AGGRESSIVE	POWERFUL	EDGY	ARCHITECTURAL
CURVACEOUS	DYNAMIC	RHYTHMICAL	CONTROLLED	ROBUST
GRACEFUL	HUMOUROUS	WARM	RELAXED	PURE
SYMPATHETIC	SOFT	ORGANIC	DELICATE	SUBDUED
CHEERFUL	EMPOWERED	BIONIC	RETRO	CHARACTERISED
INTELLECTUAL	FUN	FLUID	HEAVY	LIGHT
HONEST	DEMURE	GRAND	SUBTLE	EXTROVERTED
TECHNICAL	PRECISE	INTEGRATED	HARMONIOUS	GEOMETRIC



**Figure 1** Top 10 designs presented to design students for aesthetic evaluation

From the results we found two phenomena. One, different products may share similar aesthetic properties. Secondly, these described aesthetic properties cover both formal aspect and symbolic aspect or associations, and the formal aesthetic descriptions are correlated to some extent with the associations.

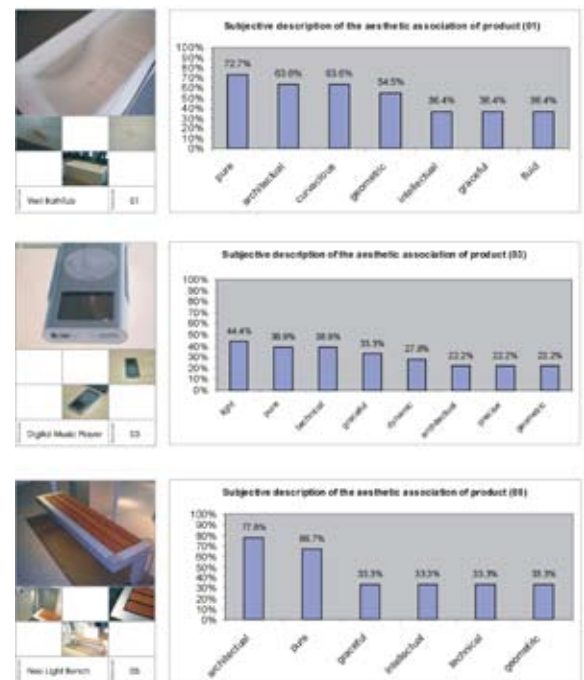
Usually, it seems difficult to find aesthetic properties to fit all design artefacts, and there is no sense in trying to apply the aesthetic features of one product to another [13, P.151]. Nevertheless, this does not mean that different products should not have some commonality in the expression of aesthetic properties. It is this very commonality or similarity in aesthetic features, even if this commonality can be quite limited, that can be applied as a reference when considering the design and aesthetic of a new product. The widely used mood-board is a good example of this.

Figure 2, as an example, shows that the aesthetic descriptors 'pure', 'architectural', and 'geometrical' are shared by three different products (a bathtub, a MP3, and a bench). For a direct and simple understanding, we may regard the descriptor 'geometrical' as the description of shape, which is an element of formal aesthetics; whilst 'architectural' seems to be the description of an association or metaphor, which has more sense of semiotic property. The descriptor 'pure' can be perceived as a visual simplicity (with the opposite as 'noisy' or 'complicated'). It is hard to say that the description of 'pure' is completely a formal aesthetic feature because when we say something is pure, that includes your emotional feeling of appreciation. In other words, verbal description cannot always make a clear division between the formal aesthetics and semiotic meaning. A further statistical analysis revealed that these three descriptors are correlated to a certain extent (with the correlation efficient  $r \geq 0.5$ ) under this research context.

Another example of such a correlation has been shown between the descriptors of 'harmonious', 'delicate', 'organic', and 'curvaceous'. Again, here 'curvaceous' may

completely address the formal aspect – shape; whilst 'organic' integrates an association between the product form and the life forms found in nature, whether the human body, types of animals, or a drop of water, usually can be 'delicate' and 'curvaceous'. Accordingly, it is easy to understand that these natural forms are correlated with 'harmonious' as they reflect the results of natural evolution.

It is worth conducting further research to explore these aesthetic descriptors and their correlations at a deeper level; and to see, how these descriptors and correlations may alter when the product context changes. As we have seen, although some products used in this research share some commonality of aesthetic properties, this cannot be taken as a universal principle. It is argued that specific product language and their correlation might be different from, say electronic products, furniture, and transport tools etc.



**Figure 2** the aesthetic description of three different products

#### 4. Student Design Workshop and Evaluation

The third aim of this research is to explore to what extent young designers are able to manipulate form and aesthetics. This has been conducted by running a practice-based design workshop, where students completed a series of

exercises plus a six-week design project (MP3 & Speaker Unit). The MP3 project and some of the exercises are attributed to a *top-down* process, where targeted aesthetic perception comes first and is then translated into the 3D forms designed by students. Other exercises are attributed to a *bottom-up* process, where the students are shown images of products (4 product categories and 50 images of different styled products for each category), and asked to interpret the aesthetic features into and make a judgement as to the product perception. The Workshop has been conducted at Southampton Solent University (UK) and Tsinghua University (China) respectively. Further analysis of the results will help reveal the extent to which cultural influence may impact on the design aesthetic and the level to which product language can be used cross culturally.



Figure 3 MP3 & Speaker Units designed by students in the UK

In this paper, we present the completed MP3 & Speaker design project and the evaluation of their aesthetic and associative features. The design brief for MP3 was based on three groups of descriptive words regarding a product aesthetic. We used the correlated descriptors found in the pilot study to constitute the groups. However, we further modified the combination of the descriptive words as follows.

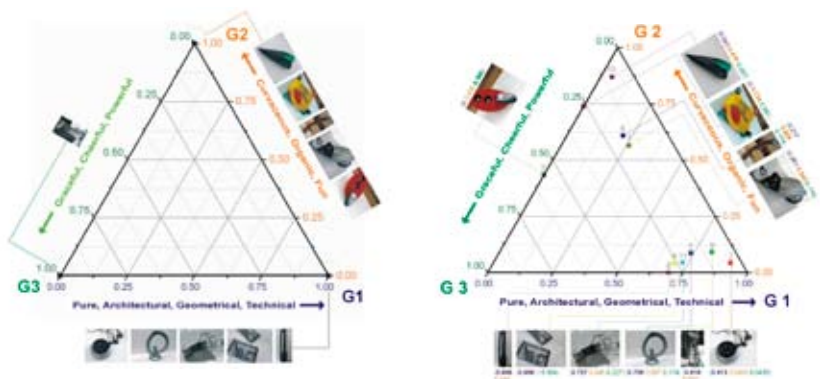
- Group 1: Pure, Architectural, Geometrical, and Technical
- Group 2: Curvaceous, Organic, and Fun
- Group 3: Graceful, Cheerful, and Powerful



Figure 4 MP3 & Speaker Units designed by students in China

Within group 1, we give an extra descriptor of 'technical'. Within group 2, 'curvaceous' and 'organic' remain, but added with an extra descriptor 'fun'. Within group 3, the three descriptors, from the pilot study, do not show any correlation between each other. Students are then asked to produce designs for the MP3 & Speaker Unit in line with any of the three groups of aesthetic properties. These deliberate arrangements of design brief aim to give more challenges for young designers to manipulate and balance the formal elements (mainly form, colour and surface finish), to match a particular aesthetic target group.

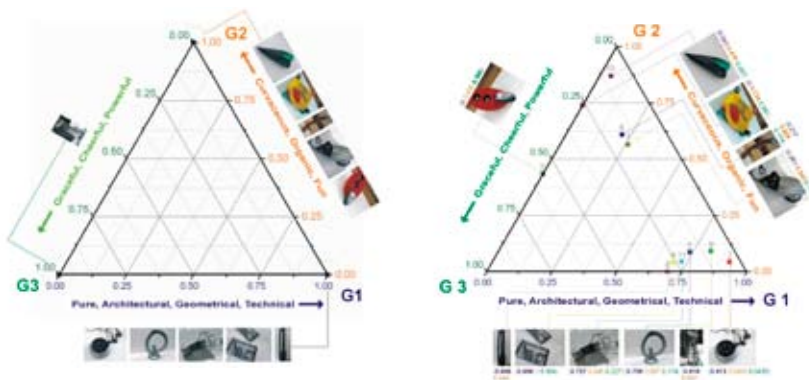
Figure 3 and Figure 4 respectively show the models of MP3 & Speaker Units designed by the product design students (Level 2) at Southampton Solent University and by the Industrial Design students (Level 2) at Tsinghua University (China).



a. MP3 design (UK)

b. Evaluation of MP3 design (UK)

Figure 5 the comparison between the evaluation and the original targets (UK)



a. MP3 design (China)

b. Evaluation of MP3 design (China)

**Figure 6** the comparison between the evaluation and the original targets (China)

Within the workshop in the UK, students were given free choice as to which aesthetic group they were to produce designs for, although we found that most students did select for Group 1 or Group 2. In the repeated workshop in China, we therefore kept the balance in the selection for groups.

The evaluated results shown in Figure 5 and 6 compare the original aesthetic target, as intended by the design students, with those that were perceived by an independent group of students who conducted the evaluation of the finished designs.

From the results of UK designs and evaluation shown in Figure 5 (a) and (b), it is clear that most of the designs of MP3 & Speaker are perceived to have a combination of the three groups of aesthetic features to some extent. However, the designs for Group 1 have most effectively matched the aesthetic target: pure, architectural, geometrical and technical (average matching rate 75.4%, see the marking points 2, 4, 5, 8 and 11 in Figure 5 Triangle (b) for Group 1 bunched around the bottom-right corner). Within the designs for Group 2, except for one design (marking point 3) being perceived to have more of the aesthetic features of Group 3, all the other designs have matched the target fairly well: curvaceous, organic, and fun (average matching rate 69.6%, see the marking points 1, 6, 7 and 10 in Figure 5 Triangle (b) for Group 2 positioned slightly away from the top corner). As to the designs for Group 3, only one design was selected from the very few designs in this group. Furthermore, this design was perceived to be within Group 1 rather than Group 3 (marking point 9).

From the results of Chinese designs and evaluation shown in Figure 6 (a) and (b), we can see that similar phenomena as those for UK designs occurs. Most of the designs of MP3 & Speaker are also perceived to have a combination of the three groups of aesthetic features to some extent. However, the designs for Group 1 and Group 2 have, again, more effectively matched the aesthetic target than Group 3. The four designs for Group 1 (pure, architectural, geometrical and technical) exactly remain in the same Group when evaluated, with an average matching rate

62.8%. The designs for Group 2 (curvaceous, organic, and fun), except for one design (marking point 8) standing at the centre of the Triangle, have also matched the target very well, with an averaged matching 79.8.3%, see the marking points 2, 5, and 6 in Figure 6 Triangle (b) positioned slightly away from the top corner. Particularly, the design (at marking point 2) in Group 2 has shown an extremely high matching rate (96.7%) to the target. Even including the deviated design (marking point 8), the total matching rate for Group 2 is still quite high: 69%. Whilst for designs in Group 3 (graceful, cheerful and powerful), the average matching rate is only 41.7%. Furthermore, one design in Group 3 (marking point 1) was perceived to be within Group 2.

The above results seem to imply that certain ambiguity can occur when we try to perceive the aesthetic features of a product, where the word associations have less correlation, e.g., in this case, graceful, cheerful, and powerful. On the other hand, the aesthetic features that have higher correlation appear easier to match. We may borrow a hypothesis of processing fluency of aesthetics to explain this. Rolf Reber and Norbert Schwarz proposed that aesthetic pleasure is a function of the perceiver's processing dynamics. The more fluently perceivers can process an object, the more positive their aesthetic responses [18]. In this research case, during either the top-down process of design following aesthetic targets or the bottom-up process of evaluation and perception of completed designs, the more fluently perceivers can process aesthetic features, the more effectively these features can be applied in designs and can be perceived. Group 1 and Group 2 have the aesthetic descriptors correlated, whilst Group 3 have non-correlated descriptors. This may address the reason why the designs for the aesthetic targets specified in Group 1 and Group 2 seem more easily to manipulate by our student designers and more easily to identify when evaluate these designs. On the other hand, difficulty exists in dealing with Group 3, either in the process of design or the process of perception as there was possibility greater ambiguity in this category. What is also interesting is that these results seem consistent regardless of differing cultural background between UK and China, which provides a good support to further explore the commonality and difference in terms of cross-cultural perception in design aesthetics.

## 5. Conclusions

Aesthetic experience of a designed product starts from the sensory perception between the product and users. Product language covers the description of formal aesthetics and the description of associations the product carries and the symbolic or representative meanings embedded in the product. These two aspects of description in product language system can be correlated to a certain extent. However, the boundaries between these two aspects can sometimes become blurred when using verbal description. Preliminary exploration suggests some correlation between the descriptors such as 'pure-architectural-geometrical' and 'harmonious-delicate-organic-curvaceous'. Young designers tend to differ in their abilities when manipulating the form of product to match different aesthetic targets. However, when the aesthetic features in one product are consistently correlated, these greater abilities seem to be evident and are facilitated more easily. Our workshops held in the UK and China show consistent results of the above, which may imply some commonality in certain aspects of aesthetics perception regardless of cultural background.

## Acknowledgement

This project was supported by the Centre for Advanced Scholarship in Art & Design – Capability Fund, Southampton Solent University. Thanks are given to Professor Cai Jun, Professor Yan Yang, Academy of Art and Design, Tsinghua University for the arrangements of collaborative design workshop.

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# Form and Movement in Domestic Networked Systems

## Abstract

It is increasingly desirable for electronic artefacts in the home to be grouped as sets, sharing data and properties across a network. A range of strategies can be used by a designer to explore the value and use of the systems for users, in particular through the properties of form and dynamic behaviours, including visual output and movement. This paper focuses on a range recent work which exploits rich behaviour and novel forms to highlight opportunities for user engagement in the home.

## Keywords

Movement, ubiquitous computing, distributed form, appropriation.

## 1. Introduction

*“They [microprocessors] will be found in the alarm clocks, the microwave oven, the TV remote controls, the stereo and TV system, the kid’s toys, etc. These do not yet qualify as UC for two reasons: they are mostly used one at a time, and they are still masquerading as old-style devices like toasters and clocks. But network them together and they are an enabling technology for UC. Tie them to the Internet, and now you have connected together millions of information sources with hundreds of information delivery systems in your house.”*[1]

Weiser and Brown’s vision of a proliferation of embedded processors in discrete objects throughout the home raises a number of questions for interaction design, including the

design of the form and behaviour and system. In our work, we have been exploring the possibilities for networked devices in the home with a variety of projects. In this paper, we use several examples in order to discuss some of the fundamental questions raised by the notion of ‘ubiquitous computing’.

Weiser and Brown (1996) use Natalie Jeremijenko’s dangling string as an exemplar of new ubiquitous computing systems. In this piece, the rate of flow of data across an ethernet network is mapped to the level of agitation exhibited by a length of string linked to a motor. In ways such as this, networks can provide opportunities for sharing information across physical objects within the domestic landscape so that the behavioural characteristics of these objects becomes pooled, and can be selectively used, or linked to one another. There is a potential for orchestrating or synchronising behaviours across space, mediated by electronic interconnections. The question is: How can we design such systems so the people encountering them can apprehend these links? What is a form design for systems of distributed devices?

In Jeremijenko’s piece the physical world becomes a richer version of a task-based GUI, where “The string, in part because it is actually in the physical world, has a better impedance match with our brain’s peripheral nerve centers”[2]. From this perspective, peripherally sensed behaviours are a feature of a spatial GUI, where





**Fig. 1** The Key Table and Picture Frame.

the effectiveness of performing tasks is enhanced by distributing the interface through space. We believe it is also useful to consider how computational features can be used to augment our experience of what we do in our homes. Our aim is not to harness the things around us to perform computation tasks, but to use computational aspects to enhance what people are already doing in their homes. What are appropriate roles for distributed systems in everyday life?

Traditionally, technologies are designed to convey information and possibilities for interaction clearly and unambiguously to people. This assumed relationship underlies much thinking about form semantics, ease of use, and interaction design more generally. Even non-traditional interfaces, such as Jeremijenko's dangling string, are assumed to have an appropriate interpretation (in terms of network traffic, say). But if technologies are viewed as extensions of normal user-defined activities in the home, rather than as a form of extended GUI, this assumption may need to be questioned. How can we design for users to appropriate the operation and even meaning of distributed devices?

In this paper, we describe four systems we have developed over the past few years that have a bearing on these questions. None were built to address these questions directly, so the answers they offer are often implicit in their larger story. Nonetheless, we believe that through the development of these systems, we have established some tentative approaches to these issues.

## 2. The Key Table and Picture Frame

The Key Table is a small table for an entrance hall, and the picture frame could hang on a living room wall. Individually, the table and frame are recognisable pieces of household furniture that perform familiar functions. The design augments these expected functions by providing the table with a load-sensing capability, and giving the picture frame mechanical movement. In addition, the objects are wirelessly linked, so when objects are placed onto

the surface of the table, the picture frame swings out of alignment. The more forcefully objects are placed on the table, the more pronounced the swing of the frame.

The Key Table and Picture Frame were developed as part of the Equator IRC. Partners at Lancaster University had been exploring weight-sensing technologies, and this inspired a range of furniture which made use of surfaces that sense objects, via shifts in their weight. We considered the ways that furniture could be made responsive to people, and could emphasise existing behaviour to promote reflection or disruption. During the design process, the pieces of furniture acquired its own behaviour, becoming semi-autonomous agents which act as thresholds into virtual or real spaces.

### 2.1. Form and movement

A strategy of unfamiliarity was used to make the table and frame stand out and appear somewhat alien in the home; also bright colours, diagrammatic forms and basic build quality made the objects feel more prototypes.

This aesthetic was chosen to make them appear part of an experiment, as if they had been produced in a science lab for the purpose of a trial. We could have customised ready-made pieces, or used furniture that was already a part of the participant's home, but we decided that this approach could desensitise a user from the purpose of the investigation.

Rather than operating as one half of a pairing, the moving picture frame was originally conceived as an independent interaction. This piece was devised for the whimsical notion of relieving people of the burden of straightening their picture frames. Titled 'Self-Levelling Picture Frame', the device used sensors and motors to constantly correct and balance itself. Developing the behaviour of the frame so that it tipped sideways played with some symbolic associations. Modifying the Picture Frame to move mechanically off balance suggests many cultural idiosyncrasies: a skewed picture indicates neglect, subsidence, burglary or simply something wrong.

Prolonging the skew for a period after the event highlights the disruption, perhaps annoying (or even entertaining) the home's occupants.

The frame therefore acts as an alert system, displaying a state of calm or varying degrees of drama. This dramatisation is extended by linking the table to the frame, demonstrating the flow of behaviour throughout the home. Much like the theatre of a slammed door, the paired system broadcasts events, perhaps to warn other inhabitants to tread carefully, or even to indicate a grand entrance. These linked objects can be seen as networks for reflection and emotional signalling between members of the home.

The Key Table and Picture Frame are not designed to be configured by the user. The two devices have a fixed interaction, calibrated and designed before the prototypes are installed. Its subtlety lies in the ability to reflect variations in the behaviour of the people who share the home. The next project that we discuss offers a variation of this model by drawing upon a suite of input measurements, offering a range of output devices with mechanical behaviours, and providing a degree of configuration between the elements for the user.

### **3. Weather Watchers**

Weather Watchers was a one-year research project based in the Interaction Design Research Studio at the Royal College of Art [3]. A field study of home meteorology was initiated to drive the development of a prototype system, in an effort to find an existing domestic context in which to explore the familial aspects of the ubiquitous computing era.

Home meteorologists are fascinated by the development and deployment of new objects and interfaces. They are curious about the underlying sciences, and possess a high level of technical knowledge. Home weather observation stations are built to record individual meteorological elements including barometric pressure, rainfall, humidity, etc. A range of sensors are used to capture the data, and can be bought individually and combined in weather stations. It is common practice to use electronic logging equipment to read these measurements periodically, and to pass the data to a computer for storage.

Weather observation is an example of an existing household practice that captures many of the features

of domestic ubiquitous computing. It involves a number of distributed devices that are both linked together and linked to wider networks of information. These devices are scattered within and nearby the home, and people must make senses of their interconnections and the way information flows among them. The devices are utilitarian from one perspective, but one can also argue that they support a form of intellectual aesthetic perception of the patterns of weather, and so will fit or disrupt the aesthetics of the home more generally. In order to explore these issues further, we investigated a particular weather watcher and developed new devices for his context of use .

#### **3.1. Existing Behaviour**

We met Bernard Butler through the Climatological Observers Link. An active contributor to the journal, Bernard had retired from the Meteorological Office, but maintained a strong interest in meteorology. He kept a range of recording instruments in and around his home in Wokingham, and also took regular readings from a local weather observation station.

A spare bedroom served as the main repository of measurement devices and collected weather data. Along with traditional analogue instruments, the room contained three computers, each with a particular role. The first linked to, and controlled, a satellite receiver mounted on the roof of the house, capturing data transmitted from weather satellites. The second computer allowed Bernard to process this data, which contained high resolution images of the Earth's surface, recorded by the satellite as it passed overhead. These images were archived, and also uploaded to Bernard's website. The third computer acted as a display for temperature and humidity readings, which were provided by a home-made sensor in the front garden. Once a minute, this data was transferred to the computer, which then plotted a graph of changing conditions throughout the day.

Also of interest was the distribution of related objects throughout the rest of the home. Barometers were mounted to the wall by the front door and near a bookcase in the living room. There were antennae mounted to the roof, an anemometer within reach of a window in the loft, to measure wind speed and direction, and homemade sensors built with PVC tubing and tinfoil in the gardens. Huge amounts of data were generated and filed, and these files spilled out of the study to fill





**Fig. 2** Photographs taken in and around Bernard's home.

bookshelves on the upstairs hallway. Thus the surfaces of the home became supplemented by tool type objects; utility existed alongside ornament and decoration. Whereas the framed photos and pictures were static, the flickering screens were updated to show new readings. These devices sat strangely among the expected furnishings.

Bernard's home – at once unusual and mundane – served as a focus for our design in this project.

### 3.2.A System of Movement

The distribution of weather measurement devices throughout Bernard's home, and his fascination with meteorology inspired a prototype system of movement for the home. This was a distributed set of linked electro-mechanical objects, whose physical behaviours were driven by weather change.

One device might represent barometric pressure, another to levels of solar radiation. These objects exhibit richer movements and different scales of actuation than traditional weather watching tools – vibrations, compression, spinning, jolts. The scale and speed of the movements are calibrated by algorithmic transformations of raw weather measurement data. The processed data is transmitted as control messages to influence the motors and LEDs. Despite the physical separation of

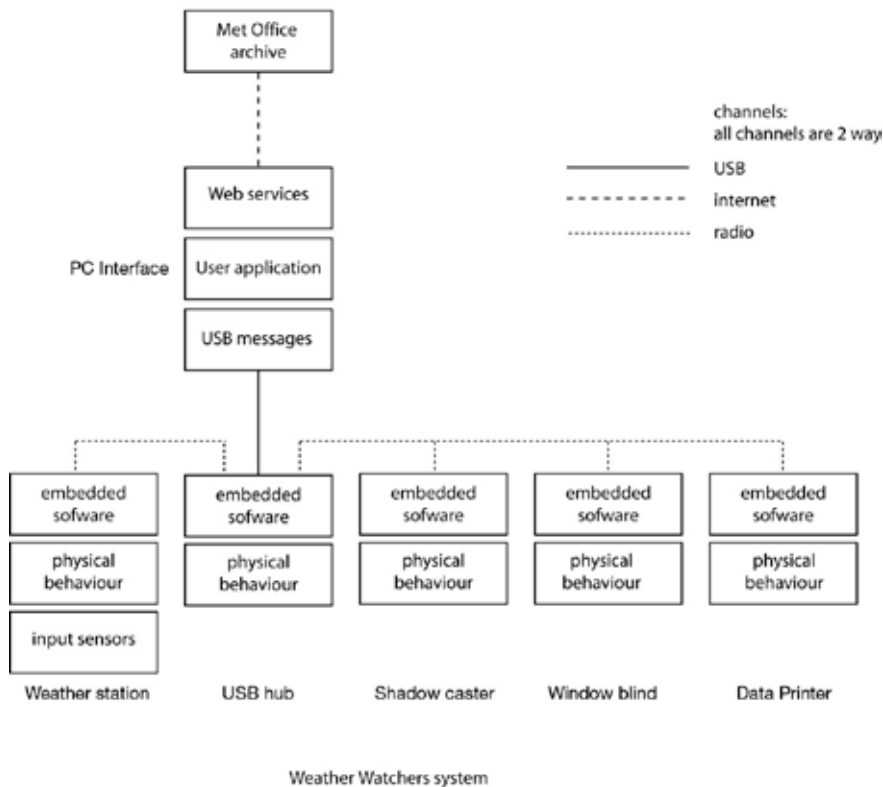
each prototype, the message sending is co-ordinated, so that each device moves simultaneously. Thus there is a sense of rhythm throughout the home. There need be no intervention from the weather observer, as Tabor suggested; these electronic objects seem to have a life of their own [4].

The prototypes have a utilitarian aesthetic – it is evident that they are capable of movement, and the range and limit of the movement is clear. They look like tools for measurement. In addition they are designed to attach to and make use of familiar features in the home, by sitting on a shelf, attaching to a window, clamping to a light fitting and plugging into the computer. Like Bernard's incongruous instrumentation, they exist amongst familiar things and are parasitically integrated into the domestic landscape.

Initial designs for a suite of objects are shown below, followed by a short description of their function.

#### • Weather station

The weather station is designed to be set up outside. Every 15 seconds a set of meteorological sensors sample the wind speed and direction, barometric pressure, temperature and humidity. Changes in these conditions create ambient movement in the output devices.



**Fig. 3** A model of the system with hardware and software components.

In addition, historic weather data can be retrieved from the Met Office archive. A location and a date can be selected, and the objects become playback devices for that particular data-set. This might be extreme weather, or data from a day with personal significance.

These two modes provide different types of engagement. The former is the default state. The behaviour is always on, like a clock. It provides a rhythm, which reflects the world outside. The later provides a more direct interaction

• **Shadow caster**

This device is designed to clamp to the flex of a ceiling light. It has a blade that sits above the light bulb and moves in a circular motion. The blade casts a shadow onto the ceiling. It was imagined that the movement of the blade would be linked to changes in wind direction.

The novel, mechanical behaviour of the Shadow caster extends the function of the light by providing an awareness of what's happening outside.

• **Window blind**

The object attaches to the inside of a window using suction cups. It uses a vertical movement to open and close a paper sail, which folds like a fan when it is compressed. By taking input from barometric pressure, this object acts as a shield between the home and outside when the weather becomes stormy.

Weather watchers draws on home meteorology to provide an example of how the behaviour of a distributed system can respond to the interests of the user. These interests become represented autonomously and spatially by being embedded in the home through the appropriation of existing surfaces and appliances. For our research, this is perhaps the beginnings of a exploration of how a language of movement and resource sharing across objects might supplement the primary, functional properties of a discrete object, so that the broader beliefs and imaginative worlds which attend, but are unacknowledged by the primary interaction, can be addressed.

In the research project which follows, we tried to move on from the illustrative quality of Weather Watchers – where the system was a characterisation of a specific interest – by designing a system that was not functionally or aesthetically determined by a particular type of data, but which was an open system that invited appropriation by any user for potentially any input.

**Fig. 4** Prototypes of Shadow caster and Window blind.





**Fig. 5** Media Mediator prototypes installed at the Royal College of Art, designed with Andy Law.

#### 4. Media Mediators

The Media Mediators were a set of networked objects capable of simple movements, with embedded electronics receiving and interpreting instructions broadcast from a computer [5]. Like the previous prototypes, the movement they performed determined their forms and mechanical structures. The context within which they would perform the movement was left open, and they had a purer form aesthetic to suggest this neutrality. They did not sit upon or attach to existing surfaces or appliances, but occupied their own space.

They were designed to invite the user to create a system of movement – something appropriate to their own interests, or to an activity within the home. In this sense they were envisioned as being descriptors for flows of domestic data, which would again be afforded by a linked and distributed system, and where a particular set of data could be replaced by another set, then a third data set, so the model of resource sharing could become foregrounded.

##### 4.1. Mediators as Media Playback

We began with an initial scenario in order to demonstrate how these blank, movement capable objects might be used. The system was deployed as a platform to enhance the experience of digital media play back. This would allow the experience of the media – be it a film, an animation, some music or a set of slides – to be extended through the home, instead of being confined to a screen and speakers. One source of inspiration for this scenario was Physical Markup Language (PML), a standard proposed by Philips [6] which has more recently become manifest as amBX [7].

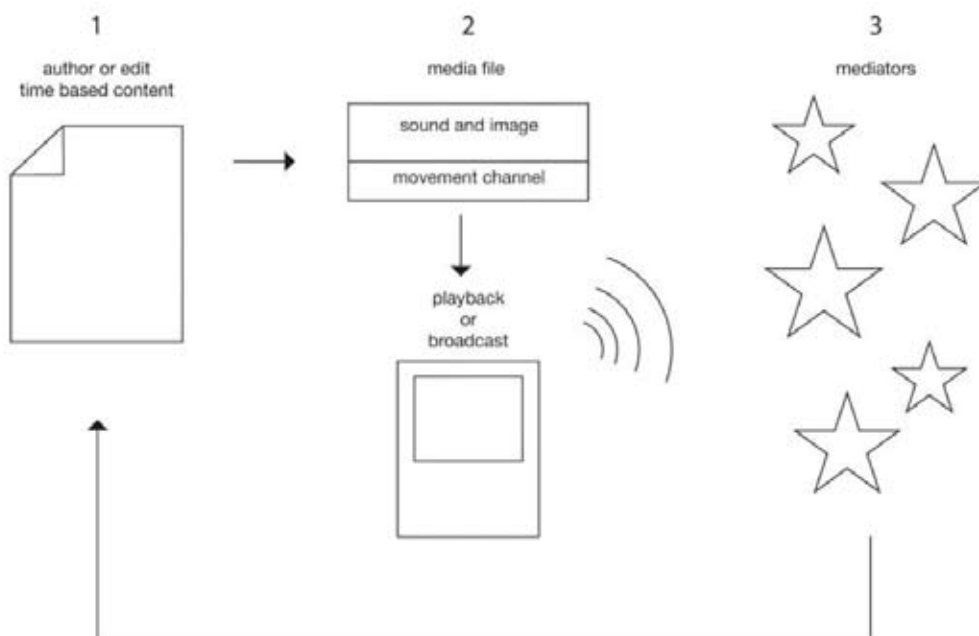
In anticipation of how a user might modify their media in a simple video editing application, a QuickTime movie

was augmented with a set of instructions. During playback of the movie on a PC – within a QuickTime based application developed by Murat Konar – the instructions would be sent to, and broadcast by a USB peripheral. This broadcast is received by the mediator prototypes, which interpreted the instructions and moved accordingly. This instruction channel was embedded alongside the sound and video streams using as an invisible, time-coded subtitle. The instruction contained three commands for each stepper motor (a finely calibrated motor capable of precise positioning) in each object, denoting the speed, direction and number of steps to perform.

In this application, the shared properties of the networked devices (in our case this was exclusively the mediator prototypes, though it could of course be any property of any appliance in any home) become appropriated and synchronised as a physical home theatre. Rather than imagining enhanced DVD's or enriched adverts, we were motivated by providing creative opportunities for the user to act as an author and publisher of the content, so these pooled properties become a set of resources for the user as a director, taking control of the technological landscape that surrounds them.

##### 4.2. Inviting appropriation

To explore other uses for the mediators, we worked with volunteers who would adopt the prototypes and find ways of using them within their own homes. These were fairly technical users: T was a PhD student with a particular interest in the semantic web and D was a sound technician with an interest in robots. The aim was to work with users who might develop a high level of technical knowledge about the prototypes and be able to exploit the openness of the prototypes design to such an extent that they might modify the original functions and properties.



**Fig. 6** A time-coded text file is embedded in a QuickTime movie; this broadcasts control messages via a USB peripheral as the movie plays. A demo can be seen at [http://www.tobiekerridge.co.uk/mm/mov/11\\_livedemo.mov](http://www.tobiekerridge.co.uk/mm/mov/11_livedemo.mov).

T thought about the system he would build with the prototypes, and provided examples of the data he planned to cause movement in the objects. Online services like instant messaging would hook into the prototypes, where they could become peripherals that expressed the presence or mood of his friends. This was extended into an application that translated a variety of written sources, including literature and news, into a range of movements in the prototypes, which echoed semantic qualities of the source text.

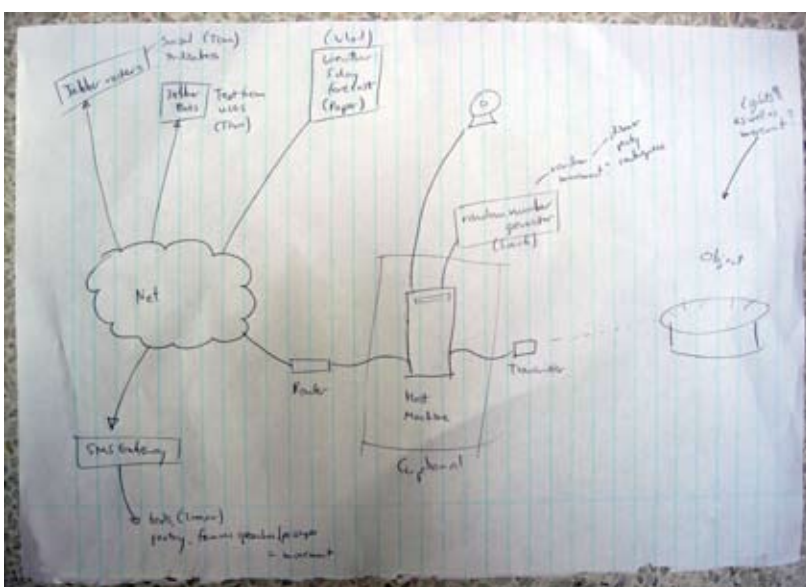
are interesting as well” and with a “slightly random, pet like” behaviour.

While our original aspirations for the system was the openness of the data they might link to, T’s suggested that he might want to gradually narrow down this choice, and eventually link to a fixed data set. Despite this he was excited by the scope of options that were available to him at the development stage, and the range of potential data sources he could test. In this respect, there was a sense that the openness and adaptability of the objects would lead to a period of testing in which the prototypes would not have a stable role, followed by a period of verifying specific roles.

While we had explicitly set out not to give the objects anthropomorphic features, like T, D was fascinated by the tension between the objects as entities and as signals. D had recently begun experimenting with simple robots, and showed us a development kit he had bought for a microprocessor-controlled crawler. After a discussion of his ideas about applications for these robots, we asked him why the media mediators might be different. A portion of the conversation is quoted verbatim here as, it contains some interesting details about the personification of objects:

Researcher: Would you like to live with the cake [one of the prototypes] or would you like to have lots of little robots crawling about your house?

D: [referring to a prototype] It’s a little more abstract, I guess, and a little more subtle. It would be easier to live with than a robot, but then people live with pets though, they assume their own personality just like these would do eventually.



**Fig. 7** A diagram made by T to depict a range of data inputs for his system of movement.

T compared two prototypes on the basis of his ability to precisely control the motion of the objects, where real world behaviour was a “direct correlation to the input parameters”. Whereas one was suited to applications that needed a degree of accuracy, the movement of the other was less predictable exhibiting “different qualities which

Researcher: How do you think an object acquires a personality?

D: It a very good question, I don't know, the same reason a car assumes a personality, or a push bike, you know if you interact with it, which you will be doing with these, it's like the ghost in the machine.

D also spoke about his interest in using the mediators to transform data into physical characteristics; "They're objects and I think it's fun that they're powered by data". He described a more visible and tangible role for data, in contrast to his experience of using a PC interface where "you don't see the data that goes behind it and what works that, and this is one of the interesting things, that these [the mediators] show data in a different way, what you can sort of facilitate with it, as objects, like a knife and a fork you can cut with it".

Media Mediators explores how a user can employ authoring processes to enrich digital content, and how this content could influence a system of mechanical movement, exhibited co-operatively across multiple appliances. There is also scope to extend this sharing with resources other than movement, and to connect to appliances additional to the specialised prototypes described here. In contrast to this distributed system, which is carefully constructed by the user, the project described next serendipitous influence from data sets that are generated from social activity taking place in local neighbourhood.

## 5. The Local Barometer

The Local Barometer seeks to provide people with a sense of the sociocultural texture around their homes: cleaners advertising in newsagent windows, nosy neighbours and pub gossip, conversations in Post Office queues, fridges or cars for sale in a local paper. A wind vane mounted on the outside of the home senses wind speed and direction, and this data is then passed to software which determines down-wind postcodes.

The software uses these postcodes as a search term to retrieve content from the web, returning classified-ads, news items, or images associated with the down-wind area. This content is transmitted to a network of small displays distributed throughout the home, where it scrolls across the screen in a direction also determined by wind speed and direction. The system suggests the imaginary

flow of local information through the home, and works to encourage reflection on the local environment.

The Local Barometer explores many of the issues we raised at the beginning of this paper. First, it involves information passed among a number of devices in the home, which raises the challenge of designing so that the interconnections are apparent. Second, it is not meant to serve as a kind of augmented GUI, allowing people to search local information, but instead to augment existing awareness of the neighbourhood. Finally, it is left open what this information might be for – it is up to the users to make sense of it.

### 5.1. Set alongside the familiar

Local Barometer consists of multiple small screen displays that are situated throughout the home. Each display has a unique form and is designed to suggest potential locations: sitting on a mantle piece, wedged between books on a shelf, plugged into kitchen sockets, hiding under stairs or hanging by a hook from a door handle.



Fig. 8 The output displays of the Local Barometer.

It is imagined that each unit will sit near existing touch points of information such as book spines or telephones in order to reinforce the idea of external events mixing with the domestic landscape.

### 5.2. Passive engagement

The notion of passive engagement comes from idea that these systems are not exactly interactive in the traditional sense. The data is streamed into the home much like that of a television or radio broadcast – not by a director, producer or presenter but by a series of automated systems that are responding to changes and events in the local environment.

The output on these displays is not entertainment but a series of structured snippets of information that are designed to be compelling and provoke curiosity, even voyeurism. These displays are small and become foregrounded or peripheral throughout the home, allowing the user to dip in and out of active engagement with the content.

### 5.3. Curious Content

The data is rendered to the displays with a scrolling motion, so that text or images gradually appear and disappear over the course of a minute or so. As each item appears only once, flows of data through the home are emphasised as transient.

A range of strategies has been used to encourage reflection, particularly with the textual content. The format of adverts from classified-ad site is specific and rigidly formatted, featuring a price, a contact number or email address. These details are removed from the data, leaving just the descriptive body, resulting in a more curious form. The texts become defamiliarised, making the information unclear and creating a certain power and ambiguity. This is emphasised with the addition of a few carefully chosen line breaks:

Challen  
piano  
upright  
circa 1950  
1 careful lady  
owner  
good condition  
all singing all  
dancing

The line breaks create moments of surprise, when meanings not intended in the original advert suddenly surface as equally valid readings of the text. The less familiar the content appears to be, the more context the readers have to provide themselves in order to make sense of the messages.

The same tactic of decontextualisation is applied when images are displayed on the Local Barometer. Stripped of their associated text, images of objects, people and places float by provoking curiosity and surprise. For instance, is the washing machine for sale or in the wanted section? Is

that a picture of a lost kitten? Why is an image of the park on display?

The approach of removing some context from the web gathered data allows users to produce their own meanings from what they see. All the information displayed on the Local Barometer is rooted in the local environment, but it is not designed as a search tool or a recommender system for showing people what the system thinks they want to see. Rather, it provides a rich source of content for users to inhabit and layer meaning upon.

## 6. Conclusions

### 6.1. Distributed Form

William Buxton [8] describes how interactions with digital systems can have different modes of involvement. Unlike telephone conversations, which have beginnings and ends and a sustained level of involvement, his proposal is for a communication medium more like a continual broadcast, with occasions of focused dialogue between other users of the system. A similar model can be used to think about how we interact with digital appliances in the home. We can imagine interface elements – the screens, buttons, and beeps that help us relate to an object – moving intuitively between the foreground and the periphery of a user's attention.

The interfaces of such objects have been described as ambient [9], where there is an aspect to their behaviour that is independent from the user. They may have a degree of agency, of behavioural autonomy [10] they may also behave as signals, using indicators of a change that we can either attend to or ignore. However, movement is a powerful attractor. Our gaze is pulled from thing to thing, and there is potential for our concentration to be attracted through these modalities rather than determining our own course of action.

We might imagine interactions with objects in the domestic interior in this way – a series of foreground and peripheral actions. For individuals undertaking private tasks there are moments of contemplation, pauses, and a sense of drifting to and from action. Throughout these modalities is the common thread of the self. This is the open-ended nature of our experience; tasks are small islands of engagement within a haze of being.



This connection between the user and outside world can be seen as the result of the organisational freedom the home affords. The interior is scattered with stuff, which represents the user's role, their interests, passions and values. It is within this landscape that we can think of the media which pushes into these electronic objects not as anonymous data, flows of abstracted binary packets, but as sensory data, rich information which fuels the behaviour of the possessions, which in turn go some way towards defining us.

### 6.2. Serving the Home

Let us now return to Wieser and Brown's computational model. This suggests that the proliferation of digital resources had been propelled by a migration from factory to home. So in addition to responding to the technological functions of newly emerging software and hardware, we have explored the cultural and psychological themes that attend this domestic technology usage. This has been clearly articulated by Bill Gaver's Equator Group [11], where a case is presented for research that looks away from the legacy of HCI's roots in work, to activity that is less clearly task based:

The home is also a setting, however, for many activities that are less clearly utilitarian. People browse through books, pursue idle speculation, play word games with one another, and admire the garden. They engage in ludic activities, acting as 'Homo Ludens' —people as playful creatures. Such activities are not a simple matter of entertainment, or wasting time. On the contrary, they can be a mechanism for developing new values and goals, for learning new things, and for achieving new understandings. [12]

In the four projects described here, we have suggested how distributed and linked systems could support these types of activity. The Key Table and Picture Frame provide an emotional signal between occupants, leading to speculation rather than providing a fixed meaning. The prototypes built for the Weather Watchers and Data Barometers project respond to open and unending flows of information, which support the user's interests and curiosity about phenomena outside of the home. Media Mediators provide an open system that can be personalised by the user, so that appliances are transformed into characterisations of the user's curiosities and interests. Rather than becoming overcrowded by

unwanted technological functionality, the home becomes reinvigorated by a sense of the occupant's identity.

### 6.3. Finding Meaning

We have considered the domestic environment as a stage for a complex choreography of rich behaviours across multiple linked objects. We have also made a distinction between foregrounded and peripheral behaviours, which might depend on the duration or the role of a particular instance of this choreography. A third important feature of rich, linked behaviour is sensitivity to a tension between the habits of the user and the ambition of the designer. With the Media Mediators we saw a system that was intended to be customised by the user. The behaviours are designed, but the affect of those behaviours, and the interconnection of multiple influences to create a choreographic chain is open. This is in contrast to the Key Table and Picture Frame, where the interaction is fixed. There is a narrative proposition about the interaction, even though this might not be made clear to the user — as the keys get thrown on to the table, the sudden tilt of the frame sends a warning to others.

As complexity and chaining of objects in real space is built up, it becomes harder to sustain the narrative ambition of the designer. With complexity comes indeterminacy, and the lives of the user floats freely from the inferences of the technology once it has moved from the context of the GUI to a real landscape. It becomes more desirable to provide the user with the ability to create affective links between the behaviours of discrete objects.

Resource sharing across distributed systems creates an opportunity for designers to provide rich and sensitive interactions for the user to experience. From these initial research directions it seems crucial to balance the ambition of the designer to pre-structure this experience with potential for customisation and authoring by the user, so that the interrelation of the system is clear enough for the user to creatively navigate but not overbearing so that the user feels they have lost control of their home to the digital beasts described by Tabor.

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# The Evolution of Trust in a Design Context

## Abstract

Trust is an evolving process. It consists of a number of stages each vulnerable to different design influences. In this paper we outline findings from a three-year research study indicating the complex and subtle way in which trust evolves in a design context. Examples from longitudinal, qualitative and experimental studies highlight the importance of design in fostering trust in online health advice. Design factors can have immediate consequences for the trust process as well as subtle effects that only reveal themselves over time.

## Keywords

Trust, design, longitudinal studies, Internet, health

## 1 Introduction

The literature suggests that design, and in particular poor design, can negatively affect peoples' attitudes towards and engagement with websites. More specifically a badly designed website is likely to be perceived as less trustworthy than a well-designed site and subsequently is less likely to be utilized. Broadly speaking this mistrust can, in an e-commerce context, lead to lost revenues as consumers seek out other websites in order to make their purchases and in a health context lead to patients dismissing good quality information and advice. Unpacking the link between trust and design influences reveals a subtle and complex interaction. Trust is an evolving process consisting of a number of distinct stages. Each

stage in the process is vulnerable in different ways to design influences. In this paper we explore the evolution of trust and examine the way in which design impacts upon that process.

## 2 The Evolution of Trust

Studies regarding trust in both an e-commerce and a health setting indicate that various factors are likely to govern the extent to which individuals feel they can trust the information and advice they encounter online. Firstly they may be influenced by the look and feel of the site – trusting, for example, those sites rated high in visual appeal and mistrusting those sites with poor visual design or with unprofessional errors [1]. Secondly, they may be influenced by the branding of the site or by the presence of familiar images, trusted logos or prominent features such as photographs [2]. Thirdly, they may be influenced by the quality of information available on the site, trusting those sites with greater perceived expertise [3] and fourthly, they may be influenced by the extent to which the advice is personalized to the individual – i.e. the extent to which the advice appears to come from and be directed to similar individuals (i.e. those with a shared social identity), [4].

Whilst these different factors appear to be important, researchers disagree over their relative importance in fostering trust. For example, some researchers argue that consumer trust (or a related construct, credibility) is

primarily driven by an attractive and professional design whilst others emphasize the importance of perceived competence and benevolence of the site in nurturing trust.

One way of reconciling these different findings is to consider an evolutionary model of trust or the way in which trust develops or evolves over time. A number of authors [5], [6] have suggested that three phases are important: a phase of initial trust followed by a more involved exchange which then may or may not lead to a longer-term trusting relationship. Considering trust in this evolutionary context helps to reconcile the tension between those models of trust which suggest that it is a concept grounded in careful judgment of institution and process factors such as vendor expertise and experience, and those models that suggest trust decisions depend much more heavily on the attractiveness and professional feel of a site.

This evolutionary perspective provides us with a number of 'trust stages'. These stages are vulnerable to different design influences and in the remainder of the paper we draw upon a number of studies to outline these vulnerabilities and tease out the different important design influences.

### 3 Trust and Design

#### 3.1 Stage 1: The Importance of the First Look

The initial stage of trust formation appears to be extremely vulnerable to the visual design of websites. In a series of longitudinal qualitative studies Sillence and colleagues asked consumers with current health concerns (the menopause, hypertension, Mumps Measles and Rubella – MMR and healthy living) to search online for advice relating to their conditions. Data collection took many forms including web page logging, verbal protocols, logbooks and group discussion. The results from the logging indicated that within ten seconds of viewing a website, people are already engaged in a rapid screening process rejecting sites with poor visual design or sites that failed to provide the correct cues to content. Sites which failed to provide simple entry points or that were not immediately recognizable as useful sites about the condition were dismissed within seconds [7].

During the follow up discussion participants were asked to describe the sites they had trusted and those that they

had mistrusted and rejected. In terms of rejection the overwhelming majority of comments related to the design of the website. The look and feel of the website was clearly important to the participants. Visual appeal, plus design issues relevant to site navigation appeared to exert a strong influence on people's first impressions of the site. Poor interface design was particularly associated with rapid rejection and mistrust of a website. In cases where the participants did not like some aspect of the design the site was often not explored further than the homepage and was not considered suitable for revisiting at a later date. Negative comments included: inappropriate name for the website, complex busy layout, lack of navigational aids, poor use of color and pop up adverts. Figure 1 shows an example of a mistrusted site. The site does not provide standard menus down the left hand side of the page, presents 'advert style' thumbnails to health topics and generally lacks appropriate cues to content.

As Hassenzahl & Trautmann [8] suggest, the 'character' of a website, meaning its visual design and its content affect users' interpretation, acceptance and further interaction with the site. Previous studies have been overly keen to point out that average consumers are poor evaluators of content too interested in the visual appeal of the website. Whilst our studies [5,7] have highlighted that genuine consumers 'wish lists' for health websites do not differ that greatly from the comments made by experts in other evaluation studies, the problem of poor design remains central. If sites fail to provide a pleasant visual experience, easy navigation or the correct cues to content they will often fail to engage the consumer beyond the homepage regardless of the subsequent quality of the content on the site. In this case both parties could lose out.



Figure 1: Example of a mistrusted site

### 3.1.1 Delayed Response to Visual Design Features

Previously we have indicated that poor design features can have an immediate impact on trust impressions leading to the quick rejection of websites. Our latest research, however, suggests that these design cues may also function at a more subtle level revealing their effects only with time.

We employed an experimental study using eye tracking in order to objectively measure peoples' attention to the content and visual design features of websites. In this study women, some with very high weekly alcohol consumption levels, were shown one of two versions a website describing the genuine link between alcohol consumption and breast cancer. The websites contained the same high quality content but embedded either in positive or negative design features e.g. adverts or trust seals. In addition to the eye tracking measures, subjective measures of risk and intention were taken and measures of behavior were taken at one-week follow up. Initially at least the women were equally persuaded by the material on both websites although they did view the 'untrustworthy' cues for longer. At the follow up one week later however, those with the higher levels of alcohol consumption who had been exposed to the negative site reported having cut down their drinking less. The findings of this study suggest that the effects of design related trust cues may change over time. The design features of the website had an influence on the women's responses to the information in terms of their drinking behavior but this influence was subtle and did not occur immediately.

### 3.2 Stage 2: Engaging with Website Content

Across our longitudinal studies we have attempted to understand the process by which people evaluate and make trust judgments about online health advice. We have noted that at the second 'stage' of trust, as people begin to engage with the content of websites they are still vulnerable to design influences. Our studies [5,7] indicate that trust can be lost at this stage through poor design. Specifically people are looking for a 'well cared for site' – one that is regularly updated and maintained. Links should not be broken, pages should display properly and articles and information should be current. Moreover, people expect websites to operate in a familiar and predictable manner and should be designed to provide users with the answers (not just to domain specific questions but to questions such as 'who runs the site', when was it last updated' and 'how can I contact the site owner?')

### 3.3 Stage 3: Personalisation and Social Networking

Once a user has chosen to engage with the content of a website they may or may not go on to develop a longer term trusting relationship with the site. At this stage of the evolution of trust issues such as personalized advice and social networking are prominent and they, amongst other issues, are vulnerable to certain design influences.

People, for example, wishing to make decisions about their health, need personalized assessments and advice upon which to make their choices. Indeed studies of online advice across a range of domains have indicated that personalization or the extent to which information is tailored to the individual is an important factor in terms of deciding whether or not to trust the information and advice and to act upon it, [4]. Providing personalized advice necessitates the user divulging a degree of personal information. For example, in order for a web site to provide a personalized skin cancer risk assessment, the user must provide the site with information such as age, skin type and past medical history.

In a study of users' attitudes towards personalized advice online we noted that the personalization features of health websites are not yet at a stage where they are impacting directly upon patients' decision making. Participants felt unable to obtain truly personalized risk assessments and advice and found many of the features on such sites far from user friendly [9].

Internet users seeking health advice are often keen to benefit from other people's experiences. The notion of the patient experience and the increasing prevalence of social networking sites brings with it complex issues for designers. Facilitating the flow of information whilst moderating inappropriate contributions is just one of the difficulties that designers wishing to provide this final 'trusting relationship' stage are faced with. Being asked to register personal details can be deemed necessary from a design point of view but without careful explanation can place the trust relationship in jeopardy. These decisions, designing for usability versus designing for sociability, are not new. Owners of online communities have been faced with making these finely balanced design decisions for a number of years now e.g. [10]. However as sites attempt to reach beyond their initial remit, of providing simple information or making one-off sales, towards the development of longer term trusting relationships with

their users designing for usability whilst maintaining the site's sociability will become more important and more difficult to achieve.

#### 4 Summary and Conclusions

Trust is a complex evolving process. However whilst it is time consuming to build up trust is something easily destroyed. Trust is vulnerable to design influences across all stages of the development process. Poor design rather than good design features appears to have the most immediate impact on trust. A well designed site allows the user to focus his or her attention on the content. Poor design, however, has the ability to destroy trust in an instant. Our studies have indicated people reject sites almost immediately because of poor visual design features. They are also susceptible to the more subtle influence of negative design cues over time. People also reject sites further on in the trust development process when they encounter an unpredictable, unfamiliar design or a less 'well cared' for website. As sites become more sophisticated in terms of their offerings so the designer's job becomes increasingly fraught as he attempts to promote a trusting relationship ever vulnerable to design influences.

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# “Are you a Delia or a Chantelle?” Engaging Stakeholders in Branding Exercises

## **Abstract**

This short paper describes the development and implementation of tools and methods used to consult stakeholders in the development of a brand identity for a software development company, and the further refinement of those tools for use in the redesign and branding of a beauty treatment product and its packaging. A cultural probe approach was used in the form of word and image cards ('Explorer Cards') to elicit stakeholders' opinions, emotions and perceptions regarding the project at hand. This method provided the design team with a pragmatic and rapid approach to the elicitation of information from stakeholders with varying degrees of design literacy.

## **Keywords**

Engagement, stakeholders, elicitation, emotion, product, personas

## **1 Introduction**

A successful brand should embody the company's personality, reputation and promises to its clients. A recognisable brand allows a company to stand out from a crowded marketplace, and provides employees with a strong sense of corporate identity. One of the main challenges in the development of a brand is the distillation of a company's often broad and esoteric vision into an actionable branding strategy. Often a branding process begins with the design team endeavouring to gain a

deeper understanding of the business through interviews, surveys or focus groups conducted with internal and external stakeholders. While these methods are suitable for larger-scale branding projects, projects for smaller companies often come with smaller budgets, meaning the designer must reduce the scope of the project accordingly. Developing new ways to draw out the seeds of inspiration in a timely and efficient manner offers the designers a route that avoids any compromise on the quality of their design solutions within a tight budget or delivery timescale.

## **2 Context**

In May 2006, Northumberland-based Tagish Ltd commissioned The Centre for Design Research (CfDR) to develop and implement their new corporate brand. Tagish have a long-standing reputation as developers of quality web resources for English local authorities. A series of recent changes (including a management buyout and a move to new premises following a serious fire) had stimulated internal discussions about the company's future direction, and brought about a recognition that the existing brand identity did not fully reflect the company's capabilities and aspirations. CfDR's brief was to help Tagish identify the perceived value and appropriateness of each of its offerings, and to develop coherent branding and communication resources to convey them. In addition, this re-branding exercise was to become a symbolic and cathartic experience, offering everyone at Tagish the chance to refocus.

### 3 Challenges

#### 3.1 Defining Brand Values

At the beginning of the project Tagish's new management were still organising their thoughts on the future direction of the company. Some of the key information required for the development of an effective and thorough branding platform – such as mission statement, vision and values – was difficult for Tagish's management to express. We recognized that to progress our project we would need to find a way of extracting and formalizing their emergent ideas.

#### 3.2 Time and Money

Understanding the core competencies of a business is key to the success of any branding project. This understanding can come from various sources: visiting a business's website, reading their business plans, or experiencing their products. A recognised 'best practice' approach suggested by authors such as Alina Wheeler [1] is consultation with internal stakeholders – namely management and employees – to identify their internal viewpoint on the company, complemented with a similar picture gathered from external stakeholders, such as clients and suppliers. As a small company Tagish's available project budget did not offer us the opportunity to conduct such a broad-ranging exercise, and so we made the decision to consult only with internal stakeholders, our rationale being that they were likely to be the richest source of information. Tagish planned to launch their new brand at the IT Works 2006 event in June, giving the CfDR design team just five weeks to complete the branding project and deliver marketing and promotional materials.

#### 3.3 Engagement with Internal Stakeholders

The new management was seeking to transform the company culture, making it more participative and inclusive. We set out to adopt an approach that not only reflected these goals, but also engaged with employees in an open and democratic manner. The question was: how could we best achieve this?

### 4 Elicitation and Engagement

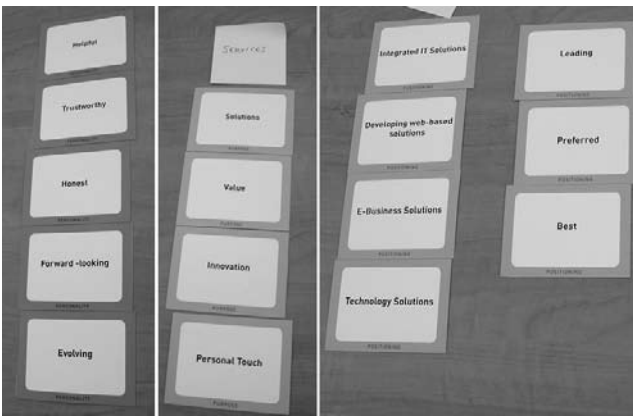
#### 4.1 Stage 1 – Brand Audit Exercise

The research phase of the project involved two stages: a brand audit exercise, and an internal stakeholder consultation. The brand audit was used to identify the current Tagish brand image, audiences and communication materials in order to evaluate the strengths and weaknesses of the existing brand. As part of this audit a competitor analysis was conducted, examining competitor brands to clarify Tagish's overall position within the marketplace, the results of which fed into Stage 2.

#### 4.2 Stage 2 – Stakeholder Consultation

Keyword Generation. The ultimate goal of the consultation was to identify, and then communicate, Tagish stakeholders' shared values and ambitions. Having evaluated traditional research methods of exploring personal constructs, such as Kelly's Repertory Grid Analysis [2], we felt that a more targeted and visually interactive approach was needed. We were aware of the methods used by Bill Gaver [3] and his colleagues at the Royal College of Arts during the Presence project. Their use of Cultural Probes informed and inspired them about their users' beliefs and desires, aesthetic preferences and cultural concerns. We felt this approach provided us with a suitable framework to build upon, and developed our own 'probe' in the form of Explorer Cards.

The managing director of Tagish was interviewed at the start of the project, and this meeting produced a broad pool of keywords and statements that were representative of the overall management vision for the future of Tagish. Keywords were then grouped under five element categories based on Tony Spaeth's corporate brand platform [4]: positioning, purpose, mission, culture and personality.



**Figure 1.** Colour-coded keyword cards

The keywords were printed onto colour-coded Explorer Cards (see Figure 1). Additionally, the personality category was supplemented with themed groups of picture cards (see Figure 2) in diverse categories such as celebrities (Delia Smith or Big Brother's Chantelle?), animals (cat or dog?) and environments (rural or city?). Images were used here for the specific purpose of providing a richer and more expressive accompaniment to keyword-based descriptions of personality.

### Explorer Cards Exercise

Individual sessions were held with six (out of eight) available Tagish employees<sup>1</sup>. Given the low number of stakeholders we were able to conduct individual rather than group sessions – which we considered a great advantage as this would allow each participant to be open about his or her true opinions without feeling restricted or led by the views of their colleagues. Each session lasted approximately 15-20 minutes. At the beginning of each session we introduced to the participant the five brand elements: positioning statement, corporate purpose, mission statement, brand culture and brand personality. The participant was then given a set of keyword cards for each element and asked to select and rank them in order of relevance. For example, participants were asked to select five keywords (out of twelve) that best described the corporate purpose of Tagish, and then to place those cards in order of importance. Visual ranking proved more



**Figure 2.** Image cards

advantageous than numerical, due to the subtlety of visual placement. For example one participant, unable to decide on a clear ranking, instead chose to overlap each card (see Figure 4) as a compromise; while another's cards were distinctively separated, indicating that they had a very clear viewpoint on that particular aspect of the brand identity.

While it is not essential to the successful running of the Explorer Cards exercise, we found that having two designers present for each session helped us gain extra depth from the responses. The main facilitator lead the participant through the exercise, while the second designer recorded pertinent points from the participant's dialogue with the facilitator (and themselves – as many would talk themselves through their Explorer Card selection and elimination choices). The qualitative information gathered here enriched the designers' understanding of participant viewpoints, making it easier to translate the Explorer Card session results into design concepts.

### 5 Reflection on the Elicitation and Engagement Process

The experience of using the Explorer Cards had positive outcomes for all parties involved. For the design team, the process was a rapid approach to the elicitation of responses from stakeholders in usually intangible areas such as perception, feelings and emotions. The results of



**Figure 3.** Keyword card sort exercise



**Figure 4.** Overlapping ranking

<sup>1</sup> The remaining two were unable to attend, however their feedback was recorded through a paper version of the Explorer Cards exercise and incorporated into the consultation results at a later date.

the process helped us develop an identity that positioned the company for growth, change and success. In addition to eliciting stakeholder viewpoints, the exercise enabled us to visually communicate the complexity of the branding process. Above all the Explorer Cards were a crucial visual embodiment of a design project process – the research stage, whose often-intangible results can be mistakenly perceived by clients as less than essential.

For the stakeholders, the process allowed them to express their viewpoints openly and creatively. They clearly enjoyed the interactions generated by the exercise and were empowered through them, with their views actively sought and visibly represented in the resulting brand concepts. One of the hardest objectives to achieve in branding is internal buy-in from employees. Through this early participation in the branding process, Tagish stakeholders were encouraged to feel a sense of ownership of the new brand. The process generated a real sense of excitement and engagement, which many organisations set out to stimulate through their re-branding endeavours.

We made further use of the Explorer Cards in a product branding and packaging project for a beauty treatment product<sup>2</sup>. Our client was unfamiliar with the processes or terminology of design, and the Cards provided a simple and accessible means of verbalizing their expectations for the new product. In this implementation we also changed the role of the picture cards, using them instead as a tool to build up a visual ‘persona’ of the client’s target consumer with image categories including Home (semi-detached or city flat?), Life Stage (single, married or retired?) and Shops (Karen Millen or TKMaxx?).

## 6 Discussion and Conclusions

To summarise, we found that the key advantages of the Explorer Cards were:

- Ease of use, requiring no additional training for designers or participants.
- Pragmatic, rapid and cost effective way of eliciting intangible information.
- Visible, explicit and engaging process that encourages inclusivity and empowerment amongst the stakeholders.
- Data collected in the form of ranked keywords and images allowed quick analysis and interpretation into design concepts.

- Ranking stage of the card-based consultation helped stakeholders to focus on primary ideals that characterised their aspirational brand identity.

Based on our experience of using the Explorer Card method in two projects, we believe they will be most useful for branding projects with limited time available for stakeholder consultation. In Tagish’s case we were able to conduct individual sessions due to the low number of participants. We recognise that this method would not be sustainable for larger organisations, and suggest conducting group sessions with 3-4 people. The beauty product branding project demonstrated how documenting participant dialogue from a group, in this case between 2 representatives of the client company, proved to be one of the most vital elements for the design team as discussions leading to the elimination of keywords were just as enlightening as the participants’ final card choices. We therefore strongly encourage the use of a note-taker, or audio recording of the sessions, to ensure valuable insights are not lost.

It is also worth acknowledging that empowering a broad pool of stakeholders to voice their opinions in these early stages of developing a brand can encourage them to speak up at all stages of the design process – a situation which may not always be desirable to the designer, or conducive to timely progress on the project.

We now hope to expand upon our range of Explorer Cards to make them more versatile for use in future design projects. We envisage that our methods of application will evolve with each implementation, and with further refinement the Cards can become a permanent feature of our design process, providing us with an adaptable tool for identifying and defining design goals.

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<sup>2</sup> The remaining two were unable to attend, however their feedback was recorded through a paper version of the Explorer Cards exercise and incorporated into the consultation results at a later date.

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# Meaningful Evaluation: A Case Study in Cultural and Semiotic Significance

## Abstract

This paper aims to identify the cultural and semiotic significance of a group of fresh design graduates in order to draw conclusions on semantic qualities associated with design products. To achieve this, two basic assumptions about culture and semiotics were integrated and then were studied through a survey. The survey addressed a group of novice designers who took part in The New Designers Show in London. It was believed that semiotic significance comes from a deeper layer of knowledge where culture is rooted. The results demonstrate that this group of designers were naive agents about culture and semiotics. The depth and breadth of this conclusion was indicted throughout the study.

## Key words

Culture in design, Semiotics, Cultural representation, product design

## 1 Basics assumptions about semiotics and culture

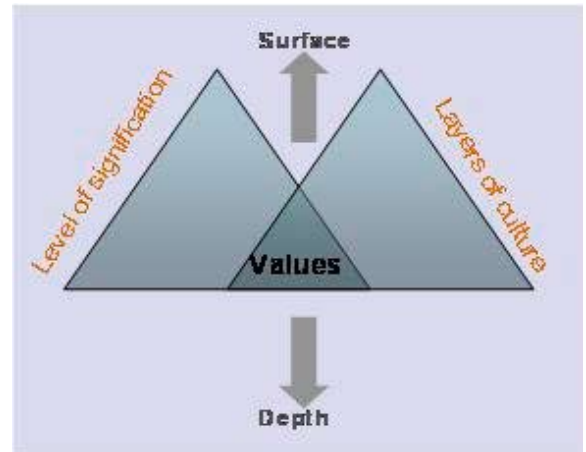
Firstly, in a system of representation, it is believed that a sign is made of two parts: a *signifier* and a *signified*. The former is the embodiment of a concept and the latter is related to the mental images of that concept [1]. For instance, the actual form of a car could be interpreted as the signifier, while the concept of a car in mind is seen as the signified. Although, the form can be unique, the concept of it is varied and diverse. These elements are

deemed to be the basic elements of semiotics and were defined by the Swiss linguist, Ferdinand de Saussure (1857-1913).

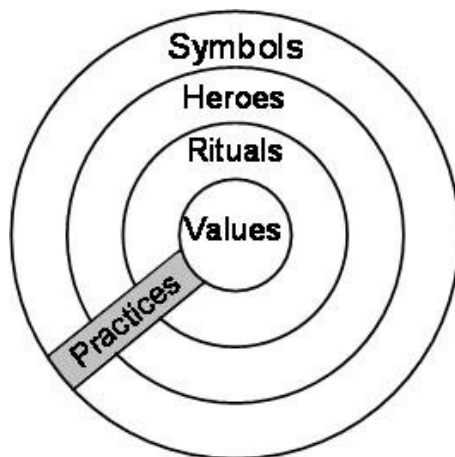
To describe the relationship between the signifier and its signified and to make it distinctive, two more terms should be considered, too: *denotation and connotation*. The denotative order is seen as primarily representational, whilst the connotative order of signification reflects the expressive and the values which are attached to a sign [1].

However, there is still another level of signification, which is targeted towards a deeper layer of signification. Chandler [1] argues that in the third level, there is myth; a mythical or ideological order of signification. For instance, a public bus shelter can be defined as a picking up and dropping off point for a user at denotative level. By using a highly-fabricated metallic finish and some certain details, a designer could signify it as a high-tech item, suggesting a representation of the current cultural movement in design and architecture in the modern Western world. Additionally, on a mythical level, one might imbue it with the idea that celebrates and admires works of Sir Norman Foster, the contemporary British architect, as one of the most influential faces of today [2] who represents this kind of style in design. From this specific point of view, a bus shelter is not only a product, it is a meaningful object, capable of signifying various meanings.

**Fig. 2** Values are in deepest layer of culture and highest level of signification



Secondly, most researchers agree on one common aspect of culture, *Layers of culture*, which implies the hierarchy of meaning within culture. Among those researchers, G. H. Hofstede is distinctive. The Dutch organisational anthropologist and perhaps the most famous and the most often cited researcher in this area proposed a set of four layers of culture, each of which encompassed a lower level, like an onion. He claimed that this onion could be peeled off in order to find out the ingredients. For him, *values* are in the core and when proceeding from inner to the outer, three more layers are revealed, *rituals, Heroes and symbols* [3]. The three layers, are likely more visible and observable and can be manifested in people's behaviours, ceremonies and artefacts they make. His model is associated with a set of practices along the three visible layers (Fig. 1)



**Fig. 1** Hofstede's model of layers of culture

On the basis of the two basic assumptions about semiotics and culture and for the purpose of the study, the following integration was suggested. From semantic point of view, it was believed that both semiotics and culture aim at generating outcomes that are more meaningful. This could be the case when they are seen within a design context.

In deepest layer of culture, there are values and in highest order of signification, there is myth. Values are tied up with cultural and myth is bound with signification. This would create a common area, myth-values which has been shown in fig. 2.

To make it more culturally orientated, one should find the overlap between values and myth in a specific

field. Designers can use cultural values as the source for enhancing meaning in their works. Any level of representation injected into design objects can lay upon a layer of cultural value. This would enable the authors to formulate a hypothesis as following: Any designer could benefit from the application of Layers of culture (rooted in culture) in his/her design activity.

Meanwhile, this question here remains: To what extent, designers are aware of this potential? To answer this question, the authors undertook a fieldwork. However, due to the short of time and difficulties to get experts designers involved, they decided to engage design students. Those who were deemed to be beginners in design practise and therefore, were called *novice designers*.

To evaluate the existing understanding of culture of novice designers, a survey study was planned and a diverse target group were chosen. The *New Designers Show* in *The Business Design Centre* based in London was selected as the venue for the survey. It brings together over 4000 graduates from all over of the UK, half of them in the target group. It includes most major design disciplines, a factor taken into account by the authors when arranging the survey. The diversity and comprehensiveness of the show provided a good base for the survey.

## 2The New Designers Show

The survey was done on one occasion, with 30 candidates taking part that year. As this survey was intended to support the qualitative data analysis and generate just basic statistics, a minimum of 30 respondents was sufficient [4]. They were chosen from different design backgrounds to participate in an open-ended questionnaire. They had all recently finished their courses and had all trained to design mass-produced items (e.g. product design and furniture design). Craft-based courses, such as jewellery design, and 2D courses, such as graphic design, were excluded. Six specific questions were designed to cover the different levels of their knowledge of culture. The questions were:

- 1 What do you think culture is?
- 2 What do you consider to be the role of culture in design?

- 3 How do you assess the cultural knowledge which you gained from the course that you were undertaking?
- 4 Which of the following area mostly intrigue you?
- High-tech design
  - Everyday objects
  - Culture-orientated projects
- 5 Which one is the more cultural product? Why?
- (Figure 3a, 3b)



**Fig. 3** Sony Walkman and a traditional style shelter

The idea behind the questions was to address certain issues about culture from different angles. Students might not be aware that for instance question 1, 2, 4 and 5 all share one theme but in various forms. This strategy was also highlighted by social science researchers [5], [6] and [7]. To find out more about the possible co-relationship between the candidates and their responses, they were also asked to fill in a box with details on *gender, age, nationality, origin, course and university*.

### 3 Results

The results, were organised into two categories. *The numbers (3.1)* give feedback from a statistical point of view. It is only related to the populations' record. *The Novice designers' responses (3.2)* provides more qualitative information obtained from the survey.

#### 3.1 The numbers

The following figures represent the information was gathered through the survey in the London-based show. Of the participants who took part in the survey, 65% were male and 35% female. One can argue that the initial result shows a significant dominance of male participants. One could assume that they were more interested in this kind of design. However, the reason might simply be due to the nature of the course, which needs many hands-on

skills in constructing, testing and manufacturing items. This involves, in general, more technical and physical activities. Traditionally, these sorts of tasks had been associated with men! The average age of participants was indicated as 23.09. They were all young designers and had graduated shortly before the show. Meanwhile, 22 was the most popular age in this respect for a design graduate. In terms of nationality, the majority of participants were British (95.65%) and just 4.35% being non-British nationals. It was reasonable to have such a majority as the survey was carried out in the UK. It might also suggest that those courses in design, which were addressed in this study, were very popular among British students. Having said that, one could argue that the higher education in Britain has not been successful enough in attracting other nationalities. It implies the result of *originality* as well (97.56%). Based on the information provided, 17 universities, also from different parts of the UK, had participants in the survey.

In general, the population of the survey and the diversity of their qualities represented the potential needed to generate appropriate data.

#### 3.2 Novice designers' response

Response to the first question (what do you think culture is), had the following responses:

- *The way of life and differences in other populations;*
- *A state of mind that people from different arrangement provide insight into their identities;*
- *It is the diversity of feeling and opinions within a society;*
- *The way different groups express themselves and the way people doing things complies of group of people views, activities, possessions, ethos;*
- *Experiencing the same things as others and create their own culture through socialising;*
- *National identity and tradition developing over time with younger generations and technological advance;*
- *All that is rewarding and stimulating but isn't essential for survival;*
- *History and art, music, technology, fashion, design, in total making history;*
- *All the characteristic and identifiable objects and icons within a particular group;*
- *Habits and beliefs and choice of selection.*

Most responses insisted on the sociological role of culture (in their own words), which underpins a way of life, as well as allowing socialising with others. Some considered quite

an objective existence for culture and equated it with design to some extent. However, almost all participants mentioned the colourful and diverse nature of culture, which was highly associated with the concept of other active members of a society. Many responses indicated a belief in the sense of the outsider and many participants thought that culture did not relate to them. Culture is for others, especially minorities. Very few responses had pointed to one of the most important roles of culture: creating meaning.

In fact, the survey showed that almost none of the participants explicitly related to the specific concept of culture in which this study was grounded: production and circulation of meaning. Although one might argue that this perception about culture had been implicitly eluded, there was still no sign of a conscious approach. To be able to apply culture in design, we should have a relevant strategy.

Question 2 brought some answers as diverse as question 1. Students gave the following responses, when they were asked to consider the possibility of any kind of role for culture in design:

- *Designing product to suit certain groups;*
- *Understanding other lifestyles and addressing them;*
- *Succession or failing a product in different cultures;*
- *Driving design in order to reflecting the society;*
- *As a marketing tool which assess the idea before and after launching;*
- *Designing on an existing culture base or creating a new culture;*
- *Influence the way a design is perceived;*
- *Passing thoughts and ideas to societies and educating an unfamiliar culture to other cultures;*
- *Inspiration to design;*
- *To locate the largest markets and making product look a certain way.*

The answers covered themes such as, *designing and marketing new products in unfamiliar markets, learning from others and educating them about ourselves, the ability to create a unique cultural trend, changing and making perceptions and culture as a source of inspiration. Among the responses, seeing culture as a means of communication to various markets* was also identified. This could be interpreted as bringing down the importance of culture as a *marketing tool*, which had been cited in various literature, too [8], [9] and [10]. In general, almost all directions in culture, which had already

discussed could be identified.

All participants almost agreed that *there was a lack of enough cultural knowledge in their courses* in question 3. *Not much, very general, limited, poor and nothing learned* was repeatedly stressed by the them. Those who came from technology-based subjects found it irrelevant to some extent. Instead, a few positive responses came mainly from 3D and Furniture designers. As the survey was done on an open-ended base, there was no measurement tool such as *Likert scale* to determine the exact percentage of dis/agreement to the statement [11]. In fact, in addition to just asking the participants to choose from a selected scale, they were encouraged to bring their own judgment to the fore.

Among those who responded positively about the level of culture within their course, there was much emphasis on *individual interest and endeavour* rather than essential requirements of the course. Doing personal research could be seen in some responses to compensate for the dearth of culture. A sense of losing the application of culture in the courses was also evident in some responses, for example: "Although underestimating the application of culture is not good but industries do not need culture".

Interesting result came from responses to question 4 when they were asked to show their interest with regards to the three product categories. A leaning towards the cultural products interpreted as a more culturally-aware designer. Here is the result:

- High-tech product (a) 25%
- Everyday objects (b) 45.83%
- Culture-orientated projects (c) 29.16%

Half the responses demonstrated an interest in designing everyday objects which could be furniture, home appliances, kitchenware and, in general, consumer products. Therefore, the enthusiasm towards designing a high-tech product or a culture-orientated one was almost the same, with just a subtle difference. It seems that culture and technology are perceived as opposite extremes to one another. However, in the middle range a more moderate area of consumer or every day items receives more attention. The point is, that certain perceptions of culture are common and can be seen almost anywhere; for example, where tradition, history, antiques, nostalgia and, in general, old things become synonymous with culture.

To complete the survey, the last question sought to evaluate the perception of designers about the concept of cultural products. Two items were selected for consideration, a typical 1979 original SONY Walkman and a traditionally-formed shelter erected in Isle of Wight. The result was Sony Walkman with 51.66% and the shelter with 38.33%. Also about 10.01% remained uncertain and chose both. In addition, each group had their own justification for the choices made:

Group A; Sony Walkman;

Associate with a moment / Evokes more emotions among societies / Symbol of new independent culture / Fits cultural empathies and desires while the shelter seems to be imitative / People use it in a new way personally but can not do the same with the shelter

Group B; The Shelter

Providing communal space / Inspired by its setting and surroundings / Encouraging interactions / Looks oriental!

Group C; both

Depends on the target group; if love music then A, if love seating and socialising then B / History and meaning behind both of them / Create two different culture / A hit the western world in early 80s, B signifies a more traditional shape

As seen, each group had their own preferences and perceptions. Performance was the main criterion for group C and visual look seemed to have played the major role for group B in choosing the shelter. Meanwhile the concepts behind group C are quite sensible as well. *To name a product, cultural or non-cultural, one needs to define what an individual's definition of culture is.* To analyse the information gathered from the last question and the others we should move on to the next section and recall some of the studies that already have been done.

#### 4 Analysis and discussion

Briefly, the statistics showed that the majority of respondents were male and their average age was 23.09 with 22 as the mode. The product design course was the most relevant course within the kind of discipline, which addressed both aesthetical and technical aspects of design. Product design seemed to be positioned between the two extremes (culture and technology).

So, one could argue that there was a sense of masculine culture within product design and similar courses like furniture design. This might be correct because of the

requirement of the course, that requires one to have adequate knowledge of technical details as well. 23.09 as the average age of participants typified the time between attending university and entering the business market.

The result showed that this group of novice designers were still naive agents about culture. They thought normally about culture and issues around it. For them culture was not seen as, inner, not us, it was external and mostly a matter of *others/outsidiers/them*. It supported the idea of other by Rudyard Kipling (1865-1936) quoted in Sardar and Borin [12] as: "Broadly speaking, all non-Western culture and civilisation are seen as the *other* of the West."

It was not surprising if the group perceived the old-style, newly-built Isle of Wight shelter oriental and, consequently, a symbol of a cultural product (a number of them mentioned this). Even the 51.66% who voted Sony Walkman as a cultural product was not a reliable outcome. Although this confirmed Du Gay's view [13] on the criteria of cultural products, but new findings were revealed through further investigation. As a personal stereo (being an old item like a Sony Walkman or a highly-technological brand new product such as iPod) it was mainly associated with other cultural products and industries. One of them, which come from an industry, known as the creative industry, is music. In a youth market saturated by various kind of music and musical-related products, it was predictable to see how a personal stereo was indicated a cultural product. However, as discussed earlier the concept of a cultural product in this study was different from what is perceived by the public especially in the music industry.

Considering the average age of participants, it was not surprising that they were under the influence of a significant American cultural clash, a large portion of which was associated with music. This idea was also reinforced through a comprehensive social science survey of cultural activities in Britain, published as, *A cultural map of the United Kingdom, 2003*. In addition, the emphasis on the marketing aspect of culture might come from the above preconception that links culture to the concept of *other/outsider*.

The remainder, which was about 10%, believed that both products could be cultural. Their analogies came from a

deeper level of culture; attitude and behaviour [3], [14], [15] and [16]. For them, it depends on what sort of people are involved in usage; those who love music and showed it in their behaviour, whilst others, prefer to socialise with others and share a communal space. While the personal stereo promotes privacy and independence, the shelter reinforces interaction, sharing and dependence. The former could be the symbol of individualism in individualistic societies, the latter a means of collectivism in collectivist ones. Therefore, the number of responses who carried this way of thinking was just one tenth of the population.

Those who perceived the shelter as a cultural product, seemed to base their judgment on the external shape (first layer of culture), while the others based their decision on the performance of the stereo. Any judgment of the performance was due to usage and certain behaviour. That is why it was linked to a deeper layer of culture.

## 5 Conclusion

A fieldwork was undertaken to examine the extent of cultural awareness amongst a selected group of novice designers. Through a survey study and by adopting an open-ended questionnaire the following concluding remarks were made:

- To many, culture dealt with tradition and history as opposed to technology;
- There was no distinction between high-tech products (e.g iPod), everyday objects (e.g refrigerator) and culture-orientated designs from a cultural point of view, [17];
- Any design item might have/find/become a symbolic value in its life span based on a particular social and cultural arrangement of a society;
- Most of the responses implied the many definitions of culture and issues of culture like subjectivity, objectivity and the concept of cultural products;
- There were no specific indications towards any of the cultural models (e.g. Hofstede's model) although there was an interpretation of the first and second widely-cited concept of layers of culture (symbolic and behaviour);
- Traditional shapes, flamboyant style and highly decorative ornaments sometimes were equated with the concept of culture;
- In term of establishing a widely accepted cultural

understanding, design education lacks a communal strategy within the extent indicated in this study;

- A coherent structure might help them to organise their understanding of culture.

Demonstrating any level of cultural understanding was equated with orders of signification in this paper. In other words, culture was synonymous with semiotics on a basis of integration of culture-semiotics. This follows from the previous work reported in IEPDE05 Conference [18]. Semantic qualities of design products could stem from this integration. A low level of awareness in the said area (culture-semiotics) amongst novice designers may well result in poor application of semantics in design.

## Acknowledgement

The authors would like to thank all design graduates for their help in undertaking the survey which made this study possible.

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# Molecular Branding: A Study on the Nature of the Relationship Between Product Design and Brand Loyalty

## **Abstract**

Little is known empirically about the effect product design has on branding. This research focuses on product design's influence on brand loyalty through a study of the attitudes and perceptions of brand loyalists and the meanings they place on the product attributes of form, color, material, texture, and brand marks. The metaphor of brand DNA and the DNA molecule within this study is based on the interaction of fundamental elements (the combinations of the essential building blocks of a brand) that lead to the evolution of the brand as a living organism able to adapt to its ever-changing environment. A literature review was conducted on brand equity, loyalty, and value. The Apple™ Computer Company was chosen as an instrumental case study because of the avid following of its products and its reputation as a powerful brand. In the collection of data an ethnographic study on the attitudes, activities, and actions of Apple™ brand loyalists was conducted and a grounded theory approach was employed due to its deductive verification and inductive qualities in handling data regarding attitudes and motivations. Semi-structured interviews, questionnaires, and product personality exercises were conducted in order to explore Apple™ brand loyalist perceptions, motivations and attitudes towards product attributes and brands and the individual meanings and values they place on them. This research concludes with the construction of a brand molecule based on the analysis of the data collected. It is proposed that this molecule is Apple's rudimentary brand DNA and

that further research and understanding of brand DNA molecules like it will lead to a better understanding of the industrial designer's role in the relationship between product design and brand loyalty.

## **Keywords**

Product Design, Brand DNA, Brand Loyalty, Product Attributes, Brand Perception.

## **1 Introduction**

In spite of the billions of advertising dollars spent globally every year on power brands, it is unclear as to how much the success of a brand depends on advertising and marketing and how much of it depends on the physical attributes and experience of the product [1]. Power brands such as Nike, Starbucks, and Apple have each depended heavily on marketing and advertising in their development and establishment. The brand loyalty of these brands is unparalleled with consumer followings that transcend national borders. Brand loyalty can be seen as the gauge by which one can determine the value of a brand [2]. The brand loyalty of power brands like Nike, Starbucks, and Apple may determine the value of these brands; however it is difficult to determine exactly what fostered such loyalty to begin with.

Little is known empirically about the effect product design has on branding and brand loyalty, as few studies have investigated this subject. The use of product design



in brand building is still in its infancy due to the fact that, in marketing studies, product design has traditionally been regarded merely as a means of increasing perceived quality. More research is needed to understand how the practice of product design can be fully integrated in the development of a brand through the development of the physical attributes, character, and personality of a product. Do marketing and advertising agencies treat consumers as merely mindless sheep herded to graze on brand pastures? Does the physical experience of a product have a substantial influence on consumer attitudes and choice?

This study investigates the correlation between product design and brand loyalty. This is done through a survey of branding theory and an ethnographic study of product attribute expectations of brand loyalists. The metaphor of brand DNA [3], [4], [5], [6], [7] was used as a basis for the study. Investigation of the product design sequences in brand DNA (the combinations of the essential building blocks of a brand) will begin to delineate product design's direct effect on brand loyalty and hence its effect on brand equity.

### 1.1 Brand Equity, Brand Loyalty and Value

Experience or more specifically consumer experience plays a major role in what is called a company's bottom line or brand equity. Cagan and Vogel [8] see brand as communicated through a 'value proposition.' Carbone [9] refers to "a total experience as the customer value proposition" and "...how dynamic a force experience can be to a company's bottom line..."

The definition of brand equity can be divided into the four categories of brand name awareness, perceived quality, brand loyalty and brand associations [10]. Aaker defines brand equity as "... a set of assets (and liabilities) linked to a brand's name and symbol that adds to (or subtracts from) the value provided by a product or service to a firm and/or that firm's customers". Quarry [11] states that "without positive, loyal customer relationships, brand equity slips, and so does the bottom line."

Although many companies overlook brand loyalty (loyal customer relationships), it should be considered a company's valuable asset [10], [12]. Brand equity, often considered 'intangible,' can be measured in terms of its overall value based on brand loyalty [2]. Travis writes, "We used to think of brand equity as a strategic tool, but

when you realize that the point of building brand equity is to create customer loyalty, ...[y]ou learn that creating customer loyalty is neither strategy nor tactic; rather, it is the ultimate objective and meaning of brand equity."

Aaker [10] refers to brand equity as a core "value". Quarry [11] supports this definition and states, "...brand image is a promise made to prospects (done fairly easily through advertising, signage, public relations, etc.), but brand equity (where the real value is) is built when those promises are kept over time through many experiences." Quarry's premise is that brand equity is the sum total of the positive experiences a consumer receives from a brand resulting in "real" values. LaSalle and Britton [13] support this premise and break down the meaning of "value" into physical, emotional, intellectual and spiritual attributes of the product experience.

Cagan and Vogel [8] refer to 'Value Opportunities' that they break down into the seven consumer values of emotion, aesthetics, identity, ergonomics, impact, core technology, and quality. According to their research, they contend that each of the seven values "contribute to the overall experience of the product and relate to the value characteristics of useful, usable and desirable." These scholars also suggest that there is a temporal aspect to Value Opportunities that make them pertinent to today and ultimately irrelevant tomorrow [8].

### 1.2 Conceptual Framework for User Experience

The conceptual framework for this study (see Figure 1.) is comprised of the product experience (based on the formal product attributes) and the brand experience (derived from formal attributes of a brand). Product experience is defined as the consumer reaction to the formal attributes of form, color, material, texture, interaction, interface and usability, terms that readily fall into the realm and responsibility of product design and product designers [8], [14], [15], [12]. This research study specifically focuses on the formal attributes of form, color, material, and texture of the product experience in order to build a form vocabulary and does not study the attributes of interaction, interface, and usability. It is however recognized that an extended study of the attributes of interaction, interface, and usability could be conducted based on this current study to further research their influences on brand loyalty.

The formal attributes of the brand experience were chosen as the key features of the expression of a brand. These were identity [10], voice [16], mission [17], promise [17], value-proposition [10], marketing [18] and advertising [19], [13]. Figure 1.0 illustrates the conceptual framework constructed for this study, which incorporates the brand and product experience into a relationship with brand loyalty.



**Figure 1.** Conceptual Framework for Product and Brand Experience

Cagan and Vogel [8] state that a brand is “articulated” through the attributes of a product. The premise of this framework is that brand loyalty is maximized in the consumer experience through the integration of the formal attributes of a product with the formal attributes of a brand. This research study postulates that brand loyalty is fully realized when the product experience is intertwined with the brand experience through product design. This conceptual framework illustrates the fundamental building blocks of a brand, otherwise known as brand DNA [3], [4], [5], [6], [7], where the product attributes together with the brand attributes work in coordination with each other to build the overall consumer experience ultimately leading to and or maximizing brand loyalty.

### 1.3 Products and Emotional Ties

There are emotional ties between consumers and products [13], [20]. Travis [2] states that, “It’s possible for a product to get over the facts of its performance without giving you the feeling for it. But if a product communicates mechanically without involving you emotionally, it will stay a product rather than becoming a brand.”

Studies in sound symbolism or phonemes have shown that respondents across several languages associate emotions

such as sad, alive and daring with the same sounds [21]. It is likely that global products will be able to evoke their desired emotions and associations across several languages when phonemes are used because of the way humans naturally associate sounds with emotions [21]. Lenau and Boelskifte [22] tested “sensory and symbolic product attributes” using words in order to delineate product character and personality. Additional studies [14] used specific words in order to assign personalities to products and concluded that there was evidence that individuals perceive the personalities of products in similar ways [23].

The words consumers use to describe products and brands are powerful influencers with regards to how consumers view products. The emotional component within the consumer experience heavily influences the levels of consumer attraction to a product or brand. The attraction of products or brands lies within the links and connections made within the mind of the consumer on both a verbal and visual level.

### 1.4 Product Design Implications

The shift from a commodity-based to an experience-based economy has given rise to the modern consumer and their demands for more experiential products [24]. Companies and their brands often gain the loyalty of these consumers by integrating product design, communications and marketing efforts in a holistic experiential offering. Cagan and Vogel [8] state that, “a brand is communicated to a customer through a value proposition. This communication must ultimately be articulated through the semantics of the product, i.e., the attributes and personality of the product as seen by the user.” Integrated use of design methodologies such as semantics, symbolism, metaphor and shape grammars will begin to provide a means for product design to more specifically address consumers emotional needs.

In order for product designers to deliver on experiential products that have an emotional brand component embedded in them, they will need to utilize design methods that are replicable and that provide a level of transparency in the design process as well as the decision making process within the companies that manufacture those products. Product designers will be essential in delivering experiential products by managing the brand attributes, meanings and experiences ascribed

by consumers to the product attributes of form, color, material, and texture as well as any other sensorial aspects of the product. Positive consumer experiences as a result of the efforts of product designers can only help to reinforce the emotional ties between consumers and products.

Cagan and Vogel, in *Creating Breakthrough Products*, reference several examples of brands working cohesively through product design. With regard to brand building, Cagan and Vogel [8] reference Iomega products and state that, “the original Zip drives did not fare well in the marketplace until Iomega created a strong brand that merged visual graphic identity with distinct product forms and colors.”

Bernd Schmitt, in *Customer Experience Management*, cites Apple as successful in innovating its brand. Schmitt [12] writes; “When Apple hit hard times in the mid-1990s, its customers—some of the most loyal around—mourned what seemed to be the impending death of a company that had genuinely changed the way they lived their lives... What saved Apple was, again, innovative spirit... Its great breakthrough innovation was the iMac... Apple put its stamp on the product indelibly by creating an original line of five brightly colored translucent plastic cases, proving that computers can actually be attractive.” Schmitt points to the fact that Apple, even in the face of market share loss, utilized design to “innovate” its products in order to reinvigorate its brand.

LaSalle and Britton, in *Priceless: Turning Ordinary Products into Extraordinary Experiences*, reference Sam Farber the retired CEO of housewares manufacturer, Copco. LaSalle and Britton [13] write that Farber early on recognized that the shortcomings of kitchen utensils market “stemmed from design.” Farber initiated a relationship with Davin Stowell founder of Smart Design to embark on a design journey that would ultimately lead to the famed OXO Good Grips product line [13]. LaSalle and Britton [13] attribute the success of the OXO products to the fact that design was used to support and enhance the consumer experience.

Cagan and Vogel [8], Schmitt [12] and LaSalle and Britton [13] suggest that product design can be used as a tool to alter or change the way consumers associate the formal attributes of a product with those of a brand. These associations make up the values that consumers ascribe

to those products and ultimately to the companies and brands that produce them.

## **2 The Meanings of Attributes**

What meanings do brand loyalists ascribe to the product attributes of form, color, material, and texture? In order to answer this question, over 330 different words and or short phrases were generated from the 25 semi-structured interviews, the 13 open-ended questionnaires, and the 13 product personality exercises. The 330 words and or short phrases were then organized within the physical product attribute categories of form, color, material, and texture.

### **2.1 The Attribute of Form**

The form category contained 170 separate words and or short phrases that brand loyalists used to describe the form of an Apple™ product. The word ‘simple’ or ‘simplicity’ was the single most commonly used word in describing the form of an Apple™ product. Approximately 61% of the total respondents for the 25 semi-structured interviews and the 13 open-ended questionnaires felt that the form of an Apple™ product had or represented the meaning of simplicity. When asked to describe his feelings about the most important physical attribute of Apple™ products, one respondent stated that it was the simplicity of its shape or form: “It’s the simplicity of it. It’s shape, the way things are laid out, color. It just seems to me to be a very modern package. It doesn’t confuse me. Like the iPod is so simple, simple to look at simple to use it.” (interview # 3.0.1)

Simplicity in terms of form was highly regarded by Apple™ brand loyalists for both its aesthetic and functional ascribed meanings. The word ‘simplicity’ takes on the meaning of an all-encompassing term that ties product form with usage in a single package: “The top surface of this machine is in particular a simple flat surface with the logo on it. The logo is flush, it’s not raised or lowered, it’s simple. And the sides, the same way, they’re simple. The hinge mechanism from what I understand is a little more complicated than the newer ones but just overall it’s just a nice simple package.” (interview # 12.0.2)

The second most commonly used words in describing Apple™ product form were ‘sleek’ and ‘clean.’ Both words were used by 32% of the total respondents for the 25 semi-structured interviews and the 13 open-

ended questionnaires in ascribing meaning to the physical attribute of form. The word 'sleek' was used as a way of describing the essential no frills quality of the form of Apple™ products: "Apple has a much more sleek design than any other computers that I see. A lot more streamlined, only like the necessary components. It's much more like contained, it's like a box. Some might see it as boring but it's more like a sleek design." (interview # 15.0.1)

The third most commonly used word used to describe the meaning of Apple™ product form was the word 'rounded'. Approximately 24% of the respondents used the word 'rounded' in describing the form of Apple™ products: "I know the new line, the G5 is a lot crisper looking than what they had with the first iMacs, which was almost like a blob shape. But I think that regardless, with their edges and their corners, they make it a point to make it rounded. I think it just makes it more attractive." (interview # 4.0.3)

Apple brand loyalists use the word 'rounded' not only to describe the physical shape of the product but also to describe the products as approachable, friendly and tender: "I think the form. If you look at this one (points to iBook) it's kind of round, nothing sharp. I think its very kind, like easy, soft. It's not masculine, you know tender." (interview # 2.0.1)

## 2.2 The Attribute of Color

The color category contained 53 separate words and or short phrases that brand loyalists used to describe the color of an Apple™ product. The word 'simple' was again the most common word used by brand loyalists, but this time for the meaning they ascribe to the physical attribute of color. Approximately 13% of the total respondents for the 25 semi-structured interviews and the 13 open-ended questionnaires felt that the word 'simple' best expressed the color of an Apple™ product. Brand loyalists see Apple products through the lens created by the product's color. Color therefore takes on meanings that are ascribed to the product's functionality as a whole: "Again simple, white with the gray inside. It makes me feel like it's easy to use. Instead of throwing a whole bunch of different colors on different buttons, the place they use colors in places like this (points to ac green led and front silver latch) it just makes it seem that much easier to use to me cause I'm not searching around for things trying to hunt them

down." (interview # 17.0.3)

Color influences the perception of ease of use ultimately altering the loyalist's perceptions of the product and it's functionality. Respondents often used several words that were similar in meaning. The group of words most commonly used by the respondents referred to the plain or neutral quality of Apple™ product color. This group of words consisted of the words; plain, neutral, basic, minimal, boring and blending. Approximately 18% of the 25 semi-structured interviews and the 13 open-ended questionnaires felt that the color of an Apple™ product had or represented a 'plain' or 'neutral' quality: "Very neutral and soft-spoken. There is no color—the gray, metal and white. They don't make me feel one way or the other they are kind of just clean. They have a nice clean aesthetic and when you throw them into any environment you want and it's ok. If I had a blueberry iMac I'd probably get sick of it pretty quickly or not feel happy all the time when I'm using it. It would probably annoy me a little bit. So I like that it's just there and blends in and I don't have to think about it." (interview # 22.0.1)

Color also influences the loyalist in terms of how the product integrates into their individual environments. The 'neutral' description of Apple™ product color takes on the meaning of a product's ability to blend in unobtrusively to its surroundings.

The third group of words or short phrases common amongst the respondents consisted of; "soothing," "ease of use," "peaceful," and "relaxed." Approximately 11% of the 25 semi-structured interviews and the 13 open-ended questionnaires used words in this group: "White. Definitely different shades of white and grays. It seems very peaceful. You're able to sit down and relax when you are working on an Apple. It's not a feeling of frustration or anger. It eases you. It's easy to look at and easy on the eyes." (interview # 14.0.2)

Meanings of color ascribed by Apple™ loyalists also relate to the psychological and physiological reaction they have to them. Product color that is described as 'soothing' or 'relaxing' ascribe those feelings onto the product resulting in an overall impression that the product is easy and or pleasurable to use.

### 2.3 The Attribute of Material

The material category contained 29 separate words and or short phrases that brand loyalists used to describe the material of an Apple™ product. The group of words most used by respondents describing material related to durability or longevity. Approximately 39% of the total respondents for the 25 semi-structured interviews and the 13 open-ended questionnaires used words in this group. This group consisted of the words; durable, tough, strong, solid, and sturdy. Apple™ brand loyalists see materials as functional elements of the product: "The substantialness of the materials they use. The G3 and G4 cases use the exterior plastic, whatever it was, was very substantial. The cases felt solid and the G5 cases is no exception to that- it's a block of aluminum and a radiator in front of it for airflow. The product feels like it's durable." (interview # 8.0.2) Materials create a feeling of durability that develops a sense of reliability and trust in the brand loyalist towards the product.

The second group of words common amongst respondents related to the functionality of materials. Although durability would fall under this category the specific use of the word 'function' or 'functional' was observed within the data resulting in a 24% count of respondents who used these words: "The Titanium books also have this frame section, the lighter colored section is actually a carbon reinforced plastic and not metal and that was chosen specifically because of its mechanical properties and not for cost issues or appearance issues. I think that says a lot to me about how they do their design work. They don't target a price point necessarily, they target the functional which is more important to me than a price point." (interview # 12.0.2)

The third most commonly used word was 'clean.' Approximately 13% of the total respondents for the 25 semi-structured interviews and the 13 open-ended questionnaires used the word 'clean' in ascribing meaning to the physical attribute of material: "To me it (material) goes hand in hand with trying to keep easy to clean. I find aluminum not that easy to keep clean. That's the main significance to me with materials. I don't care what kind of composite it is as long as it survives." (interview # 21.0.3)

### 2.4 The Attribute of Texture

The texture category contained 15 separate words and or short phrases that brand loyalists used to describe the texture of an Apple™ product. The word 'smooth' was the

single most commonly used word in describing the texture of an Apple™ product. Approximately 37% of the total respondents for the 25 semi-structured interviews and the 13 open-ended questionnaires described the texture of an Apple™ product as being smooth: "The thing (iPod) would be a little off if it was anything but smooth. Sliding into a bag or having it in your pocket or something like that. I tend to prefer things to have a smooth surface." (interview # 12.0.2) The term 'smooth' tended to take on a more functional meaning as in how the smooth texture of an Apple™ product slid into a bag or pocket with ease.

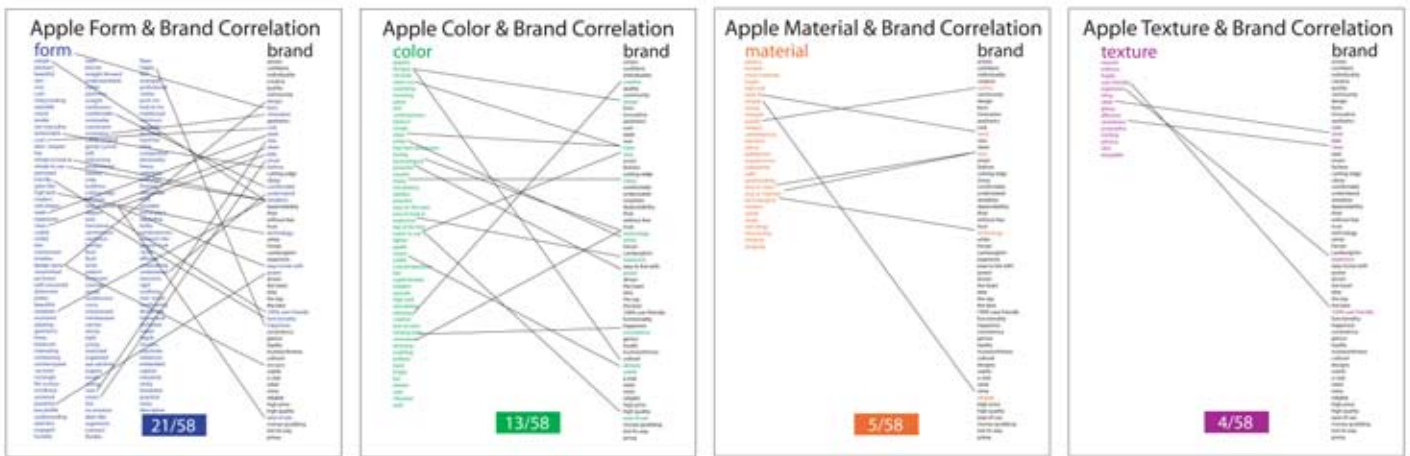
The second most commonly used word in describing Apple™ product texture was 'glossy.' This word was used by 18% of the total respondents for the 25 semi-structured interviews and the 13 open-ended questionnaires in ascribing meaning to the physical attribute of texture: "I'm a big fan of this glossy white. It just doesn't seem that a computer should be anything else—any kind of texture. It's just a box for other things so putting some kind of texture on it would be artificial. This thing (iPod) the way it slides into your pocket it's the best thing in the world. The iBook is the same I just want to pet it (stroke computer)." (interview # 24.0.4) The term 'glossy' tended to refer to the feel of the Apple™ product in which the loyalist was compelled to physically interact with the surface texture for visual as well as tactile pleasure.

### 3 From Attribute to Brand Perception

How do loyalists transcribe product attributes into brand perceptions? In order to answer this question descriptive personality words were generated regarding the brand loyalists' perceptions of the Apple™ brand. A total of 58 separate words and or short phrases were generated from the 25 semi-structured interviews, the 13 open-ended questionnaires, and the 13 product personality exercises. These 58 words and or short phrases, representing loyalist perceptions of the Apple™ brand, were then separately cross-referenced with the groups of words representing each of the physical product attributes of form, color, material, and texture in order to develop a correlation between the meanings brand loyalists ascribe to product attributes and their perceptions of the overall brand.

### 3.1 Apple Brand Personality Traits

The 170 different words and or short phrases generated by the respondents representing the physical attribute of form were cross-referenced with approximately 58 words



**Figure 2.** Apple Form, Color, Material, Texture and Brand Correlation

and or short phrases they generated within the study representing the brand (see Figure 2.).

### 3.2 Apple Form & Brand Correlation

Exactly 21 words representing the form matched up with the 58 words representing the brand resulting in a 36% correlation. The sheer numbers of words generated by the studies regarding form and the large number of those words correlating with the brand suggests that brand loyalists make certain brand perception connections with the attribute of form.

### 3.3 Apple Color & Brand Correlation

The 53 different words and or short phrases generated by the respondents representing the physical attribute of color were cross-referenced with approximately 58 words and or short phrases they generated within the study representing the brand.

Exactly 13 words representing the color matched up with the 58 words representing the brand resulting in a twenty-two percent correlation. The numbers of words generated for color were considerably less than that of form indicating that brand loyalists made fewer correlations between the attribute of color and their perceptions of the Apple™ brand.

### 3.4 Apple Material & Brand Correlation

The 29 different words and or short phrases generated by the respondents representing the physical attribute of material were cross-referenced with approximately 58 words and or short phrases they generated within the study representing the brand.

Exactly 5 words representing the material matched up with the 58 words representing the brand resulting in a seven percent correlation. The numbers of words generated for material were considerably less than that of both form and color indicating that brand loyalists made even less correlation between the attribute of material with their perceptions of the Apple™ brand.

### 3.5 Apple Texture & Brand Correlation

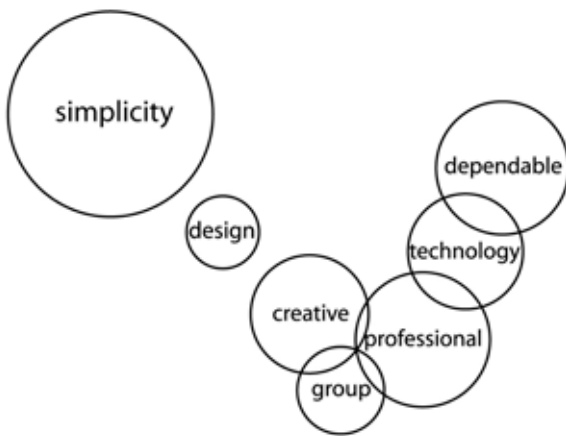
The 15 different words and or short phrases generated by the respondents representing the physical attribute of texture were cross-referenced with approximately 58 words and or short phrases they generated within the study representing the brand.

Exactly 4 words representing the texture matched up with the 58 words representing the brand resulting in a little less than seven percent correlation. The numbers of words generated for texture were lower than that of form, color, and material indicating that brand loyalists made considerably fewer correlations between the attribute of texture with their perceptions of the Apple™ brand.

## 4 Brand Interpretation

How do brand loyalists interpret brands? In order to answer this question Apple™ brand loyalists were asked to comment on a series of questions addressing their attitudes and feelings about the brand and what it stands for. Several reoccurring themes developed in the analysis of the 25 semi-structured interviews and the 13 open-ended questionnaires leading to the accumulation of 58 key words that brand loyalists use to describe the Apple™ brand. These 58 words were analyzed for patterns and organized

into groups or categories by their general meanings as interpreted by the researcher. The 7 categories of simplicity, dependable, technology, professional, creative, group, and design were chosen to best represent the groups or categories of words in the analysis process (see Figure 3.).



**Figure 3.** Brand analysis bubble diagram based on the 7 groupings of the 58 words representing the Apple™ brand.

The ‘simplicity’ category contained approximately 12 related words encompassing the simple and easy to use aspects of the Apple™ brand. The ‘dependable’ category contained approximately 10 words relating to dependability, quality, and trust. The ‘technology’ category contained roughly 8 words that covered the wide spectrum from technology to innovation. The ‘professional’ category contained approximately 14 words pertaining to a professional, elite, and high-end quality of the brand. The ‘creative’ category contained 5 words that related to creativity and individual expression. The ‘group’ category contained 4 words representing the Apple™ community of users. Lastly, the ‘design’ category contained 5 words pertaining to design, aesthetics, and form.

The ‘dependable’ category is linked to the ‘technology’ category through the idea that technologies can be seen as dependable or trustworthy. The ‘technology’ category relates to the ‘professional’ category due to the association professionals make with technology. The ‘professional’ category is associated with the ‘creative’ category as creative professionals use Apple™ products and have become associated with the product. This observation reoccurred throughout the study. The ‘creative’ category relates to the group category in that many loyalists

viewed creatives as a niche group targeted by Apple™. The ‘simplicity’ category of words would seem somewhat disconnected from the other categories if it were not for the ‘design’ category. The ‘design’ category of words relates to the ‘creative’ category through creative expression as well as relates to the ‘simplicity’ category through form and aesthetics. Although a smaller category by comparison, the ‘design’ category is a crucial category in the make up of the loyalist’s perceptions of the Apple™ brand.

When looked at 3-dimensionally (see Figure 4.), the design category of words can be seen as the fusing element in bridging brand loyalist perceptions of simplicity with the rest of their perceptions of the Apple™ brand in what could be considered the rudimentary Apple™ brand DNA molecule. This molecule, not unlike the human DNA molecule, is a complex configuration of elements that can be altered by even a single element. Regarding the existence of Apple DNA, Steve Jobs, co-founder and CEO of Apple was quoted as saying “There’s a very strong DNA within Apple, and that’s about taking state-of-the-art technology and making it easy for people.” [25] The brand DNA molecule presented here was based on the words generated by brand loyalists within this study and represents a temporal view of the Apple™ brand. With each new Apple™ product introduced into the market from this point on, there is the potential for the brand molecule to change based on the new meanings consumers place on the physical attributes of those products. Much like the DNA molecule and the ever evolving human genome, changes to the Apple™ brand molecule will



**Figure 4.** The Apple brand DNA molecule as a 3-dimensional reassessment of the brand analysis bubble diagram and the resulting relationships between the fundamental elements of the brand.

continue to evolve the Apple™ brand in a kind of product design genome [26]. Design as one small element within the Apple™ brand DNA molecule can potentially alter the entire Apple™ product genome through its relationship and connection with the other elements of creative, dependable, technology, professional, group and simplicity.

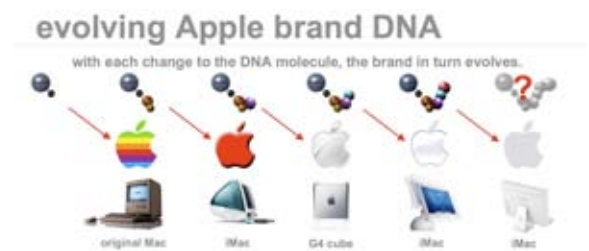
Apple™ brand loyalists, in their world of meanings, make associations between what they experience with Apple™ products and what they believe to be true about the brand. As businesses, manufacturers, and industries further use product design in the development of brands, more research will be needed to support or refute this claim. The potential for product attribute design to be used as a tool to benefit consumers, businesses, manufacturers, and industries could be greatly increased if such research is conducted.

### 5 The Attributes of a Brand

Consumers do not have access to company brand attributes as these attributes are not found in any brochure or company website. Brand attributes are a product of both marketing and advertising efforts. Apple's success is no exception to this. Marc Gobé, noted author of Emotional Branding, states that, 'Without the brand, Apple would be dead [27].' In his book, *The Cult of Mac*, Kahney in his interview with Marc Gobé, writes: "Gobé noted that Apple has always projected a human touch- from the charisma of Steve Jobs to the notion that its products are sold for the love of technology... The human touch is also expressed in product design, Gobé said. Apple's flat screen iMac, for example, was marketed as though it were created personally by Steve Jobs and Jonathan Ive, not factory workers in Asia [27]."

Apple's brand essence has been communicated to the general public in the past through the traditional vehicles of advertising and marketing. Today, Apple is a relatively well-known brand with over 25 million users [27]. In recent years, Apple™ appears to communicate a great portion of its brand essence through the design language of its products in addition to the traditional channels. Although this may be evident to some degree in the physical product attributes of first Apple™ Macintosh introduced in 1984, these attributes are overshadowed by Apple's \$100 million record advertising budget for that same period [27]. Amidst severe hard times for Apple™ in the mid 1990s, a profound change in physical product attributes was witnessed in

the development of the original iMac. Schmitt [12] states, "...Apple put its stamp on the product indelibly by creating an original line of five brightly colored translucent plastic cases, proving that computers can actually be attractive." True the iMac had other features such as internet ready access and a G3 processor that contributed to its success, however the lasting influence of its physical attributes lingered on for several years in the form of 'jewel-toned' translucent cases for a myriad of other products in other industries [12]. Schmitt [28] reports that in 1998 *BusinessWeek* wrote; "Its [Apple's] translucent teal casing is a bold departure from the acres of putty-colored PCs on desktops everywhere." Prior to Apple's release of the iMac, it too had 'putty-colored' computer casings much like the rest of the computer industry (see Figure 5).



**Figure 5.** The Apple brand DNA evolution from the original Macintosh to the 2005 third generation iMac.

As the data analysis of the research in this study suggests, the Apple™ brand attributes of simplicity, ease of use, creativity, professionalism, technology and dependability are bound together through the emerging brand attribute of design. Although product design has probably existed within the brand since its earliest beginnings, the establishment of design as an even greater constituent of the brand will occur as more loyal Apple™ users begin to recognize the value and consistency of Apple™ product design.

#### 5.1 Brand Loyalty and Truth Value

This study has operated on the notion that brand loyalty is the result of reinforced truth-value in a brand [7]. Upshaw [7] goes on to state that '[a]ll brands fundamentally seek the same result: a covenant of trust based on a customer's set of expectations.' Brand loyalty and trust go hand in hand in terms of the user interaction with the physical attributes of the product experience. More research is needed to further reveal the inner workings of brand loyalty and trust so that a clearer understanding of its effect on brand equity can be assessed. What is important to understand is not



necessarily a grandiose cause and effect relationship but rather an incremental effect relationship as loyalty and trust must be earned over time through repeated fulfillment of consumer expectations.

## 5.2 DNA and the Nature of Relationships

Brand DNA can be defined as the words and perceptions of users contained in memory over time [4], [6]. The nature of the relationship between product attributes and brand loyalty lies within the strength of the bonds between the individual elements comprising the brand DNA molecule (see Figure 4.0). Based on the data patterns within this study it is proposed that strong bonds within the brand DNA molecule regarding product attributes reinforces brand beliefs that eventually lead to brand loyalty. Overall brand loyalty may be threatened if the bonds are weak between the product attributes of form, color, material, and texture and the other key elements of the brand within the mind of the user. This study contends that all brands have brand DNA and that the notion of bond strength within brand DNA applies to both powerful brands like Apple as well as a variety of less powerful brands. Any brand has the potential to attain greater levels of brand loyalty through a well-managed blend of product design and brand experience attributes. The strength of the relationship between product attributes and brand loyalty exist within a continuum of weak and powerful brands within the marketplace.

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# Bikes Don't Break Legs – VisCom as an Emergent Phenomenon

## Abstract

Visual Communication Design lacks a compelling description of its own practices. In the past VisCom has attempted to redress this through reference to modernist or postmodernist design theories, each of which has assisted and impeded our aims in equal measure. In this paper I suggest a model of visual communication practice that describes our praxis in relation to existing social and scientific models; while refusing to deny the value of either systems of craft or semiology to the formation of diverse and successful communications.

## Keywords

Conditions of applicability, Meaning and perception, Graphic Design, Graphic Communication, Visual Communication, Theory, Practice, Scientific and Social Theories.

## 1 Introduction: 'the conflict between essence and appearance'

'The objects in use by the new generation suffer from the fatal compromise between a supposedly "artistic" intention and the dictates of technical manufacture; from a feeble turning back to historic parallels; from the conflict between essence and appearance.' (Tschichold, 1928) [1]

If I turned up one day with a leg in plaster, and when asked how my leg came to be broken replied that, 'my bicycle broke it', I might be telling a socially sanctioned 'truth' as far as I knew it (a sign that would pass as a signification

of an 'explanation'): but I would not actually be *explaining* anything. If I carried on, saying that I had hit the kerb, and crashed to the ground breaking my leg, I would be attempting to give a fuller accounting of the event: but still not possess anything approaching a full description, one that would allow me to draw conclusions for the future about the accident. If I could describe: the physical characteristics of the combined physical system that was 'me' riding the bike interacting with the road surface, the environmental conditions, possibly a consideration of the social system that supports safe bike use; at that point I might have a working description of my accident. Visual Communication is in the daily position of telling the 'truth' as far as it knows it about its practices. Occasionally it generates some compelling explanations; but in truth it only possesses weak descriptions of its activities. In this paper I will attempt to describe a model of design practice based on the scientific theory of Emergent Evolution (or Emergence).

Design (theory and practice) is replete with descriptions of this or that designer's practice, each description has a multitude of manifestos, and any number of 'designer's statements'. These texts have a common obsession with the eternal flow from *form* to **function** and back again; few of them try to tackle the question of what happens between a designer's initial spark of inspiration and the creation of a successful design artefact: I would venture that we even lack a convincing definition of success.

I must confess that in common with many other working designers in the field, I never spent much time considering how the act of design actually functioned. I was happy in the knowledge that it did. When I became an academic the issue took on a greater urgency: my job was now to guide design students in their task of becoming rounded and well informed designers and initially I was confident that the subject's understanding of its own functions would have moved on in the years between my being the student and my being the tutor. Driven by the combination of social pressure and technological change I had witnessed in industry how could the subject's understandings of its own practices have failed to advance? I was (and continue to be) quite surprised to discover that the internal epistemologies of the subject had moved on very little (if at all) in the intervening years. We find that the internal epistemologies of art and design still owe more to the culture of the apprenticeship and the art school than to any of the myriad writings of theorists in the cultural realms. I suspect that this is a statement that will cause immense annoyance to many teachers and practitioners in the VisCom (Visual Communications)<sup>1</sup> field and at the risk of annoying them even more I will attempt to explain this statement through this paper.

The art and design community has always been very good at turning out individuals whose practice can reflect on and inform the culture of others, while also reflecting on the applications of their own craft,<sup>2</sup> as they are received by a specific audience. Unfortunately while the subject is strongly informed about uncovering meaningful readings for, and then communicating with, a particular audience, we are poorly informed about the internal processes that lead us to generate this solution. To be blunt we lack an epistemology of design. We (the designers of the world) lack an explanation about how the decision we take now, effects the elements we already hold in play, let alone those which we might add next. We talk about each decision being 'fit for its purpose', but without having a definition of what 'fit' is. In truth I do not believe that we have a clear understanding of how our practice actually forms a working design.

This paper forms part of a current trend in investigating how design (as a mode of address) works. External readings of the functions of design as a system, if not common, are at least extant. Klaus Krippendorff – in his 2005 book *The Semantic Turn – a new foundation for design* – does

sterling work in bridging the gap between the people who have been studying human thought and its artefacts: philosophers, linguists, sociologists and cyberneticians, and the people who create them. However his specific treatment of the Visual Communications Arts is lacks depth, being less than two pages long. Niklas Luhmann's *The Reality of the Mass Media* is much more pertinent, and Deleuze and Guattari's *Anti-Oedipus* has shown us whole new ways in which communication can signify across many levels. Disturbingly for designers all of this attention is exterior to the subject area. Krippendorff (2005) explains why this can be dangerous:

'Sensing the opportunities that new technologies seem to promise, new scholarly disciplines like artificial intelligence, communication science, plus various hybrid professions, cognitive engineering and design management, as well as such technical specialities as computer interface design, have emerged and are blazing trails into territories previously claimed by designers, In this information-rich, fast-changing, and increasingly individualistic culture, contemporary design discourse is no longer compelling. Thus, industrial design finds itself at a critical turning point.'

(Krippendorff, 2005, Intro 3 para.1) [2]

He expands this further saying,

'Discourses can be enormously productive of new artifacts, run out of steam, or vegetate by merely reproducing themselves. Their artifacts vary greatly, from abstract theories to medical practices to rather concrete material arrangements. Discourse communities can grow in size or shrink. When below a critical threshold, discourses die, leaving artifacts behind that other discourses may appropriate, as archeology does with artifacts from extinct cultures... Although discourses are organizationally autonomous, they respond to other discourses by redefining their identities and redrawing their boundaries. Within such boundaries, members of a discourse community know who they are and can feel to belong. The boundaries of discourses are more or less permeable, however. *A weak boundary invites colonization by other discourses.*'

(Krippendorff, 2005, p.25) [2] (My emphasis.)

There seems to be so little interest from within VisCom to form our boundaries and to own our own narrative. It is worth laying out at this early point some of the issues I will not be discussing in this paper:

- I am specifically not saying that there is a singular

<sup>1</sup> I will use the umbrella term Visual Communication, as opposed to Graphics, Graphic Communications, Graphic Design, Interactive Graphics, Illustration, etc

<sup>2</sup> I will be talking about 'craft' quite a lot in this paper. In this context I mean craft to mean sets of culturally limited forms of praxis whose uses are acceptable within a particular area of making things; the term carries connotations of facility and guile. By opposition I will use the term Practice to talk about less historically or culturally bound approaches to making things.

measure of fitness, or that we can deterministically know the full nature of the end result by an analysis of the parts of a design.<sup>3</sup>

- I do not believe that there is a single über-formula that can usefully reduce the activity of design to a deterministic process: I will discuss why such an endeavour is unlikely to work later in this paper.
- I am not suggesting that the modernist mirage of a single language of design exists. VisCom is a culturally relativist activity from beginning to end, and until we have a global monoculture – from the pair of children in a São Paulo playground to the largest global social network (a truly vile thought) – we can never have a universal language of design.
- I am not suggesting that this model of practice replaces or subsumes any existing design movement. It simply works by presenting a model of how the culture that any such design movement represents works together with the technical underpinnings represented by craft.

I do however believe the science of Emergence offers us a good working model to explain how, from the view-point of the designer, the elements that make a successful design can seem, almost magically, to come together. In many ways this paper is intended to be both a declaration of defeat – we can never predetermine the nature of a visual communication – and a celebration that we can strive to understand our own own praxis; that we don't operate inside a black-box with a brief at one end and an artefact at the other.

That we can know 'fit' when we see 'fit' is part of the mystery of design, that we can demonstrably create artefacts, whenever we desire, that speak to an audience is quite remarkable.

## 2 Graphics and Emergence

Graphic Design or Illustration, Graphic or Visual Communication; the multiplication of names give some indication of the difficulty of defining the subject. There are so many internal political, pedagogic and semantic tensions at play – amongst a group of individuals who are very much aware of the power vested in defining the signs, and in assigning those signs values – that it is in no way surprising that it is very difficult to find a definitive definition of the subject. In fact it is remarkable how scarce any such definitions are. For example we have:

'Graphic design is not, in most cases, a thing-in-itself—it's a formal property, a rhetorical dimension, a communicative tissue of something else.'  
(Poyner, 2002, p.126) [3]

I'm not completely sure what this means, but I suspect I disagree. By contrast I rather like (for its beautiful disingenuous bluntness) Michael Bierut's definition: 'Graphic design is a way to make a statement. But it is—and always has been—also a way to make a living.' (Bierut, 2002, p.181) [5] But Bierut of Pentagram and AIGA is hardly the blue-collar toiler you might suppose from the nature of the quote.

Once it was easy to view visual communication as a simple bridge from on the one hand art and design to on the other commerce. There was a time when it would have been quite honest to talk of *Commercial Artists*. We are now in a transitional period: changes of technology have led to simplistic views of art in service of business losing validity. It is quite feasible for a designer to act as auteur, activist and commercial artist from the same workstation, during the same day. Künsters and King note the existence of this change:

'Mainstream audiences are often nonplussed by this kind of work (self directed and authorial), not understanding the point of graphic design that is not being used in the service of mass communication.'  
(Künsters and King, 2001, p.7)[6]

The form may 'look' like mass media and superficially speak to the same significance, the tools of delivery may likewise seem familiar, but the messages created today are more diverse than at any time in the subject's history. Following the slow eclipse of postmodernism, as a guiding star for visual communication designers, confusion reigns. Poyner's following statement on post-modern graphics reflects this perplexity:

'In postmodernism, modernism's hierarchical distinction between worthwhile 'high' culture and trashy 'low' culture collapse and the two become equal possibilities on a level field.'  
(Poyner, 2003, p.11) [7]

Though this statement speaks to a certain time and space, it recapitulates the design wars of the Twentieth Century. It ignores one of the key systemic intentions of visual communication, that of speaking to (or for) someone who

<sup>3</sup> Unlike Bertrand Russell who in 1927 stated that, 'We may say that this is the characteristic merit of analysis as practised in science: it enables us to arrive at a structure such that the properties of the complex can be inferred from those of the parts. And it enables us to arrive at laws which are permanent, not merely temporary and approximate. This is an ideal, only partially verified as yet; but the degree of verification is abundantly sufficient to justify science in constructing the world out of minute units.' (Russell, Bertrand, *Analysis of Matter*, 1927 (1992), Routledge, London.) [4] Truly a statement of it's time.

is not the author of the communication. I may dislike *The Sun*, and like *The Guardian* so I cannot judge their value and modes of operation dispassionately, in design terms on a 'level field'. I am not the intended recipient of one system of significance (*The Sun*), but am very much the recipient of the other (a design academic, need I say more?). There is no level field; in both of the papers mentioned above we have successful attempts to use form (embodying relevant regimes of signs in artefacts) to speak to the values of a particular group (relevant regimes of signs):

'We call any specific formalization of expression a regime of signs, at least when the expression is linguistic. A regime of signs constitutes a semiotic system. But it appears difficult to analyze semiotic systems in themselves: there is always a form of content that is simultaneously inseparable from and independent of the form of expression, and the two forms pertain to assemblages that are not principally linguistic. ... it is impossible to attach any particular privilege to the form or regime of the "signifier". If we call the signifying semiotic system semiology, the semiology is only one regime of signs among others, and not the most important one.'

(Deleuze and Guattari, 2004, p.124) [8]

It may seem a bit pedantic to take such exception to Poyner's statement, but the concept of 'playing field' is a valuable one to consider here. The regime of signs – be it Graphics or Illustration, or hang gliding –conducting the operation is not the arbiter of which possible readings might be made of a communication (the playing field); we cannot absolutely define the final reception of any VisCom job. Our role as designers is to deliberately speak with other's voices. This is not simply a matter of saying that modernism was wrong to say only singular reading were valid, but also of drawing attention to the weakness of postmodernism's assumption that there is nothing but singular readings. There will be readings that have greater currency than other reading, but only for durations and circumstances bounded by the discrete and partial nature of the culture doing the reading (and cultures can get amazingly discrete and partial with their readings). But within those readings, at that time those readings are 'real' (valid, appropriate). Road signage systems 'work' within credible definitions of work (the serve as navigation), books meet viable criteria for legibility.

'Maturana and Varela (1988:141-176) take human cognition as an operationally closed system that develops its own internal correlations (constructs its own worlds), preserving the ability to live in the face of recurrent perturbations from an otherwise unknowable outside. This would imply that artifacts, like colors, may have external causes but are conceptualized, constructed, and experienced by our own nervous system – without knowable correspondences to what could-exist without a human observer.'

(Krippendorff, 2006. p.41)[2]

So, there will be times when form, and formal systems (classical typography or renaissance composition) have a strong validity and times when they have none at all. This selection process that delineates this validity is one that I will return to later in the paper.

'Furthermore, designers cannot completely evade the issue of form. It makes no sense to talk of graphic design that is purely conceptual: graphic ideas are visual ideas – ideas about word and image – and form is a vital element in their execution.'

(Künsters and King, 2001, p.6)[6]

The potential range that the form of a message may take is now so plastic that form is no longer a limitation but a liberation. Technology currently allows designers a multitude of compatible conduits for any one job. And this transitional time requires a reassessment of our practices; we have lost the assurance offered by traditional craft, then lost the confidence gained through the liberation of craftlessness. In a spirit of clarity I offer this closing quote, which is about as close a working definition of Visual Communication as I can find:

'Graphic design is the practice of creating visual form using words and/or pictures for the purpose of communication. The communication must have meaning (otherwise it is not understandable), and it must create value (it must be worth something to somebody).'

(Cavelli, 2003, p.76)[9]

### 3 Emergent Design.

'Networks predate complexity, from biology to society and technology. In many cases, large-scale, system-level properties emerge from local (bottom-up) interactions among network components.' (Sol & Valverde, 2006, p.1) [10]

Emergence is a scientific theory that is closely connected with Chaos Theory and Complexity, it deals with systems that demonstrate novel properties that arise through the interactions of a multitude of lower level components.

‘If “complexity” is currently the buzzword of choice for our newly minted millennium – as many theorists proclaim – “emergence” seems to be the explication of the hour for how complexity has evolved. Complexity, it is said, is an emergent phenomenon. Emergence is what “self-organizing” processes produce. Emergence is the reason why there are hurricanes, and ecosystems, and complex organisms like humankind, not to mention traffic congestion and rock concerts. Indeed, the term is positively awe-inspiring. As physicist Doyne Farmer observed: “It’s not magic...but it feels like magic.”’  
(Corning, 2002, p. 1) [11]

It is both a remarkably old and dangerously new idea. Corning, in his 2002 paper, cites sources that place its origins around 1874 as a direct response to Darwin’s Theory of Evolution:

‘...the term “emergent” was coined by the pioneer psychologist G. H. Lewes in his multi-volume *Problems of Life and Mind* (1874-1879). Like many post-Darwinian scientists of that period, Lewes viewed the evolution of the human mind as a formidable conundrum. ... (Lewis) argued that, certain phenomena in nature produce what he called “qualitative novelty” – material changes that cannot be expressed in simple quantitative terms; they are emergents rather than resultants. To quote Lewes:

“Every resultant is either a sum or a difference of the cooperant forces; their sum, when their directions are the same – their difference, when their directions are contrary. Further, every resultant is clearly traceable in its components, because these are homogeneous and commensurable... It is otherwise with emergents, when, instead of adding measurable motion to measurable motion, or things of one kind to other individuals of their kind, there is a co-operation of things of unlike kinds... The emergent is unlike its components in so far as these are incommensurable, and it cannot be reduced to their sum or their difference (p. 413).”  
(Corning, 2002, pp. 2-3) [11]

In many ways these seem to be extensions to ideas as old as Spinoza’s Passions. Spinoza writes of ideas that work in *Composition* with our minds to extend our range of action,

and others that Decompose with our minds to reduce our range of actions:

‘There is no Good and Evil, but there is good and bad. ... The good is when a body directly compounds its relation with ours, and with all or part of its power, increases ours. For us, the bad is when a body decomposes our body’s relation, although it still combines with our parts, but in way that do not correspond to our essence, as when a poison breaks down the blood.’  
(Deleuze, 1988 p.22) [12]

What Emergence and Spinoza’s Passion have in common is the acknowledgement that all that we are (as creative agents) and all that we do (as creative agents) is form networks that in turn change our relations with the environment in which we operate. Corning gives us a definition of Emergence that starts to hint at why I see Visual Communications design (as well as many other social and technically innovative systems) as emergent:

‘I would propose that emergent phenomena be defined as a “subset” of the vast (and still expanding) universe of cooperative interactions that produce synergistic effects of various kinds, both in nature and in human societies. In this definition, emergence would be confined to those synergistic wholes that are composed of things of “unlike kind” (following Lewes’s original definition). It would also be limited to “qualitative novelties” (after both Lewes and Lloyd Morgan) – i.e., unique synergistic effects that are generated by functional complementarities, or a combination of labor.’  
(Corning, 2002, p. 10) [11]

In other words combinations of ‘things’ form synergies all of the time (I suspect that this is a very modern reading of the Passions). A play of warm air in Texas may blow a strand of straw into the air; this is simple synergy. The same play of air, combined with warm wet air coming up from the Mexican Gulf, mixing with cool air from the prairies forms a tornado, and at that time *emergent* phenomena will have come into play, and a strand of straw blowing into the air is the last thing we have to worry about.

We see this in biology. If we could divorce all of the cells of your body, one from another; ‘you’ would be no longer be present you would lost *functional organisation*. If we could magically reconnect them all the body might again live. On one level this life would appear to be an emergent phenomena, but in fact emergence still has not occurred. At this stage our reintegrated body is a











**Ergonomics** – Quite simply how knowledge of human capabilities may inform the design of artefacts. The International Ergonomics Association (2000)<sup>4</sup> defines Ergonomics as: ‘Ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system.’

Twas brillig, and the slithy toves  
Did gyre and gimble in the wabe:  
All mimsy were the borogoves,  
And the mome raths outrabe.

Twas brillig, and the slithy toves  
Did gyre and gimble in the wabe:  
All mimsy were the borogoves,  
And the mome raths outrabe.

*twas brillig and the slithy toves  
did gyre and gimble in the wabe  
all mimsy were the borogoves  
and the mome raths outrabe*

Twas brillig, and the slithy toves  
Did gyre and gimble in the wabe:  
All mimsy were the borogoves,  
And the mome raths outrabe.

**Fig. 12** Ergonomics. Each of these typeforms has demonstrated differing levels of readability and legibility in rendering the first verse of Jaberwocky by Lewis Carol: despite being the same point size and all being the same weight.

**Environmental Considerations** – How the placement of the artefact affects the uses that the artefact may be used for and possibly offer alternate uses for the artefact beyond that envisaged by its designers. A movie ticket has a very special meaning that is entirely geographically linked (and which is beyond its ergonomic functionality). In certain environments it may find alternate values as a note or a beer mat.



**Fig. 13** Environmental Considerations. Here we see some of the uses of the 2008 Olympics logo. Each forms new meanings (monumental, personal, material, etc.) by virtue of its location.

**Technological Means** – The nature and availability of the technology is a limiting factor in how communication between two parties can happen. ‘Interaction (actual interaction between the sender and the receiver) is ruled out by the interposition of technology...’ (Luhmann, 2000, p.2) [16]. Access to technology is far from uniform (and I don’t mean high technology, I mean any technology), so the technical means we have at our disposal to engage with a design brief clearly effects the form of the end artefact. ‘...the technology of dissemination plays the same kind of role as that played by the medium of money in the differentiation of the economy: it merely constitutes

a medium which makes formation of forms possible.’ (Luhmann, 2000, p.2) [16]<sup>5</sup>



**Fig. 14** Technological Means. The technology at our disposal defines the reach of our message and the nature of our audience.

Enumerating all of these different classes of the design process that composes<sup>6</sup> the finished artefact, from out of the total number of possible elements, that define the fitness landscape that we operate in, raises some serious issues. If with think of all of the individual elements that are contained in any one of the aspects of a potential design, and then multiply this by all of the other elements in all of the other aspect you quickly become involved in what mathematicians call a *Combinatorial Explosion*.

Combinatorial Explosion is when the number of combinations of elements within a problem space grows beyond any reasonable brute force, trial and error method of dealing with it. Rheingold (1985) [17] explains it like this:

‘The problem of the combinational explosion can be easily visualised as a tree structure. If the decisions needed to choose between different options are seen as the branches of a tree, then a simple two-decision example would yield two branches on the first move, four on the next, eight on the one after that. By the time you get to sixty-four moves, each with twice as many branches as the previous move, you won’t be able to see the forest for the branches. If you increase the number of cases to be decided between from two to three, it gets even more snarled: After two moves on a triple-branching tree, there are nine branches (instead of four); after three moves there are twenty-seven (instead of eight), etc., *ad infinitum*.’

Rheingold (1985) [17]

So, we can see that in a cultural system of interrelating potential design elements (*our design problem space or fitness landscape*) as large as that that I have outlined above, the chances of any given designer just ‘happening’

<sup>4</sup> Accessed at: [http://www.iea.cc/browse.php?contID=what\\_is\\_ergonomics](http://www.iea.cc/browse.php?contID=what_is_ergonomics), on: 11/07/07

<sup>5</sup> Luhmann also raises another potential class of contribution that I have not included as it has a somewhat historical relevance. He talks of ‘assumptions concerning acceptability’. This concept speaks to the old ‘push model’ of media and communications. In the current (and future) fragmented range of possible media channels this is a less distinct category and can, I think thus be rolled into Technological Means. [18]

<sup>6</sup> I use the term ‘compose’ in line with Spinoza and Deleuze’s interpretation of Spinoza. For more on the applications of this concept see my paper: ‘The Joyful Passion of Production.’ Published in The International Journal of Technology, Knowledge and Society, by Common Ground [In Press].

to arrive at a working (let alone good) design solution is close to zero. As Dennet (2006) notes:

'All design work is *ultimately* a matter of trial and error, but a lot of it takes place "off line," in *representations* of decisions in the minds of people who consider them carefully before deciding for real on what they think will work best, given the limited information about the cruel world in which the designs must ultimately be tested.'  
(Dennet, 2006, p. 187) [19]

Let me offer a brief example:

If we imagine a very simple design job with the following potential elements:

1 Page

- Paper size (say a choice of 2)
  - background colours (4)
  - choice of type colour (4)
  - choice of shade (10)
  - choice of font (rather than allowing access to all the fonts in the world let's keep it to the OS agnostic 6 of Arial, Courier, Georgia, etc.)
  - choice of type size (say 10 to 16pt = 10, 11, 12, 13, 14, 15, 16.) So that's 7.
- = We have 13,440 potential combinations.

At a rate of one choice per second – and not allowing for sleep, food, trips to bathroom (and we've all had those kind of jobs) – we have three and three-quarters hours of continuous work, just to work out which elements we might use. This calculation only looks at one page and does not even allow for the cultural subtleties like small caps, differential shades for different letters, composition or artworking the job. Design carried out in this way would never happen.

A successfully completed complex design job is way beyond the possibility of chance. So we can essentially discard chance (or luck) from consideration as a source of successful design solutions.

However on a daily basis the visual communication design process clearly does work, played out against a multitude of cultures all across the globe. Somehow we are beating the odds, and doing so in a way that is so unlikely as to be almost unbelievable. This 'unlikeliness' is one of the classic hallmarks of an emergent system at play. The social scientist Luhmann coined a term for this dramatic (almost implausible) movement from a sea of possibilities to a

functional and distinct system; he called it *Komplexitätsgefälle* or Complexity Differential.

'Luhmann defines complexity in terms of a threshold that marks the difference between two types of systems: those in which each element can be related to every other element and those in which this is no longer the case. In information-theoretical terms, complexity designates a lack of information that prevents a system from completely observing itself or its environment. Complexity enforces selectivity, which in turn leads to a reduction of complexity via the formation of systems that are less complex than their environment. This reduction of complexity –Luhmann speaks of a complexity differential (*Komplexitätsgefälle*) between system and environment—is, essential. Without it, there would be nothing, no world consisting of discrete entities, but only undifferentiated chaos. The need of systems to maintain an asymmetrical, "simplifying" relationship to their environment can perhaps best be illustrated in the psychic system. A psyche that becomes too complex runs the risk of turning "pathological" in the sense that it will be unable to make decisions, perform simple tasks, or function in society. What we call "madness" is nothing more than the hyper-complexity if the psychic system that can no longer distinguish themselves from their environment.'

(Eva M. Knodt's forward to Luhmann, 1984) [20]

And this for me is the key. Design must operate on some level that is more than 'inspiration', 'craft', or 'referencing culture'. If we ran through all of the combinations of elements available; 'those in which each element can be related to every other element', we would have a near infinite sea of junk. Conjugations and synthesis of elements that would make no sense (even if we accept the linguistic theorists idea that visual communication has some sort of internal grammar and syntax), and tiny islands of meaningful design. On one hand we have cultural chaos and on the other cultural systems, and the description of the pathway from one to the other is Emergence. See figure 1.

Luhmann speaks about how the recipient of a communication makes an act of selection from the available meanings;

'If one begins with the concept of meaning, it is clear from the start that communication is always a selective occurrence. Meaning allows no other choice than to

choose, Communication grasps something out of the actual referential horizon<sup>7</sup> that in itself constitutes and leaves *other things* aside.'

(Luhmann, 1984, p.140) [18]

But also talks clearly of the act(s) of selection that must be made by the person forming the communication:

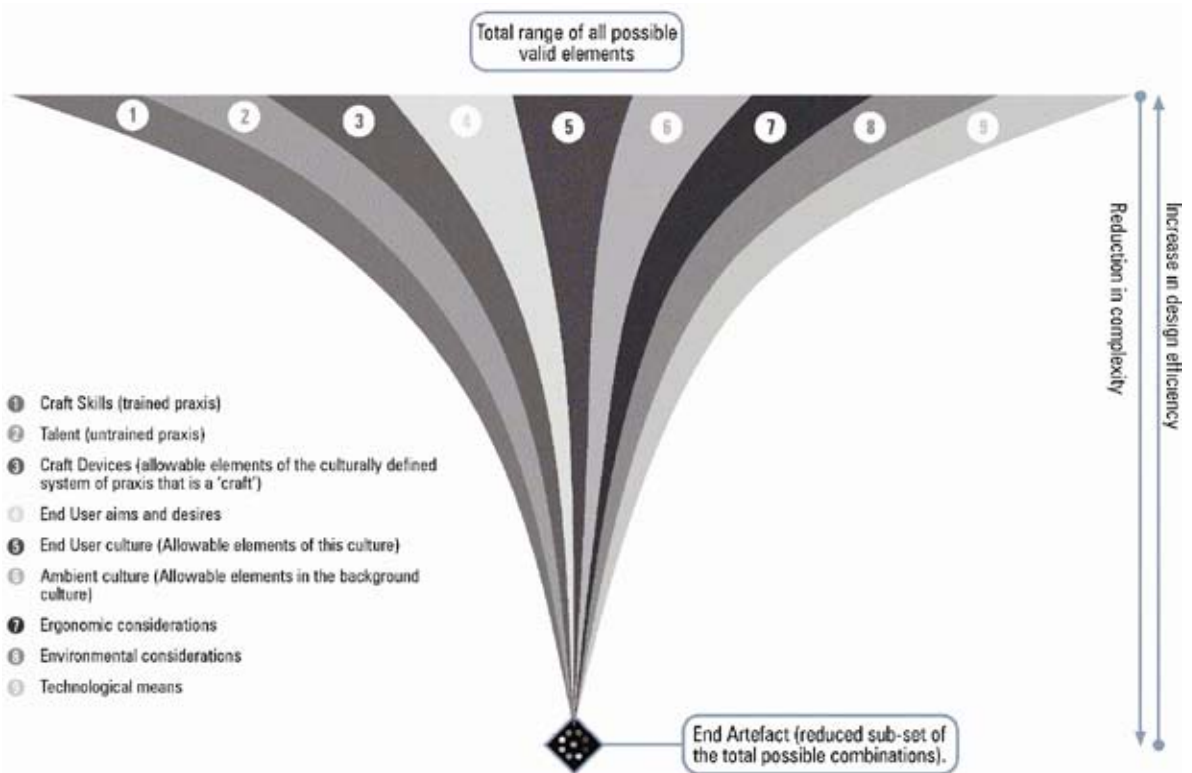
'As far as information is concerned, alter (Luhmann's term for the originator of a communication) must view himself as part of the meaning world in which information is true or false, is relevant, repays utterance, and can be understood...In one respect he must interpret himself as part of what can be known about the world, for the information refers back to him (otherwise he could not apply it).'

(Luhmann, 1984, p.141) [18]

It should be noted that when Luhmann refers to 'himself' he clearly means not a physical corpus, but a totality of corpus, mentality, social role and world-view, a Deleuzian regime of signs. We see selection (in a Darwinian sense) acts as the engine of his *Komplexitätsgefälle*, driving the reduction of the referential horizon until, arising as

an emergent entity, we have a clearly defined artefact. Seemingly in defiance of all the laws of probability.

This selection however acts through the agency of a *fitness landscape*, a thought tool derived from mathematics, but used widely across sociology, biology, economics, etc. (The sciences that observe and comment on humanity), but not in the arts. And the *fitness landscape* itself selects for visible difference to the background landscape (high peaks in the landscape). Luhmann notes in *The Reality of the Mass Media*: 'The code of the system of the mass media is the distinction of information and non-information. The system can work with information. Information, then, is the positive value, the designatory value, with which the system describes the possibilities of its own operating. But in order to have the freedom of seeing something as information as information or not, there must also be a possibility of thinking that something is non-informative. Without such a reflexitive value the system would be at the mercy of everything that comes its way; and that also means it would be unable to distinguish itself from the environment, to organize its reduction of complexity, its own selection.' (Luhmann, 2000, p.17) [16]



**Fig 15** Complexity Differential in a design context. As the number of elements in a design fall the possible interaction also fall, and the efficiency of the design may improve, as the ratio of number of elements to the work the design must do changes.

<sup>7</sup>The 'referential horizon' referred to by Luhmann is a nice way of combining the classes of design constituents above. They form a horizon that may hide a world of other possibilities, but we cannot see them to determine their relevance to the current job.

A *fitness landscape* (sometimes called a *probability space*) represents all possible combinations of a set of properties (in his 1995 paper *Technological Evolution and Adaptive Organizations* Kauffman cites such diverse possible examples as being Second World War fighters, chairs and peptides). Areas or ideas that are fit are represented as being high peaks, ideas that are unfit are low lying areas (and it must be noted that fitness is a contextually relative 'fitness'). The activity of selection carried out across this landscape is characterised as a search. '...biologists have pictured such adaptive evolution as a search across a space of genotypes for "fitness peaks" on rugged, multi-peaked, mountainous "fitness landscapes"' (Kauffman and Macready, 1995, p.1) [21]. A fitness landscape in which all elements connect equally with all other elements, where each reading is as valid or as valid as any other reading e.g. Luhmann's 'undifferentiated chaos', is described as a fitness landscape with one peak. 'Any other configuration is suboptimal and can walk to the global optimum by successively changing each part to its optimum state. Thus, the landscape is Fujiyama-like, with a single peak and smooth sides.' (Kauffman and Macready, 1995, p.7) [21]. A landscape that has lots of choice, i.e. in a state of reduced complexity, is defined as having many peaks. 'As K (the number of functional connections) increases from 0 (nothing connects) to N- 1 (every point connects with every other point) landscapes become increasingly rugged and multi-peaked, while the peaks become lower due to increasing levels of conflicting constraints,' (Kauffman and Macready, 1995, p.7) [21].

These observations would be of no more than (moderate) academic interest if they did no more than describe the design process (i.e. self-organisation via a drop in complexity through the action of selection based on a search). But while this theory cannot act predicatively or prescriptively (nor would I wish it to be), it can generate explanations of certain cultural phenomena., for example, cliché. Cliché can be thought of representing low easily accessible peaks on a fitness landscape. The higher the peak on a fitness landscape the fitter it is, but equally the harder<sup>8</sup> it is to scale, and more dead-ends will typically have had to be tried before the peak is reached (which is quite a nice summation of the act of trying to do something original in a design job). A cliché by contrast would represent a solution that can be reached easily, by everyone operating on this fitness landscape; a solution to be sure, but not a very fit. But more importantly, this

acknowledges that this landscape only represents one possible reading of the fitness of its constituent parts. Should we expend the time and effort to change the contributing elements, the landscape changes and the cliché is no longer a cliché, but is now a witty reworking of an old idea. The iPod and its many imitators present a nice example of this effect in action. It is easier to ape, or make superficial rewritings of a given design solution than to innovate: Which also presents the danger of producing something so outlandish that no-one knows what it is. (See the Dennet quote below.)

The idea of emergent visual communication also explains the effect so often witnessed in mass communications of an a once fresh idea becoming the object the law of diminishing returns, in spite of the level of resources pumped into it. Initially when we have a high peak in the fitness landscape, the searcher who scaled it will have expended a considerable amount of effort to reach it, and presumably have reaped whatever the rewards that result from this effort (be it advertising revenue, increased web traffic or recognition for a new font). However, having committed to a particular solution (in the total fitness landscape), it becomes more difficult (in terms of effort) for the searcher to return to the low-lands of unfitness, search again and scale a new peak. So they will attempt refinement rather than innovation. We can see this effect in advertising campaigns where a once novel approach becomes stale, and requires increasingly excessive efforts to capture the fleeting imagination of the viewer. E.g. The Halifax Bank's 'Howard' series of adverts, by Delany Lund Knox and Warren. Adverts which have gone from the simple conceit of a bank manager so obsessed by his product that he starts to radiate with the sexual glamour of Tom Jones; to the grandiose product of a warped imagination equating being a high-rate saver with an 'Oklahoma' flavoured version of the U.S. Land Rush. Complete with a remodelled Mount Rushmore. Kauffman and Macready suggest that this is to be expected as part of the nature of a rugged (many solution) fitness landscape.

'Thus, under random sampling with replacement, the expected waiting time for each improvement step increases by a constant factor after each improvement step. This implies that the mean rate of finding improvements should *slow down exponentially*..' (Kauffman and Macready, 1995, p.8) [21]

<sup>8</sup> Harder in the sense of expenditure of time, energy and resource.

In other words, if we are not careful we lock ourselves into a set of solutions, within a regime of signs, because it becomes too difficult for us to back up and re-evaluate from scratch.

Daniel Dennet gives us a viable mechanism to explain why only some of these potential novel combinations generated within a given fitness landscape can generate viable solutions; solutions that will resonate with the intended audience.

‘The curiously paradoxical idea – something *invisible* that *looks like* a person (has a head, eyes, arms, and legs, perhaps wears a special helmet) – is different from other self-contradictory combinations. Consider the idea of a box that has no interior space to put things in, or a liquid that isn’t wet. To put it crudely, these ideas are not interesting enough to be puzzling for very long. Some nonsense is more attention-grabbing than other nonsense. Why? Just because our memories are not indifferent to the *content* of what they store. Some things are more memorable than others, and some things are so interesting that they are well nigh unforgettable, and still others, such as the random string of words “volunteers trainer regardless court exercise” (pulled by me “at random” from the first newspaper story I could lay my hands on just now), could be remembered for more than a few seconds only if you either deliberately repeated it to yourself dozens of times or made up some interesting story that somehow made sense of these words in just this sequence.’

(Dennet, 2006, pp.118-119) [19]

## 5 Conclusion

‘... life is full of complex systems that have deterministic rules at the lowest levels, but whose large-scale conditions are intractable. The future states are indeterminate and a small variation in initial conditions causes a huge difference in the outcome.’

(de Vries) [22]

There are tools in the world outside of the design/theory debate that allow us to see beyond our own limited readings of the nature of our accustomed regime of signs. Being of themselves different is no guarantee of anything at all, beyond the difference itself. This is often enough. Merely being different can sometimes allow us to look back and see elements of our own nature that would otherwise be hidden from us. In this paper

I have tried to cast a different light on the practices of visual communication, beyond craft practices and beyond semiotic explanation, while in no way trying to invalidate them. They are manifestly true within certain circumstances, and this is perhaps the point: visual communications should no longer look for monolithic über-solutions. The designer needs to be aware that there are none, just singular design solutions operating within the fitness landscape. As Negri noted when contrasting Spinoza’s Passions against dialectic thought: ‘The falsity of the dialectic is that of a key that would open all doors, whilst [Spinoza’s] ethics on the other hand is a key adequate to singularity.’ (Negri, 2004, p.4) [23]

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# The Tale of Complementary Twins

## **Abstract**

In the totality of a composition certain things will usually stand out as figures against a less structured ground. But the relation between figure and ground is not always so. This paper intends to illustrate a more intimate relation between the two and reveal the potential narrative that they hold. As it gains the structure of a story, it needs all three of the entities of a narrative; the author, the reader, and the narrator.

## **Keywords**

Figure, ground, void, empty, movement, narrator, narrative.

## **1. Introduction**

Figure/Ground images have always mesmerized the observer; the creation of the first figure cannot be done without the simultaneous perception of creating the second. As we draw the first stroke of the firstborn's shape, we create its complementary twin; and their perfect balance was so that one cannot be twisted without disfiguring the other.

Yet the joy of conceiving the twins only lasts a few breaths away after that eureka moment when the ground has finally given out its figure. We congratulate ourselves for having the eye of an eagle, and we acknowledge the maker for being shrewd. So ends the story.

Hence we started with an intriguing story, and ended realizing there was actually no story. Nevertheless, we feel good about ourselves. This gratifying end feeling has been exploited in various manners to give those in need that momentary satisfaction. One particular computer game uses this trick to give its player just that. The player is supposed to find some hidden items in several chambers and locations within a haunted mansion, and he is to expect those objects to be in any scale; an elephant can be one of the tiniest figures in the picture and a pen can be as tall as the high French windows facing the portico. As a whole picture, every chamber and setting in that computer game makes perfect sense to the viewer, nobody would misunderstand the function of each chamber at the first sight of it. But it is actually when we have found those hidden items that we see each room as non-real, because those pictures are made up with objects that have no relation with one another. The reason why a toilet brush can exist within a window drape, or an eggplant on the door of an old shack, would be too bewildering for anybody to try to perceive without any precious reward at the end of the endeavor.

Figure/Ground is the perfect complementary twins. When two figures relate so intimately to each other, it is against our understanding that their co-existent is merely for the simplest meaning of existing.

Is it two people facing each other, or is it a vase? All we know it is a composition, it shares one media, it shares the same lines. Do the two make one story? Or is it actually two stories that cross each other?

## 2. Figurative ground?

Sharing the same properties of lines and shapes is commonly used for morphing in graphic animation, with which we can transform a circle into a pig or maybe a tooth paste into a cellular phone. But what we see in images such as faces/vase is not a sequential transformation; both figures exist at the same time and yet seemingly within different layers.

Most people would see either two faces or a vase, when one image becomes the figure, the other one automatically becomes the ground. When we consider the nature of this simple composition, it might actually give light to the condition of our current visual environment. In this period of time when our environment is undoubtedly saturated with images, we can hardly still see a single figure against a blank or empty background. What we usually see as ground now is actually figure(s) that we decide to care less. Hoffman's enumerated rules of perception have already indicated that we *actually construct what we see*, i.e. we choose what we see, even when we are only confronted with a single image against an empty background.

Human visual perception is still an astonishing wonder that even our most advanced computer technology can only manage to model a fraction of its abilities. But the wonders of figure/ground images, glowing areas, or hidden figures still have only been used relatively little in terms of advancing the ways people read graphic images, and thus bring our visual intelligence up to another level.

We have known to read alphabets from right to left, others left to right, and still others from top to bottom. Words that are represented in images, such as the Egyptian hieroglyphs or the far-eastern characters, are still read within the similar systems of reading the alphabets. The relation between figure and ground has been commonly seen as one being more prominent than the other. But as we can see in the faces/vase image, one is not more prominent than the other; we only pay more attention to one than the other. What we should take into account is that it has an agreeable union without

humbling the other as the backdrop and hence presents the possibility of having the economy of space.

Two decades after areas were deliberately set aside as open spaces or voids to give solution to urban congestion, the term *new economy of space* was introduced by Rem Koolhaas when he reclaimed void as an area of habitation. In the time where we now have visual congestion, perhaps it is time to reclaim the blank (unstructured) background.

Mallarmé brought to attention the white background between alphabets as he acknowledged it as a place to move between characters and paragraphs in his visual poetry. But Teiji Ito<sup>1</sup> may have proposed an intriguing conception of the empty background as he reminded us that it is actually called the *empty brushstrokes*, it is the space where the brush leaves the surface and restrain itself from leaving its mark on it. Here we see the relations between words (meaning), figures (the characters themselves are graphic images), movement (the brushstrokes on and off the surface), the ground or the empty background of the surface, and the three dimensional interstitial space or void between the writer and the surface.

We tend to see the far-eastern characters as an art of itself, or in some compositions the relation of the characters to the surface they inhabit. But when we have understood the empty background of the surface as the *empty brushstrokes*, the whole process of writing the characters on a particular surface; the movement between the body, the hand, the brush and the surface; has also become an art of itself.

What is the *raison d'être* of such art? Is it the message conveyed in the written characters? Is it the act of making it, the *poiesis*? Or is it the relationship that such art can establish between words, images, the surface, the three dimensional space, and the element of movement; its ability to make sense the existence of things around an active being?

Whatever the answer is, movement is an essential element to make such a firm union of a composition. Had that been a composition of speech, would the movement element equal to a verb or merely a *conjunction*?

<sup>1</sup> Mukai, Shutaro :Characters that Represent, Reflect and Translate Culture – In the Context of The Revolution in Modern Art. In: The Empire of Signs edited by Yoshihiko Ikegami. John Benjamins B.V. (1991)

### 3. Movement as narrator

After we have realized there is a vase and there are two faces facing each other, how likely is it for us to try to connect the two images that seem to be in different layers but share the same properties within one composition? Most people would say they would not try to connect the images but would see them as separate objects. Though we can try to imagine numerous possibilities to make a story between the faces and the vase, to be able to immediately identify that there is a story one would need more clues to see the linkage. Whether it is important or not for a composition to possess a story, may well be an issue that is argumentative to some. But can the issue of meaning be contained in a few words? Does not a *designed* composition do have a story behind it?

While an image can give a certain meaning to the reader, to link an image to another and draw a story (or extended meaning) from them, one would need syntax to be able to read well. In the condition where the composition is a still image, to give more clues to a composition such as faces/vase, more images would have to be included in the composition to reveal the story. In the case that the composition is a digital image, the story could be revealed with certain elements of movements of the figure(s), such as if the vase begins to spin, or one the figures start mouthing some words (sound element will definitely add a vital dimension, but this paper would exclude it from the discussion for the reason of focusing on the visuals). Simply adding some depth to the figures (e.g. embossing) will immediately give a decision to the reader on which is the figure and which is the ground.

Adding the element of movement gives more meaning to the figure involved (e.g. whether the faces are feminine or masculine, coarse or refined). As soon as we put in the movement element, suddenly all the dead objects and figures come to life. When dead figures come to life, a scene of a junk yard will probably be the equivalent of a market place where people just come together and socialize, where an old tire becomes the Old Tyrell or a used tin can becomes Tiny Tino, and so their story begins. A scene which initially looks non-real can suddenly produce a fascinating story when the objects start moving and communicating with one another.

Narratives by nature are compositions that are purposely created to touch our emotion; to soothe, to excite, or

perhaps to condemn us. But we need to be clear that though narratives are naturally emotionally charged, it does not necessarily mean that when we have experienced a series of sensations we actually have gone through a certain narrative. As in the case of experiencing the computer game mentioned earlier, though the game excites the player's emotion it actually does not contain a narrative.

To the same extent movement as narrator also has the potential to be an unreliable narrator as in the verbal narrative, if by ignorance or by deliberate attempt it deceives the reader or leaving the reader to speculate how to interpret the story. A reliable narrator of a narrative composition should give the reader an understanding of what Heidegger calls a *gathering of world*, a configuration of things that reveal their meaning through the coming together; solid or void, in their fullness as well as in their emptiness.

### 4. Figure/Ground = Full / Empty?

"I have a simple philosophy. Fill what's empty. Empty what's full. And scratch where it itches."<sup>2</sup>

One commentary on a certain film reads: "*a new movie full of NOISE...FLYING OBJECTS...SEAFOOD...CELEBRITIES...COMPASSION...TRAVEL...HONOR...GRAVITY...BULL...he was full of it.*"

Evidently we do not fill what is empty neither do we empty what is full. We fill what is meaningless and we empty what is meaningless for meaninglessness can take the form of both emptiness and fullness. So far we understand that there are different layers of meaning, from the pragmatic to the symbolic. If we wish a certain object to have a long period of life, then we need more than just a pragmatic meaning, for when the functionality of the object expires, it becomes a meaningless object. If we are going to count on the pragmatic then in order to have life longevity, the creation of the object must have a high level of anticipation for future usage, which is now becoming more complicated to accommodate considering the increasing speed of information transfer. Will the perpetual drive for newer technology make it meaningless to talk about the *meaning* of an object? Will handing down objects from one generation to another be something of the past? What would memorabilia be like in the future?

<sup>2</sup> Alice Roosevelt Longworth  
- Wikiquote

Much has been said about meaning in the eye of the reader, but one thing needs to be understood that we in fact see objects *through* the eyes and not *with* the eyes, and therefore meaning comes not from our visual system but from somewhere else. We do not define meaning by what we see.

Multiple meaning is a luxury for designer. In one interview the American architect Frank Gehry sensibly called his creation 'my children', referring the process of creation the same as giving birth to and nurturing a child, from the point of conceiving the original ideas to the making of these ideas into being. As a parent would say that there is no greater joy than seeing their children grow and mature, that is also the kind of joy that a designer would experience when they see their creation develop a cultivated meaning as the object interacts with users or the casual onlookers. Refining is part of the *poiesis*, the making. The variety of meaning conceived by the readers only becomes troublesome for the designer when there is an intention to capitalize the creation. No matter how meaning varies from one reader to another, it is the designer who gives the first meaning to his creation, the very reason it comes into being, and the original meaning of the creation is not nullified just because others have different interpretations of it.

## 5. Conclusion

This paper has started with an examination of the intimate relationship between figure and ground. Even in certain compositions where the 'ground' is not as figurative as in the faces/vase composition, the less figurative part of the composition still holds a decisive role in the existence of the 'figure(s)', if we consider it as the *empty brushstrokes*, as termed by Ito. The relation between figure and ground that is previously seen two dimensionally now has become spatial due to the recognition of movement element within the composition. And these *empty brushstrokes* are not simply wild punches in the air; they convey meanings which in some cultures can even be parts of a certain ritual.

Figure/Ground is the perfect complementary twins. They were born together to gather a world, a world where neither is humbled and neither is ignored. Who would tell their story if all chooses to be still and silent?

*The rays of sun creep in through the dewy leaves. Breeze follows and dance the leaves of the waving branch. Tick, tick, tick, tick, whooosh. Maylee closes her eyes as her face is touched by the scattering rays. Arms outstretched she whirls her body in rhythm with the coiling wind. Her spirit rushes and compels her body. "Balance!" shouts her spirit. "Win the strength and grasp the brush!" She twists with vigor and casts the strokes. Nay! It's air she arrives and not the surface. "Pause," utters her spirit. "Win the space and not the surface." Tick, tick, tick, tick, whooosh. Maylee's spirit leaps with joy, as she gazes poetry painted in space.*

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# A generation-specific approach to Human-Machine Interfaces

## Abstract

In the design of technological products, age must not be viewed as a bodily stigma any more, but rather as the precondition of extensive know-how concerning technology. This project follows a generation-specific approach, based on the theory of lifelong formation by early experience with technology. This formation provides clues for product development since for various generations of users it represents the basis of their technological know-how throughout their lives. We would like to introduce and discuss this new research approach as well as to present the first empirical results.

## Introduction

Since the beginning of the 21st century technological innovations have been entering the home and the workplace at an increasing pace, and transforming, formalizing and standardizing our ways of interacting with technology [1]. In the process, the know-how that is required if we are to utilize technology successfully is changing rapidly and in some areas fundamentally.

As an example we may take the heat regulator on household ovens. In some models the long-serving dial has been replaced by a touch-sensitive control panel. Thus, learned actions or sequences of movements involving haptic, visual and acoustic feedback that allow virtually “blind” operation are being abandoned or replaced. In place of them, often complicated means of

operating household appliances must be learnt anew.

These difficulties can have dramatic consequences for old people if they occur in appliances or devices connected with safety such as emergency call devices or medical equipment. Since negative experience with such technology can make users feel insecure, they may fail to take advantage of what can be very useful aids in everyday life, put at our disposal by modern technology.

Since little is done to address this problem, the result is a society divided into those who are adept at dealing with modern technology and possess the necessary technological competence – and who are by and large young – and on the other hand the majority of older people who are skeptical about using new technology, not to say flummoxed and even anxious about it, and who have a strong preference for conventional technologies. According to Pippa Norris, age – along with educational level and geography – is one of the central categories of the “digital divide” [2] which separates people into those who can use modern media, communications and services and those who cannot.

If the question of old people’s ways of interacting with technology is discussed, it is generally ergonomic aspects that are foremost in the endeavor to make technology usable by old people too<sup>3</sup>. Our project, by contrast, proposes a different approach. The central question it will research is the knowledge or know-how that people

<sup>3</sup>For instance *Design for all*.

have acquired during their lives with regard to operating certain key technologies. Systematic analysis of these generation-specific expectations and concepts in dealing with technical artifacts is a necessary condition for the design of products that are suitable for old people.

## Theory

We would like to present an approach which constitutes the basis of a novel concept in the design of technological products. Here, age should not be seen as a bodily stigma any more, but instead as the precondition of the existing know-how and of the resultant mode of interaction with technology.

Our thesis is based on the assumption that convergent understandings and expectations of technology may be found in various generations [3 and 4]. In order to establish categories of shared experience for the various generations, the technical biography of individual users needs to be examined. Particular attention is paid here to what are known as key technologies. Key technologies are those which have a determining influence on users' ideas and expectations regarding technology as a result of the intensive use thereof when the users were young. Thus the study reveals the shared experience of different age-groups with key technologies; and this experience shapes their basic knowledge and judgment with regard to the use of technical artifacts [5 and 3].

What we will observe therefore is the generation-specific profile of human-machine interaction using semiotic processes. The observation of semiotic processes is conducted on the basis of the human-sign-object constellation (as well as the three subordinate fields of semantics, syntax and pragmatics). In the task of drawing up a detailed description of users and their use of technology, the observation of technology as text [6 page 238] can be applied, according to which "diverse, though not arbitrary utilization options" are written in during the production of technical artifacts ("writing"). Utilization itself can be termed "reading" and is an "active, autonomous and knowledge-requiring performance on the part of the user". [6 page 239] The "interpretative flexibility" that arises from this, and the not fully determined meaning of technology, underline the approach; various generations may have different interpretations of what technology is or may generate differentiated meanings themselves. Utilization of

technology thus requires "knowledge of collective, social conventions" [6 page 241] just as much as the use of texts does.

Observing and describing the processes of *reading* and *writing* as semiotic processes makes it possible to decipher the relationship between technology and users (and utilization contexts). This relationship is rooted particularly in the pragmatic deployment of signs and their syntax and in the actions that ensue from them.

The use of key technologies is here considered to be a cultural practice requiring knowledge of collective social conventions in terms of practical and contextual knowledge. This knowledge or the absence of knowledge can be observed with particular clarity when the human-sign-object constellation gets disrupted. Disruption commonly results from a user's pragmatic perspective when signification contexts no longer meet the user's expectations. Examples of this are:

- 1 New symbols needed for hitherto unknown actions find no correlation in the user's existing knowledge. With few exceptions, it is rare for unambiguous signs to be realized in practice.
- 2 Graphic user interfaces permit the operation of a wide variety of functions per interface, but the clear assignment of switch/sign to function is lost.
- 3 Guidance of users via interactive screens can be very flexibly adapted to situations but brings with it the risk that users may be made disorientated by polyfinal menus.
- 4 The desire for increasingly pictorial expression on graphic user interfaces leads to the introduction of signs that are not generally comprehensible.
- 5 With the disappearance of certain artifacts and actions from everyday life, existing know-how is wasted.
- 6 Signs from the sphere of professional technology utilization are imported directly into personal use. These signs are unknown to non-professional users.

Examples of the key technologies that are important to the various generations are those which users made frequent use of when they were young. Intensive use appears to result in a long-lasting (particularly pragmatic) influence that conditions the way users interact with technology. It is possible to cite key technologies which have lastingly shaped the technological know-how of many

young people at the same time. Empirical studies could show that the 1960s generation was profoundly influenced by the record player; in the 80s the focus shifted to the digital screens on stereos, while from the mid nineties the interactive menus of game consoles like PlayStation and Nintendo were decisive.

From this, clusters of related configurations of input / output and the symbol level can be established. The significance of input element differs in accordance with the configuration that is used. Thus for example the meaning of the joystick, which was developed to control cranes, is to be differentiated from its meaning in the context of controlling visual media. The special configurations each require specific abilities of abstraction in conjunction with sensorial perception and sign interpretation. Where a crane operator perceives multiple stimuli, not only visual but also for instance sounds or vibrations, all of which provide information about the system, it is necessary – in the case of joystick control via a computer terminal – to take note of a variety of parameters in parallel, mostly depicted visually.

### Methods

On the one hand we study the genealogy of human-machine interfaces (HMI) in a variety of different utilization contexts. Here the human-machine interfaces are collated historically and classified on the basis of their inherent sign systems. In the process we differentiate according to combination of input and output elements (joystick plus analog display differs from joystick controlling a 3d simulation) and where useful, the application context is referenced.

In addition, within the framework of the historical evolution of human-machine interfaces, the various interaction concepts are analyzed. These include for example the generally consecutive sequence of input elements in the case of mechanical devices (e.g. typewriters or calculators), the possibility of parallel interaction in the case of electrical/analog devices (e.g. synthesizers) and the concept of polyfinal hierarchical menus in digital devices (cell phones, organizers, computers). Substantial differentiation between forms of interaction forms is expected especially in the case of digital technology with its diverse possibilities of interaction (mouse-based, key-based, menus or scroll maps, etc.).

The collation of this information will be achieved by means of the following interviews which explore biographical memories and experience to identify forms of interaction with particular HMIs with respect to various devices. The cataloging will also be of assistance in formulating specific questions and evaluating diffuse recollections.

In addition to analyzing HMI our approach will also make use of interviews with key informants in accordance with David R. Millen's theory of "Rapid Ethnography" [7]. Interviews with key informants allow the rapid collection of data which go beyond the personal experience of individual users and reveal what problems users generally have with certain devices or specific interfaces. Specialist retailers for example can be expected to give more discriminating answers regarding what problems users commonly have with particular devices and HMIs of various technology generations.

On the basis of this information it will be possible for the interviews with users to be more sophisticated in conception, and for the evaluation of them to be more thorough. The users will be asked about their own formative technologies, with a special focus on the technology they used frequently when they were young. Here, aspects of the physical manipulation of the technological devices are as important as the matter of their perceived social significance, frequency of use, and motives for use. The questions will relate specifically to "important" and formative experience and to the technologies that were frequently used. The distinction between important and formative on the one hand and frequent on the other is made in order to differentiate between devices subjectively perceived as important and devices which, although unpopular, were nevertheless crucial to shaping the individual's response to technology. Finally, users will be asked targeted questions about such technology. It is hoped that they will give information on these specific topics:

- when was it first used.
- positive and negative experience when using the devices.
- the operation and functioning of the devices.
- the meaning of the controls and symbols.
- the context of use.
- who used it.

The views and data given by the users will most probably be strongly distorted by memory and idealization.



However, in terms of naive function description (cf. [4] “naive physics”) they are interesting because they afford an insight into the pragmatic perception of technologies. Analysis of the interviews is expected to provide information about the reception and appropriation of various human-machine interfaces, which can then be interpreted for the purposes of instruction manuals – such as in the search for metaphors for interaction, visualization, and concepts of physical input devices, etc.

### Prospects

As well as introducing the new design research approach we will present the first empirical results on how the interaction of older people with technology has been formed, as well as what expectations older people have with regard to new technology.

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# EYE-JUMP

## Abstract

Promoting creativity is now a compelling issue on the government agenda and in educational policy-making in the UK. However, there needs to be a greater emphasis placed on the cognitive processes that motivate children's curiosity and the promotion of their observational skills, helping them to realise the creative possibilities to be derived from everyday experiences and objects. Through conducting a broad range of multidisciplinary theoretical research, a key intrinsic motivational drive has been identified that links the surprise response with the generation of creativity. An experimental prototype guided by a novel conceptual design method was produced to verify this link. It demonstrates how through the appropriation of a simple child's toy into the domain of digital technology a novel artefact is produced to elicit surprise, stimulate children's intrinsic motivation and foster creative thinking.

## Keywords

Surprise, creativity, CSM method, EYE-JUMP, physical interactive learning experience

## 1 Introduction

This proposal describes the production of an interactive prototype guided and informed by the Creativity Surprise Model (CSM) – a conceptual framework that describes the process of how a surprising experience can further stimulate a sequence of drive emotions to generate

creative thinking [1]. The emphasis for this design was to draw children's interest towards the more considered observation of everyday objects in their surroundings that are generally taken for granted. Through stimulating their curiosity with the cognitive challenge of designed surprise it is hoped that they will learn to perceive things beyond superficial appearances, developing their creative skills to envisage unique interpretations and transformations far beyond the ordinary function of these familiar objects, encouraging them "to become attentive to the more subtle qualities and changes of form which are present in everything their eyes and minds rest on" [2]. Observation in the real world is the formative exercise for developing children's 'scientific creativity' [3] and [4].

The project aims to support the generation of creative potential within children between the ages of 7 to 11 years. Piaget describes children in this target age group as being at a stage of cognitive development that is characterized by having very 'concrete' ideas about how things are, should be and should function. This is expressed in a form of 'functional fixity' that inhibits their creative thinking. Certainly, this is not to suggest that children in the concrete operational stage lack creative ability, but rather the challenge is to break away from the logical structure of convergent thinking, as it is recognized that analytical thinking tends to kill the creative ideas too quickly – 'that's silly' they would say, and the idea is discarded.

Thus, interactive designs need to be tailored to suit the specific cognitive and technical competencies, interests and needs of young children, if they are to foster their cognitive development. The prototype EYE-JUMP design directly focuses on breaking down rigid processing by providing an unusual interactive experience using a commonplace object. This experience directs children to observe ordinary things from novel perspectives.

The first step towards creativity is to nurture curiosity and interest, certain structural stimulus characteristics, such as novelty and surprise can lead to motivational states that result in curiosity and exploratory behavior [5]. These stimuli function as the 'hook' – used by Csikszentmihalyi and Hermanson [6] to capture visitor attention. A surprise circumstance occurs when one's previous expectations do not 'fit the case'. According to a psychology study conducted by Meyer et al [7] and [8], the process begins with the appraisal of a cognitive event as exceeding a threshold value of schema-discrepancy (or unexpectedness), this is realized by a comparator mechanism, the unexpectedness function, that computes the degree of discrepancy between new and old beliefs or schema. Increasing the surprise intensity can be achieved by widening this discrepancy between the 'stored information' and 'fresh input'. The key technique in this case is to lower the expectedness of users and switch an object's operation from a familiar to unfamiliar outcome.

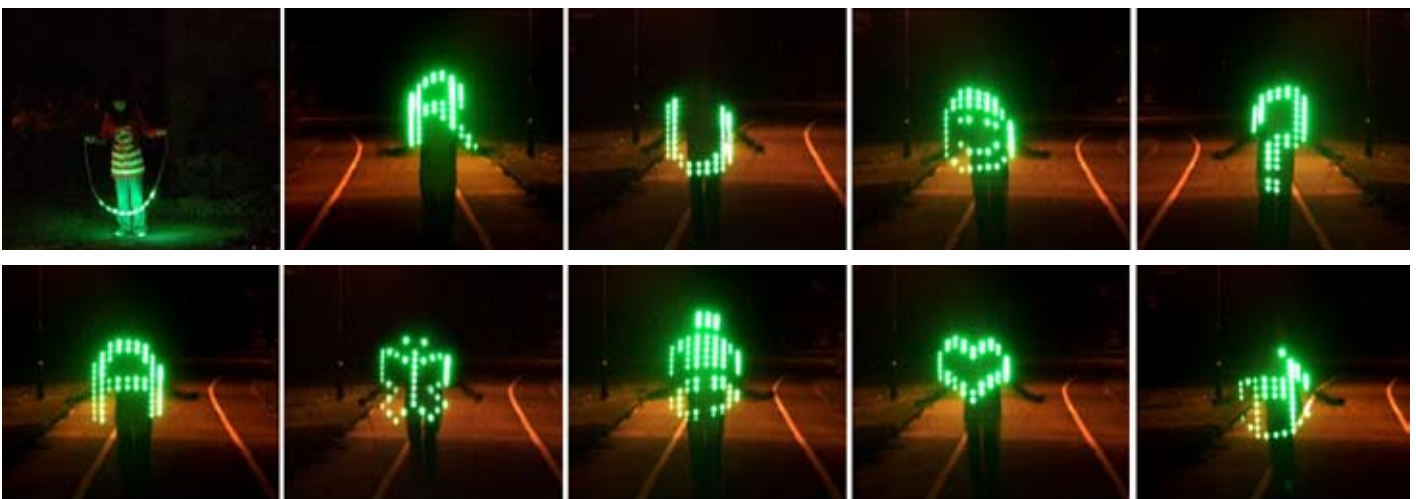
To establish a low level of unexpectedness, the prototype is required to follow the simple method whereby a

familiar object used in a familiar way. When the appearance of this object is reinforced by familiarity of operation, an additional lowering of the unexpectedness threshold is anticipated. The design goal is to encourage participants to anticipate what will happen next as a strongly held belief, which will then be confounded by the objects subsequent operation. In effect, the unfolding interaction relies on a form of misdirection – a term commonly used by conjurers and magicians. To switch from a predictable outcome to a surprising event requires that the subsequent performance outcome is previously unrelated but functionally compatible with the objects existing operation.

## 2 The Construction of EYE-JUMP Prototype

The prototype EYE- JUMP™ (skipping rope)<sup>1</sup> was constructed by combining a simple familiar object in conjunction with embedded local micro processing technology to provide a new interactive experience for children. The EYE - JUMP™ uses the natural phenomenon of illusion. The familiarity and elegant simplicity of use of the skipping rope was considered to be highly compliant with the objective of establishing a low unexpectedness threshold within the operator. The rope would form the interface, and with the use of embedded LEDs images could appear from within the spinning rope as if projected onto a spherical screen: different manipulations of the rope could produce a variety of images. (Fig. 1 shows images and letters displayed on the skipping rope during the skipping process, Fig. 2 displays the logo of Coventry University.)

<sup>1</sup> Patent applied for: patent registration number is 0623202.9.



**Fig. 1** EYE - JUMP™ prototype. Images can be displayed at any position along the path of the ropes spherical motion, and sound is synchronised with the images.



**Fig. 2** Coventry University logo

Recognizing the importance of an audio stimulus in children's play the device also includes the provision of a small sound system. The natural rhythmic aspect of skipping has been traditionally exploited to the extent where in some settings the activity becomes a dance, synchronized to the beat of the accompanying music. This adaptation has led to the inclusion of a rudimentary musical tune embedded into the skipping rope, (in this case 'Twinkle Twinkle Little Star') which is synchronized to the cyclic building of each new LED image on every revolution of the rope. The intention is to simultaneously stimulate many of the children's senses, thereby increasing the attractiveness of the activity and the diversity of its appeal to children.

The EYE- JUMP™ (skipping rope) utilizes simple known features combined with embedded computing/display hardware and the element of misdirection by lowering down the unexpectedness to elicit surprises, without compromising the original object's functionality. It operates as would an ordinary skipping rope, however; in this case its movement produces both visual and audio information. By intentionally embedding advanced electronic devices within a simple object to generate a surprise-eliciting event, we can not only manipulate the spectator's perception, creatively modifying their experience of the familiar in unexpected ways, but extend the principle to explore the creative possibilities of many other intuitive interfaces by utilizing the participants existing skill set and prior knowledge.

### **3 The Operation of the EYE - JUMP**

The children will be encouraged to pick up the rope and skip with it (as in playground games). Depending on the rate of rotation, an image will appear as if on an illusionary screen. The resulting texts or representative images can be seen by both skippers and observers. Sound is synchronised with the images as they are produced by a programmed microprocessor. Children can adjust their skipping speed to perceive the best visual and audio effect. Different skipping tricks can also extend the ways of playing with the prototype. It can be played with by single or multiple users, i.e. a rope can be engaged with either individually (swinging or skipping with the rope) or in pairs

(rotating the rope), or in threesomes (two swinging and one jumping over it), with spectators also experiencing the illusion.

### **4 The Conclusion**

The EYE-JUMP demonstrates the effective use of elegant simplicity and compatible combinations. It provides children with opportunities to:

- 1 Engage in a concrete experiment through the manipulation of a real object that demonstrates physical phenomena rather than simulated one.
- 2 Use their existing skill set to intuitively operate the exhibit without technical instruction.
- 3 Connect children emotionally with the exhibit due to their prior experience of skipping. Particularly, in operation when the new experience does not fit with any prior knowledge and where the consequent cognitive shock may motivate the children's curiosity and inquiry.
- 4 Encourage intuitive play and enhance natural social interaction. The familiar nature of the skipping rope encourages the children to become a participant in a physical interactive process and importantly through their play they themselves become the exhibit in relation to new onlookers (the additional participants).

The prototype provides a vehicle for developing an understanding of the scientific principles that lie behind the persistence of vision effect and sound synchronisation: but most importantly, it is to encourage children to look at an ordinary object from a new perspective – novel and alternative uses of a familiar object and present a significant challenge of the 'function fixity' of their concrete view about the function of the humble skipping rope. Being skeptical towards the 'obvious' – the ability to see things from a new perspective – is one of the essential prerequisites for creativity. The intention of the interactive prototype is to 'teach' children to observe and discover new uses for those ordinary commonplace things that we have ceased to notice and ultimately hope that they can sustain and apply this ability in their own daily lives.

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# “Lila” :Where the Action Is ... Collaborative Learning and Play Through Virtual and Physical Interaction



**Fig. 1** Data collected from contextual inquiry shows everyday lives of parents with small children.

## Abstract

This paper explores the “humanization” of digital technology in the context of child’s play, specifically targeting the synthesis of physical and digital interaction to make a case against a product market that has become increasingly cold and screen-based. The concepts illustrated in this paper represent an approach to designing activity-based centers with embedded technology for young children of varying ages – in essence a proposal for the next “sandbox.” The immediate focus was to engage children in shared creative activities that would engage the imagination, enable cooperative play, and encourage transitions between screen-based and physical activity. This project began as coursework and research in the School of Design at Carnegie Mellon University in Pittsburgh, Pennsylvania (USA) and continued as part of the /d.search-labs at the Technical University of Eindhoven in the Netherlands as collaboration between these universities.

## Keywords

Interaction Design, Intelligent Systems, Children, User Experience, and Collaboration

## 1 Introduction

Parenthood can be a wonderful, yet straining time for new parents. Despite the ubiquitous presence of technological products intended to support everyday issues in child rearing and monitoring, parents often struggle to achieve

a balance in raising children and maintaining their identity. In families with more than one child, this balance act is further enhanced by trying to attend to each child’s needs individually, while maintaining and encouraging a healthy interaction between them. While some products can often be successful at helping parents to address the individual needs of children, in this scenario, most fail in addressing needs of the other players, the parents.

A large portion of contemporary children’s toys and products has been modernized with electro-mechanical noise making apparatus (visual and auditory). This excessive overload of “bells and whistles” contribute to turning a normal household into what we call a “kid house,” where toys and child-centric products visually, physically, and acoustically dominate the space (as shown in Fig. 1). After having children, many people tend to put their lives and their lifestyle on hiatus. As a result, their homes can become cluttered with toys to entertain, games to occupy, fences to contain, and specific devices that add to the wealth of objects in the home. In addition, there is a whole market for special “add-on” enhancements, which are retro-fit to existing products that often disrupt the way they these products were intended to function and live in the home. Examples include electronic noise-emitting mobiles, stroller interactive gadgets, and highchair and car seat entertainment widgets. True to any product design, there is a point where too much visual information or complexity creates a negative effect in interaction [1].

Recently, there has been an attempt to integrate unrelated products into larger systems so that living and working environments can be customized to the subtleties of people's lives. Toy design, on the other hand, seems to subscribe to a different philosophy where "more is more" and the associated value in a toy is directly related to its ability to "attract" adult shoppers. This approach to designing toys can have a great impact on the home environments, mainly by acting as foreign entities that have an inappropriate fit with the visual presence in the home.

Parents often feel that children, especially in the first few years of life, need to be continually stimulated by new and different toys. This behavior reduces the lifespan of most toys to only a few months. As a reaction to this method of thinking, there is a need for more permanent objects in a child's life; toys that "grow" with the child and can simultaneously live in an adult environment. This method involves "design[ing] activities to allow for expanding complexity and supporting children as they move from one level to the next in use of the product [2]." With more permanent objects in a child's life (and adult's too) a new and deeper relationship with the object can develop among the people, object and environment/context).

Over the past few years, there have been numerous projects that blend digital and physical interaction. Of note, 'POGO' [3] used physical and virtual media to allow children to invent stories on an interactive table, and 'Playware' [4] explored ambient intelligence in the physical play of children through a set of tangible tiles. The opportunity in this space is not completely new, as these works are great examples of tangible interaction in play, however the blending of digital and physical components, and the structuring of interaction within a given context presents opportunities to explore how product form language can enable a synthesis of entertainment, engagement, and learning. As part of an undergraduate degree project in Industrial Design at Carnegie Mellon University (Pittsburgh, USA) and continued research at TU/e: Technische Universiteit Eindhoven, our team researched issues of product integration, entertainment, and monitoring in families with multiple children with the intended goal of developing an interactive product that enhances interaction between siblings and parents, reduces parental stress, and achieves a balance in entertainment technologies/features (bells and whistles).

## 2 Designing Products for Children (and $\neg$ Adults)

### – Opportunity #1

According to toy designers who consulted on our project, little attention is given to parental interaction with these objects unless they involve programming, setup or battery changes. Little or no thinking goes into how this toy will behave in context; rather they are designed specifically for child interaction at the product level only. Although children interact with these products most often, their parents will also have a product experience. Will these products be passive unseen objects in the home? Or will they take on a more dominant and vocal presence? Perhaps a fitting analogy here is that from a parent's perspective, certain toys can behave more like second-hand smoke. "Designers have a responsibility to provide good play opportunities for kids...When you think about toys, blocks are a classic example of a wonderful toy for young children. We want to be more about blocks, not toys that limit your options and imagination, not toys with just one answer," says Werner [5]. The implications that arise from this other level of interaction must be taken into consideration when designing toys. To avoid children's products becoming stress-inducing objects, it is necessary to integrate the life of the toys into the parent's lives.

## 3 Achieving Some Sense of Parental Autonomy

### – Opportunity #2

There have been many attempts to create products that can entertain a child like a television does, educate in an unconscious way, and engage a child's imagination. The unfortunate scenario is that many of these products are cheaply built, have exaggerated and poor quality acoustics, and are flooded with flashy and unnecessary features. The average lifespan is less than a year, as children grow tired and bored of the flash, and in some cases long for more direct response physical interaction. Current products, such as those seen in Figure X, cover a wide range in this spectrum. The LeapStart® Learning Table, shown in Fig. 2,



Fig. 2 A "bells & whistles" and traditional toy in comparison



**Fig. 3** Our team's research concluded with a video montage as means to record findings and generate reflective statements.

is an example of this imbalance in input and output. The exaggerated noises it sends in response to simple physical actions are not proportional. However, wooden blocks (also shown in Fig. 2), as primitive as they may be, balance action and reaction. Building up blocks, and then knocking them down, is a clear way to show cause and effect to children in scenarios where distance, weight, form factors, and material have significant affect on interaction.

Some products are designed specifically to elicit a sense of freedom or autonomy for parents. Such products, like video baby-monitors must provide reliable, safe feedback for parents to relinquish control and constant observation. Some products may even occupy or entertain children such that a parent may obtain a few moments of detached activity or perceived autonomy while their children play. Although the idea of the television baby-sitter is frowned upon, according to the parents in our studies, it works. But, in the long-term, too much television watching can have adverse effects on a child's development. However, if an activity (or toy) can engage a child like TV can, educate in a supportive and enjoyable way, and entertain children, while simultaneously enabling parents to step away from constant monitoring for a moment, some sense of parental autonomy can be gained. In an ideal scenario, a parent or caregiver can then choose to carry on activities in close proximity, but not be consciously focused on monitoring their children.

#### 4 Clarifying Product Opportunities

In order to determine the exact design opportunity under the umbrella topic of parental autonomy, our team gained access into the homes and lives of families with young children and conducted contextual inquiry sessions. We were personally able to interview and observe the interactions and routines between parents and their young children, aged 18 months to 5 years. This activity allowed for a varied set of answers to our questions, which encompassed topics from the general processes of parenthood, daily parental and child routines, products purchases and usage, the birthing experience and process of transition to the home, and adaptation to life with more than one child. Research activities included direct interviews, guided product tours, guided environmental tours, written surveys, observation and video recording, photographic documenting, with literature searches and personal insights as supporting evidence.

From the contextual inquiry sessions, we identified the following three main areas that our product concept must address: the “kid house” scenario and environmental compromises parents made in adapting to life with multiple children, mechanical and product interaction issues of products for children, and the emotional implications within the interactions between siblings and parents. A brief list on findings/observations follows.

#### Environmental:

- Spaces were cluttered with kid “stuff” juxtaposed with adult “stuff”
- Baby things did not fit with the style of the home: “baby house” scenario
- Some toys are not age appropriate for all children: what is entertaining for the older child is often unsafe for the younger one.

#### Mechanical:

- Electronic toys add too much unnecessary ambient noise to environment
- Corded power to some devices was not always easy and often unsafe
- Battery powered devices did not last very long/once drained, they hardly ever were replaced

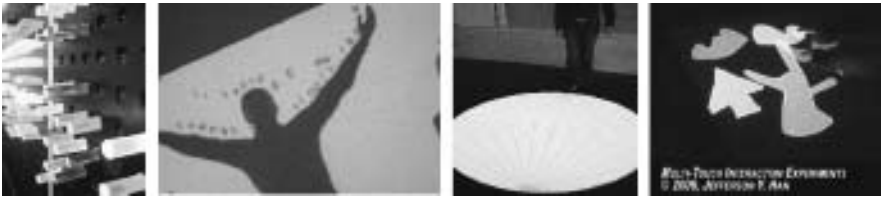
#### Emotional:

- Older child feels resentment if toys need to be put away in order to keep the younger child safe.
- Older children often had issues with sharing: sibling rivalry over toys
- Mother/father feel pressure to divide their time equally

From our conversations with the families, it became apparent that in order to accommodate the newborn, parents adapted their lifestyles with their firstborns. Issues such as safety became a critical point of focus; toys that would usually lie around for the older child might become a choking hazard for the younger one. As a result, parents had to set up new constraints and rules for the firstborn, which can often create resentment and intolerance towards the newborn.

As a post-research summary, we compiled our findings from our participant families into a video (Fig. 3) to illustrate common threads, themes and forest the





**Fig. 4** Observed applications of available technology at the Children’s Museum of Pittsburgh. Multi-Touch image from <http://mrl.nyu.edu/~jhan/ftirtouch>

**Fig. 5** Criteria used to prioritize design criteria

<p><b>1 Select Primary Design Criteria</b>  <b>The product MUST...</b>          Have intuitive interaction for children of varying ages          Promote and enhance relationships among family members          Have an activity set that can be initiated and terminated by the child          Be educational or entertaining          Challenge children’s abilities and stimulate their senses          Meet or exceed current child safety requirements          Have provided some sense of relief for parents overseeing two children          Have an appropriate aesthetic</p>	<p><b>2 Select Secondary Design Criteria</b>  <b>The product SHOULD...</b>          Be capable of simultaneously involving at least two children          Challenge the cognitive abilities according to the age of each child</p>
	<p><b>3 Select Tertiary Design Criteria</b>  <b>The product MIGHT...</b>          Be customizable and programmable for parents and children          Be constructed with minimal use of materials and parts</p>

groundwork for the conceptual design process. Following is a list of key words that were used in focusing the design concept:

- Sibling Resentment      Balance
- Schedule                    Change/Adaptation
- Multi-tasking              Meaningful Relationships
- Involvement

Our findings encompass a very wide range of toys and interactions, which could be divided into four quadrants: physical with small motor skills (e.g., “Mr. Potato Head”) physical with large motor skills (e.g., Outdoor playhouses), digital with small motor skills (e.g., Video games), and digital with large motor skills (e.g., “Dance Dance Revolution”). For our product, within this matrix, we wanted to have the great physical qualities of older toys, and the technological advantages of the newer ones.

Within today’s market, the design opportunity we have identified has not been explored very much by the toy industry, and responds very well to our child development research. This sort of venue has mostly only been explored and applied in more public environments such as children’s museums, which tend to be very experimental with the typologies of interactions available.

Our next step, therefore, was to visit these public spaces (museums, malls, outdoor facilities, etc.). We observed applications of technology to create physical environments for the stimulation of children’s minds, as well as social environments to bring together children of different ages within the context of a shared experience (shown in Fig. 4).

We were then able to come up with the following set of specific criteria, as seen in Figure 5, by prioritizing the key issues into those that must be solved, the ones that should be addressed, and the ones that might be reflected in our design solution.

## 5 Design Direction

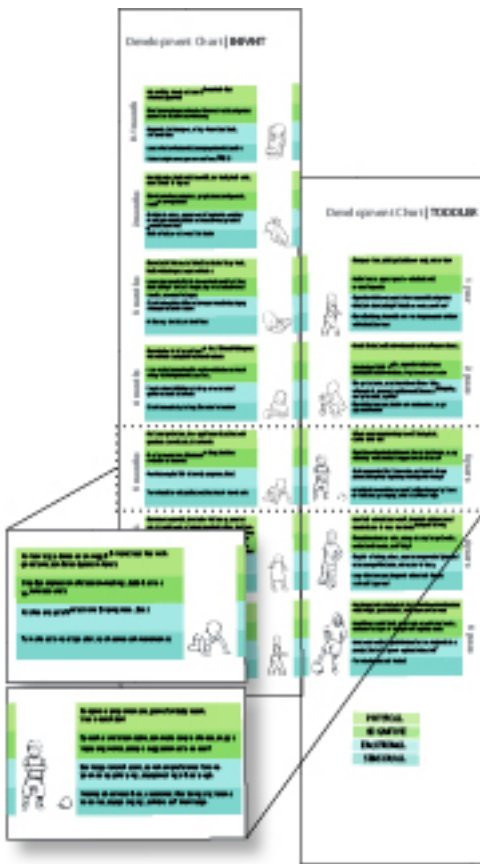
### 5.1 Design brief

Our findings showed that with the birth of a second child, family lifestyle changed dramatically. The rhythm that had been developed among mom, dad, and firstborn, had to be rebuilt to address the critical needs and new schedule of the new child. Therefore, the focus of our project centered on the interactions between the two young siblings once the family adjusted to life with the new addition and achieved a more balanced and normal schedule.

Understanding the interactions between siblings during play, exploration, and mealtimes was crucial to our design process to discover opportunities where the parent or primary caregiver can gain some distance from hovering above the children at all times. In an ideal scenario, we hoped to discover an opportunity where a mother could prepare dinner while her kids played in an adjacent room needing only a sensitive ear to make sure they were safe and playing well together. One of our initial findings was that every child is different – having differing abilities. To better understand children and the drastic changes in abilities between ages 18 months and 5 years (a common age gap among American families with 2 children is 3-4 years), we simplified the physical, cognitive, sensorial and emotional attributes of an “average” child at each stage into a visual tool that was used to validate observations and findings and help guide design explorations (as seen in Fig. 6).

Through the use of this simple tool, we were able to forecast certain interactions during play according to children’s capabilities at various ages. With the aid of this tool, and direct input from the families we observed, we felt that a successful concept must involve a mix of media that blended the worlds of physical and virtual play.

We determined that the area of opportunity would be in designing a product that would initiate positive and



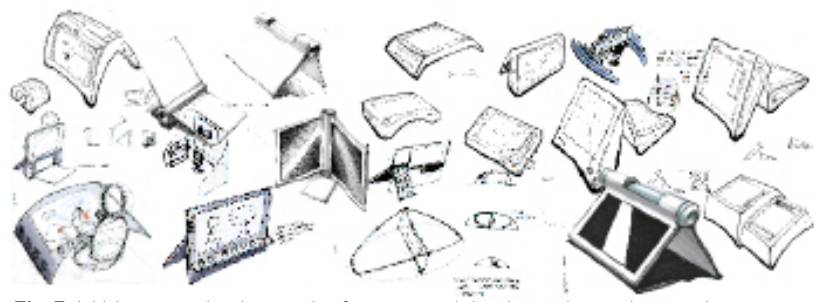
**Fig. 6** Example of a slider-chart used as a tool to quickly understand physical-cognitive-emotional-sensorial attributes of children

cooperative interaction between the two children, while attending to the needs and interests of both. If we are able to keep two children of different ages safely and simultaneously engaged in one activity, parents might not need to invest so much focused time or attention in order to oversee them. Our hope was that this product would relieve some parental stress by offering brief moments and breaks or present the feeling that it was okay for a parent to direct their attention to their own tasks for brief amounts of time. A surrogate baby-sitter was deemed impossible and undesirable by most parents we interviewed; however, they all seemed to express the desire to be able to “walk away” for a moment without dragging the youngest child with them.

### 5.2 Design Explorations

Throughout the entire design process, we were aware of the necessity to have the parents be considered our end users as well. In order to avoid contributing to the “baby house” phenomenon, our material, form, and interaction choices needed to stay balanced and directly linked to the needs of both the children and the parents.

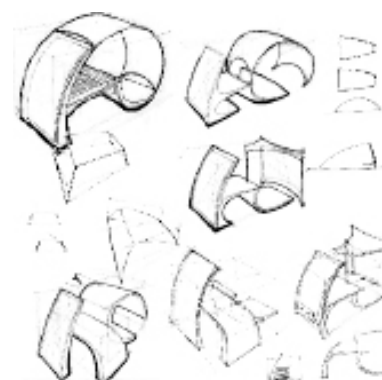
Our first concepts came from the idea that we wanted to create a digital system that would allow two children to draw collaboratively. We saw this as a good area of opportunity, because this is a particular activity that, regardless of age or specific ability, any child can participate in. Our initial sketches ranged from small digital screens to large environments (Fig. 7).



**Fig. 7** Initial concept sketches ranging from personal drawing stations to large environments.

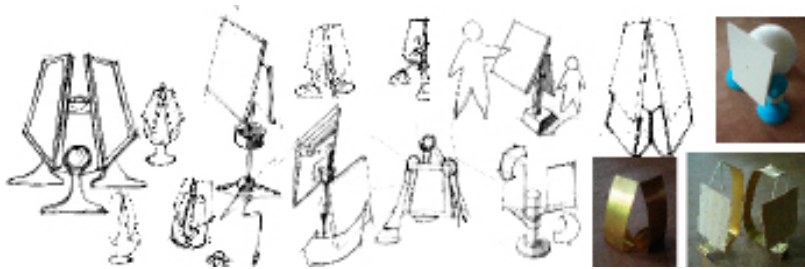
The physicality of digital objects and space became essential issues for concept development. In order to satisfy the criterion of relieving the stress of overseeing two children, we needed to create more of an environment that would entice the children to play in the same local area. Considering the varying abilities of children, we needed to explore different kinds of interactions within one product/space – viewing the behavior of the children and the parent(s) as choreography. The first aspect within the interactive product space was the digital touchscreen; the second aspect was the physical components; the third aspect was using the product space to define the local environment. One of the challenges of supervising more than one child is keeping them in one space simultaneously, which is why we started thinking about our concept in a larger spatial sense. This idea also afforded the concept of physical play, incorporating whole body movement around the product space in addition to minor movements within the product space, instead of just individual activity on a screen.

Subsequent concept sketches incorporated the ideas of movement through the product space to explore the idea of creating an environment that housed three different types of interactions (Fig 8).

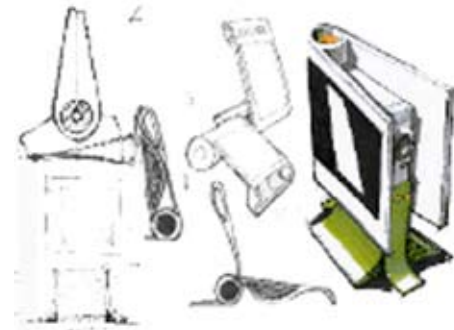


**Fig. 8** Explorations on the concept of integrating three types of interaction: digital, physical, and small motor:

Since the larger set of interactions we were trying to initiate centered on sharing and not competing, the placement of elements in the concept, and therefore the placement of the children in relation to each other, became essential components in scripting potential behaviors. In our next round of sketching, we developed concepts that would fit the screens together in a triangular configuration. In this format, the children would neither be facing away from each other, nor placed against



**Fig. 9** Concepts illustrating potential configurations of a three-part system.



**Fig. 10** Variations on the "flower-like" form.

each other in competition; rather they would both be able to face the projection, highlighting their collaboration (Fig. 9).

After assessing our criteria in greater detail, our next step was to make the distinctions between each area of interaction more clear, and help drive the form through expressive form features (as shown in Fig. 10). Hence, we decided to incorporate a pegboard, which would be driven by physical objects (pegs), but would also have digital output on the screen and the projector. Our three areas of interaction were now set – the pegboard for input, the digital touchscreen for drawing, and the projector for output.

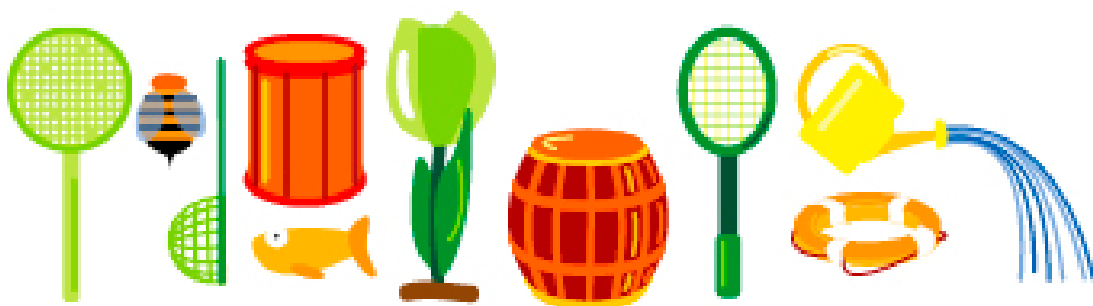
In the following stages of sketching, we explored the integration of these new areas of interaction. The form evolved into a "flower-like" shape, that could unfold to expose the interactive components, and fold up creating a simpler appearance and having a quieter presence in the home. By developing a product that would change positions as such, we were bringing about the implications of levels of sharing, as well as space saving factors, common in everyday households.

### 5.3 Design Proposal and Criteria

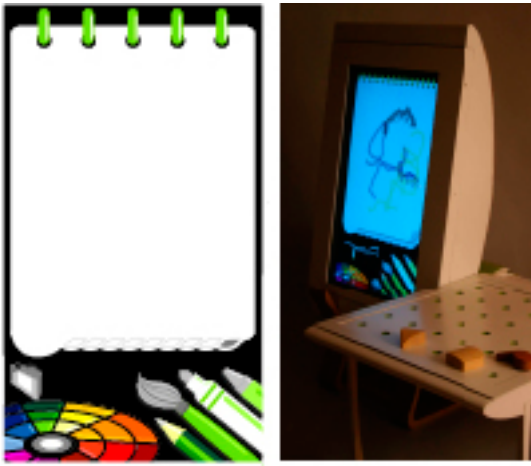
The final design involved creating a more specific set of design criteria, focusing on the intended interactions within the concept. Of particular importance were the interactions between children, between adults and children, between the children and product, adults and product, and between product and surrounding environment.

Beyond the design criteria for the physical attributes, we defined the language for the graphical side of the interactions (sampled in Fig. 11). Graphics were necessary for two elements within the concept: the interface of the touchscreen, and the animations from the pegs. The language and style we were looking to create in the graphics had to compliment the language of the physical form and match the type of behavior of the children.

To achieve a cursory understanding of kid-focused graphic communication, we developed a matrix of current styles placing each specimen in a specific quadrant created by axes that ranged from symbolic to representational and photorealistic to abstract. We determined that our graphic language would fall in the abstract/representational



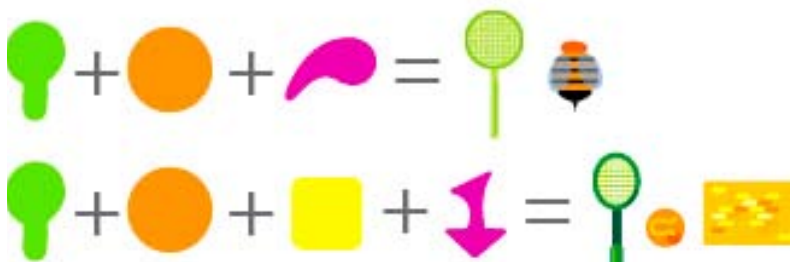
**Fig. 11** A sampling of the graphics used in "Lila's" animations.



**Fig. 12** Touchscreen interface shown as it appears in use.

quadrant, to allow for simple, clean, and recognizable forms. As the graphics would appear in real-time with the pegs' placement on the board, their simplicity was a necessity to being able to identify the objects quickly. In keeping with the same style, the interface on the touchscreen also had to be simple and intuitive (Fig. 12). The focus of the screen should be on the child's creation, and not on the interface. Besides the given factor that the child is drawing on a screen, the interface should evoke natural interactions, to feel as though the child is, for example, finger painting on an easel. The drawing instruments are based off of real tools, and even the aspect of page turning to start on a clean page, is implemented in the interface.

The essence of the product lies in the result of the collaboration among the areas of interaction listed above. While the children are able to work from separate elements within the unit, when they play cooperatively, they create stories together. The pegs are not only inviting looking objects to hold and play with, but are the components of varying animations and stories. Each wooden peg represents either an object or an action, which is translated to a graphical image (Fig. 13) when plugged into the board. By showing children this direct relationship between a physical shape and its graphical counterpart, our goal was that this can teach them to find this relationship among other objects in the physical world around them. Some of these possible combinations are shown in Figure 14.

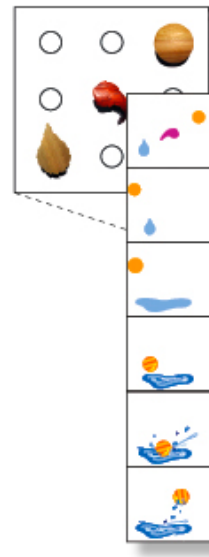


**Fig. 14** Initial graphics turn into more specific graphics, depending on the combination of pegs put on the board



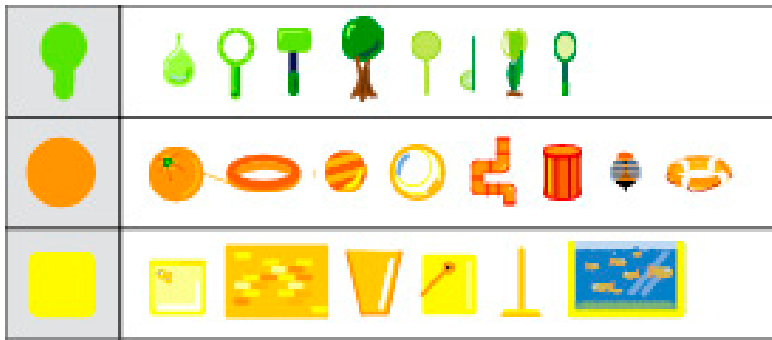
**Fig. 13** Initial graphic output for the six wooden pegs.

Children's toys should require little instruction. Often, if told how or how not to play with a toy, children will become frustrated or uninterested. This product does not require any instruction, though there is an order within the system, which the children will learn through experimentation. In this prototype, in order to create an animation, a child must first plug in either 2 or 3 object pegs, followed by the action peg. Just as in creating a sentence, an action defines the end of a phrase, and gives the objects in a sentence something to do (Fig. 15). While this order is creating a beginning, middle, and end to each story, it is also teaching about cause and effect. The children will be able to experiment with the effects of using different combinations of objects as well as different placements on the screen, and will directly be able to see what happens when objects interact.



**Fig. 15** Example animation sequence from the circle, drop, and throw pegs.

The object pegs consist of simple nondescript shapes (refer to Fig. 13), but when translated to a digital graphic, each specific object is determined by the order in which the pegs are placed onto the board. By originally providing the children basic shapes to play with, not only are these forms they can intuitively understand, but encourage imagination by not forcing literal interpretation. A circle,



**Fig. 16** Sampling of possible object translations from simple shapes.



**Fig. 17** Projection and touchscreen “notepad” feature.

for instance can be anything from a sun, a ball, a ring, to a cup (as seen in Fig. 16). The possibilities are endless, and we want to encourage children to recognize this through exploratory interaction.

The concept of turning a two dimensional shape into a three dimensional object on screen may be new to small children. To account for this when designing the animations, one thing we did was assign every object peg a different color on screen. For instance, every time the square shaped peg is used, it is represented on screen as being a yellow object, and every time a circle peg is used, its objects are orange. The clear distinction between object pegs and action pegs was also necessary. Physically, the pegs are made from two different kinds of wood. The objects are all made from light colored wood, and the actions made from dark wood. Digitally, the action pegs always appear in the same shape as the peg, and are always purple in color. The action pegs are the only instance in which purple is used in the graphics, thus guiding the children to see this connection. Assigning these common threads to the shapes will help the children follow the relationships from 2D to 3D objects.

The animations created are displayed not only on the projection, but on the touchscreen in front of the other child as well. While the child at the pegboard is creating the specific scenarios, the child at the screen provides the stories with a greater context, setting, or foundation to build upon. The combination of these elements is what is displayed on the wall, naturally showing the

## 6 Design Argument: Establishing a Virtual Play Space

*Ryan and Sarah are anxiously awaiting their names to be called at their family pediatrician. To make the time pass, they decided to play with “Lila” while they wait. Sarah, age 3, is attracted to the soft looking wooden pegs, while her brother, age 6, goes right for the touch screen. Sarah shuffles through the peg collection, and begins to plug them into the board on the table, while Ryan starts drawing a picture on the screen with his fingers. After a brief moment, they both smile in amazement at the screen as Sarah’s shapes begin to form into a visualization of a tulip growing from a small seed. Ryan*

*is intrigued and decides to make the garden grow even bigger by adding grass and more flowers alongside Sarah’s tulip. They are both proud of their creation, and call their mother over with excitement. Ryan tells “Lila” to replay their story, and the family watches as it is projected on the wall.*

The locations of the pegboard, digital screen, and the projector are directly linked to their uses. In a closed position, the digital touch screen and the pegboard are opposite from each other, allowing for a sense of excitement, expectation and wonder among the children. It is not until the children look at the projection on the wall that they can see the result of their individual efforts coming together. In an open position, the screen still stands at an angle like an easel, and the pegboard rests next to it parallel to the floor and 45cm from the ground, standard table height for this age group. The implications of collaboration while in the open position become much stronger, because when working side by side, the children can see each other as a team and at the same level. It will encourage them to communicate through language, but mostly through artistic form and input, to create a personally crafted story that they can share and be proud of (Fig 18).



**Fig. 18** “Lila” defines a sense of space by concentrating activity around its form.

This type of collaborative interaction can promote a sense of accomplishment and reward for the children. If they work together in different tasks, they can liven up the space by sharing their creations with their family through a projection on the wall. Since both the digital touchscreen





**Fig. 19** The flower metaphor in “Lila” is shown here in both the earlier and the latest prototype.

and the pegboard are independent entities, there is still space for a sense of individuality in case the children would in fact choose to play on their own.

The general form is the result of drawing visual cues from nature to create a dynamic form for this electronic product (Fig. 19). The flower-like aesthetic, complemented by the use of the colors green, white, and light colored wood, evokes a very simple, quiet and clean feel. The action of opening this device mirrors a blooming bud as metaphorical reference to creativity. Pragmatically, this physical transformation enables “Lila” to be stored more efficiently when not in use. Like a flower, the base of “Lila” is sturdy and strong (wood being the perfect material functionally and esthetically for this) while the top is more delicate and inviting to the touch.

The flower metaphor is enhanced by the visual form where the tops are curved outward and away from each other in order to create a feeling of growth and reflecting a driver of the product concept – the growth of children’s imaginations and their creativity. Furthermore, “Lila” can grow with a child. A one year old child might be fascinated

by the big shapes of the pegs and the way they plug in and create a picture on the wall, whereas a child of 4 years of age can start discovering the way objects interact with each other through the animation sequencing. At the same time, a child of 8 years of age, can create more elaborate drawings on the digital screen and script out increasingly more complex stories on the pegboard driven by outside influences or personal experiences.

The choice of materials and colors also played a large part of achieving our goals through form. With a calm, quiet, light, open, simple, playful, pleasant, and natural aesthetic, “Lila” is interesting and engaging for children, and palatable within many adult environments (Fig 20). The only noise made by “Lila” occurs during animation playback; however, we have observed that children can generate quite a buzz when excited about something, so we expect “Lila” to cause much stir. This may, in effect, provide some audible feedback about the children to a parent who briefly leaves the room. There are no small moving parts or physical noise-emitting objects that may become repetitive, irritating and stress inducing, thereby creating a distinct and different experience to many contemporary toys.



**Fig. 20** “Lila” form factors and design details.

## 7 Testing and Feedback

“Lila” is an ongoing project between TU/e and Carnegie Mellon and is presented in the context of this paper as a working prototype. Immediate next steps include further refinement of the visual library, peg set themes, and continued contextual testing with children and parents – we want to learn about “Lila’s” impact on child development and impact in the home.

User studies of the initial form prototype were conducted with children and parents in and around the Pittsburgh, Pennsylvania area and Carnegie Mellon University, while testing of the final working prototype has been ongoing in conjunction with the Technical University of Eindhoven in the Netherlands. The working prototype of “Lila” was demonstrated to the public for the first time during Dutch Design Week 2006 in Eindhoven. Aside from observing users of all ages interact with “Lila,” sessions were structured to obtain both informal feedback and reaction to the system as well as task-based activities to test navigation, cuing, and perceived understanding of controls. Upon completion of this initial testing, we created a brief demonstration video illustrating a typical user scenario (Fig 21 below).

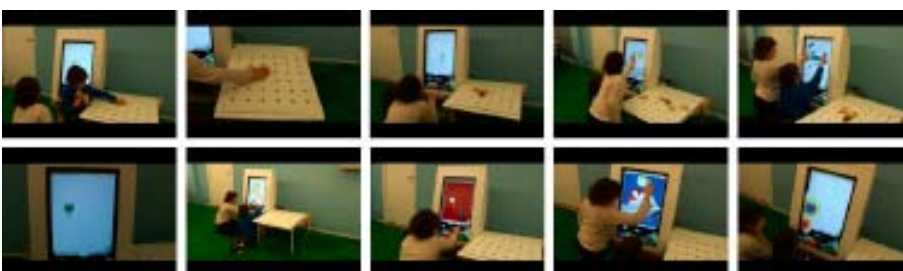
While more thorough user testing of “Lila” is still being conducted, initial rounds of testing did yield positive feedback from parents, interaction design professionals, and most importantly, children. The children demonstrated an understanding of the cooperative nature of “Lila,” with older children generally gravitating to the touch screen, and younger ones to the wooden pegs. In a couple cases, an interesting relationship also occurred, which we had not anticipated. The parents became engaged in the storytelling, as opposed to standing back and merely observing. “Lila,” in form and function, was just as intriguing and attractive to the adults as it was to the children. This extra level of cooperation could play a key role in expanding “Lila’s” capabilities to be even more inclusive and encourage adult

participation. “Lila” is intended to exemplify intelligent and simple interaction in a unique product form and to show how synthesizing tangible and digital interaction with open-ended storytelling can create a cooperative activity for a broad range of ages.

## 8 Summary and Potential Extensions

For prototyping and testing purposes, we limited the number of object and actions pegs to obtain general feedback on our concept. However, the market applications for “Lila” would require the implementation of the same types of interactions within the animations with the use of a much larger number of pegs. This number could actually grow as time goes by and as the complexity and possibilities for different types of objects and actions increase. The pegs might be sold in special packages according to themes and types of objects and actions; for example, a circus or farm set. This can allow for the creation of specific backgrounds and environments in the animations and more uniquely customizable experiences. “Lila” provides a platform for experiences which can be customized, enhanced and adapted to the varying abilities of players and potentially, “Lila” can grow in complexity with a child – thereby extending “Lila’s” lifespan and presence in a child’s life.

Currently, the maximum number of pegs for one animation is 3 objects plus one action. As development continues, “Lila’s” system will allow for the combination of a larger amount of object pegs, increasing the number of possibilities and activity within an animation sequence. We envision this growth to mirror a Rube Goldberg contraption or an arrangement of dominos; nearly infinitely expandable. This may enable a “cascading effect” (similar to the “Mouse Trap” game: an exploration of a chain reaction) with which children can create additive sequences, more specific stories with breaks and pauses, and explore the physical characteristics of objects as they relate to actions and reactions.



**Fig. 21** Screenshots of demonstration video captured at TU/Eindhoven to show user interaction.

## Designing for non-humans: the essential challenge for communicating design function.

Although the initial premise of our project was to design a product system that would co-exist within a house environment, the possibilities for the integration of “Lila” into other more public areas and environments seems appropriate. Public places such as hospitals waiting rooms, museums, retail spaces, doctors’ offices, airports, schools, or anywhere children wait, are potential venues that would benefit from having a product like “Lila”. Some companies now are beginning to realize that in order to make usually stressful experiences, such as hospital visits or automotive purchases, more pleasant, they must consider the entire experience for families with young children, and use the environment as a tool for creating some sense comfort.

Another possible application for “Lila” includes a therapeutic interactive system for children with autism. The current techniques used to help these children communicate are very crude and have an overly-engineered appearance. “Lila” presents an opportunity to integrate a more refined communication instrument that might enable children to identify objects, create sentences, and be able to visually communicate their needs more effectively.

As technology keeps advancing at it’s current pace, and children’s toys become more screen-based and less physical, a solution for a new kind of interaction that blends physical activity with digital simulation is very promising. “Lila” provides the world of flat digital screens a three-dimensional and physical quality that it currently lacks and which has made previous generations of toys very meaningful in the social, physical and cognitive development of children.

### Acknowledgements

We would like to thank the Carnegie Mellon University School of Design and the Technical University of Eindhoven for providing us with the opportunity to develop this concept. This project would not have been possible if not for the talent and generosity of our programmers, Philip Mendels and Joris M. van Gelder, as well as the entire group in the /d.search-labs at TU/e.

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**Fig. 22** “Lila’s”  
touchscreen drawing  
features being explored.





# Designing for non-humans: the essential challenge for communicating design function.

## **Abstract**

Designed products embody cultural assumptions and may rely on visual or linguistic instructions for use. One group that often uses products but that cannot access these designed meanings are the wild and domestic animals that share urban, agricultural and conservation areas with humans. Animals sharing human spaces present an important design challenge. By designing for animal users, the industrial designer can not only improve our environments and our interactions with other animals, he or she can also stimulate the development of innovative ways of communicating design that can be applied to any kind of design practice. Here I review common problems and solutions that occur at the human—non-human animal interface. Common unsuccessful designs to reduce friction between humans and animals include exclusionary designs such as walls and traps that attempt to eradicate the problem rather than solve it. Design is an excellent tool for promoting desired interactions between behaving individuals, but this capacity is rarely used when designing for human-animal interactions. I discuss the importance of empathy with the product user, and how to use basic insights into behavior and psychology to improve empathy and consequently design. I end with six suggestions for how to approach design for animals in human environments, including (1) develop empathy for the user (2) become familiar with basics of animal behavior (3) be sensitive to the specific proclivities of the users in question (4) take advantage of the user's

Umwelt to reduce necessity for learning (5) promote positive interactions and (6) search for creative solutions to the causes rather than the symptoms of human-animal interactions.

## **Keywords**

Communication, design, empathy, Umwelt, urban ecosystem, animal welfare

## **1 Introduction**

Designed products embody the designer's assumptions about how to use a product and communicate with the user. The greater the cultural background shared by the user and designer, the easier this task should be. Designing for users who share no cultural background with the designer presents an opportunity to challenge preconceptions and stimulate innovation. Wild animals, pests and pets often interact with products that were designed for humans, but have very different perceptions and needs. Urban designers are aware of the issues surrounding the sharing of spaces by humans and animals, and there is a body of practice and more than one academic journal devoted to the topic. Industrial designers seem less aware of this challenging population of users and how to design for both us and them. Here I would like to discuss the scope of potential for designing for non-human animals, particularly wildlife, and to suggest some principles of design for animals that can also be applied to humans.

## 2 Why design for animals?

Animals don't buy manufactured products, but local authorities, conservation organisations, wildlife trusts, biologists, farmers, gardeners and pet owners do. Such people take an interest in the behaviour and welfare of the animals they interact with. Animals can be economically valuable resources, cultural icons, indicator species, disease vectors, pests, and companions. All of these functions are contingent on the animals' behaviours and interactions with people or with environments altered by people. Designing solutions for human-animal conflicts and use of habitats can help to maintain functioning ecosystem services while contributing to human economic activity ("reconciliation ecology") [1]. Promoting positive co-uses of conservation areas is an important management goal in reserves [2,3]. Arguing that nature and wildlife contributes to the social and cultural discourse of urban life, geographer Jennifer Wolch argues for the need to "re-animate the city in both our thinking and practice" [4]. Indeed, the re-animation of the suburb, the farm, the reserve, and the imagination is also called for.

Designing for animals is a way of bringing intelligent solutions to challenges that arise at the interface of human and animal worlds. Human users expect their physical environments to be orderly, to be designed for their comfort and benefit. We like to be able to modify our homes and landscapes to suit the way we want to live. Similarly, animals typically are looking for something in the modified environment that matches what they evolved to want and need. Many people who work with animals have developed a body of practical knowledge about designing for the animals they know. However, these are not always sufficient for the novel and significant problems occurring in urban habitats and conservation areas [5, 6] and fresh, intelligent and design-led approaches are needed.

Another reason to design for animals is that humans are animals too. Principles and skills learned from designing for animals are transferable to designing for humans. The experience of designing for animals should enable the designer to break through assumptions and norms more easily when designing for humans. On the whole, where designing for animals is successful, it is evidence based. Designers may not always want to go this route in designing for humans, but sensitivity to the ways in which design can go right or wrong when tested rigorously will help when designing new products and services.

## 3 Typical problems and solutions, or Could one design a pedestrian crossing for a hedgehog?

Animals going about their lives often come into conflict with humans. In urban and suburban areas, a common problem is for wild or feral animals to invade people's gardens, eating expensive plants and soiling the lawn. A typical solution is to kill the offending animals. Culling is a common strategy when the animal population is greater than what can be sustained by the habitat, but has also been used, for example, to keep a handful of peacocks out of a single garden [7]. As a solution, this is not inspiring. On agricultural land, crop raiding by species as varied as geese [8] and elephants [9] is a similar problem, as is predation on livestock by wild carnivores [10]. Culling groups or killing of individual "problem" animals is also used in these cases, but does not appear to be particularly effective [9, 10]. Disputes over resources between members of the same animal species rarely result directly in death, suggesting that resorting to killing is bypassing natural behavioural mechanisms of "dispute settlement." Other, more humane, solutions often fail to take into account the behaviour or psychology of the animals involved, and thus fail. A village in Devon spent £40000 on installing a cattle gate to keep feral goats out of their gardens [11]. While a cattle gate is a clever and elegant solution to keeping cattle out of an area, it has no effect on goats, which are more agile and not afraid of heights. In Valdivia, Chile, a population of sea lions frequents the fish market to beg for fish, and has become both a tourist attraction and a threat to fishermen, who are sometimes attacked and bitten [12]. The first solution was to build a wall separating the market from the ocean, but the sea lions were able to bypass the wall. The second proposed solution, to build floating platforms for the sea lions to sit on in the ocean near the market, is now being implemented. This solution, however, neither facilitates nor prevents the sea lions from accessing their source of fish at the market. One fisherman has claimed that, when approached appropriately, the sea lions are invariably calm and friendly. It has also been reported that waving a white handkerchief at a sea lion is an effective deterrent. This suggests that the underlying problem is not sea lions per se, but how to interact with sea lions. This problem has not been addressed by either of the design solutions. Design is an excellent way to modify interactions between behaving individuals, but this capacity is rarely tapped when trying to manage animal-human relations.

Some solutions that modify animal-human interactions might benefit from being integrated into standard designs. In New Delhi, India, monkeys have been known to board subway trains, causing chaos, probably because they were terrified. It was reported that in one incident “a monkey boarded a train at the underground Chawri Bazaar station and reportedly scared passengers by scowling at them for three stops. It then disembarked at Civil Lines station” [13]. A man with a langur monkey was employed to scare other species of monkeys away from trains. If the frightening properties of langurs were identified, then perhaps these could be incorporated into the design of train doors or platforms. A more radical approach would be to design trains that humans and monkeys could both use, without terrifying one another.

Other common problems involve animals failing to recognise the dangers of human infrastructure. While human children are taught to take care when crossing a road, and not to touch electrical wires, hedgehogs and birds do not receive this kind of instruction. Some animals may in fact get the wrong message: raptors raised in captivity and then released into the wild preferred to perch on the poles bearing electrical cables, which resembled their perches in captivity [14]. Animals cannot read “Danger: High Voltage” signs, or understand zebra crossings and pedestrian lights. Such solutions work only for humans. Are there ways in which wild animals could be warned away from busy crossings and power lines? Could they be attracted to safer parts of the environment? Could one design a neighborhood pedestrian crossing for a hedgehog [15, 16]?

There are also many examples of effective solutions where human and animal interests have conflicted. Breitenmoser et al. [10] and Osborn and Hill [9] review, respectively, designs for products and techniques preventing predation of livestock by wild carnivores and for reducing crop raiding by African wildlife, at least some of which are successful. The range of human-animal conflicts and their solutions is wide, and often idiosyncratic. For example, a pair of hawks known as Pale Male and Lola nest on the façade of a landmark co-op in New York. After residents complained about the debris that fell onto the sidewalk, the nest was removed. Following protests, the nest was replaced, with the addition of pigeon spikes to improve the nest's grip on the façade and an architect-designed rail to prevent spillage [17]. This cycle of animal improvisation,

followed by conflict, and finally resolved through human improvisation, is repeated around the world. What is needed is a body of practice that can unify and improve on ad hoc solutions. Design-led knowledge and innovation have the potential to improve the human environment for all its users.

#### **4 The animal welfare approach, or How does one make an elephant happy?**

One group of people who have been designing for animals for many years are those who study animal welfare. Animal welfare approaches are primarily aimed at animals that are being used by humans for some purpose and are cared for by humans, including farm animals, zoo animals, and laboratory populations. This paper is more aimed at designing for animals that incidentally interact with humans and their environments, but the animal welfare approach is important and successful so I describe it here.

The goal of designing for captive animals is to maximize their welfare and minimize their pain, suffering, and frustration. A mistake that many well-intentioned people make is to assume that they know what an animal wants, or what makes it feel satisfied. People studying animal welfare have developed a variety of techniques for asking animals what they want. One way to ask animals what they want is to give them binary choices between different rewards or situations [18]. Chickens were given the option of standing on two different forms of flooring, and were then scored on how much time they spent standing on each type. The chickens stood more on the type of flooring that had been recommended against, resulting in new recommendations and designs [18]. Another way to ask animals what they want is to train them to pay a cost to obtain a reward, and find out how high a cost they will pay for different kinds of reward or situation. Chickens were taught to squeeze through small holes in partitions to access food or other chickens. The subjects in the experiment were willing to pay a high squeezing-through-holes “price” for food but would not pay to access others [18]. This indicates that although chickens are social animals, they are quite happy to avoid others. The example also shows that a creative design for paying a “price” (squeezing through holes) also enables elegant experimentation. A design that takes advantage of natural behaviours allows humans to “communicate” with the animal about its preferences.

In the meat industry, animal welfare means keeping the cattle or sheep calm as they go into the slaughterhouse, and minimizing the pain and trauma of slaughter. The main designer of animal processing facilities in the United States is Temple Grandin, a professor of animal science with autism who sees similarities between her own thinking process and animal cognition, allowing her to empathize with the livestock [19]. She has designed ramps, chutes, restraints, and whole facilities, which can be seen on her website ([www.grandin.com](http://www.grandin.com)). Guiding her design is an understanding of the psychology of herd animals, what motivates them, frightens them, and reassures them. For example, electric prods can in some cases be replaced by white plastic bags waved at the animals, which is both a cheaper solution and less cruel (note the similarity to the white handkerchiefs used to frighten sea lions in Valdivia). But because flapping and fluttering objects scare cattle, they must be removed from animal processing facilities to prevent the animals from spooking and balking. Zoos face difficult animal welfare problems. Lack of space is only one factor in reducing the welfare of some animals. Another problem is boredom and uniformity of stimuli, or what is termed lack of “enrichment”. In common with other captive animals, zoo animals do best when they can satisfy the whole range of their natural motivations, including the desire for social companions (if they are social animals), hunting and foraging, nest building, reproducing and caring for young, grooming, hibernating or migrating. These urges can be very difficult to satisfy in captivity. The design of enrichment that prevents distress and pathologically repetitive behaviours (known as stereotypies) and promotes natural behaviours is an important endeavour still in development [20]. Elephants in particular always seem to have depauperate enclosures, because they quickly destroy trees and grass, and pose difficult husbandry problems [21]. Although most zoos are undeniably vastly better than they were in the past, lack of funds, lack of knowledge, ease of maintenance, and the destructive capacities of large animals often present significant challenges to design.

### **5 The Umwelt, or Empathy with a tick**

When Temple Grandin designs holding pens and slaughter facilities for cattle, she uses her well-developed empathy with cattle to design spaces that calm the cattle. Calmness is invaluable to veterinarians and the cattle industry because it makes cattle processing and care more efficient and humane. She writes “I use my visual thinking skills to

simulate what an animal would think and feel in a given situation. I have to imagine what experiencing the world through the cow’s sensory system is like” [22]. Empathy is key to creating objects and environments that encourage animals to behave in a desired way. But ignorance of a particular species’ behavioural and psychological characteristics can lead to errors in design solutions, as I pointed out above. Empathy needs to be based in knowledge.

In the nineteenth century the German biologist von Uexkull developed the idea of the Umwelt. Every animal, humans included, lives in a world defined and bounded by its sensory experiences, known as its Umwelt. Von Uexkull illustrated his idea by describing the life of a tick, which can detect and respond to only gravity, light, and butyric acid. It moves away from gravity and towards light; when it perceives butyric acid, it lets go and falls, hopefully onto a passing animal from which it can suck blood. Von Uexkull’s tick lives in a world composed only of these three sensations. Other animals have more complex Umwelts, but all Umwelts are bounded, sometimes surprisingly so.

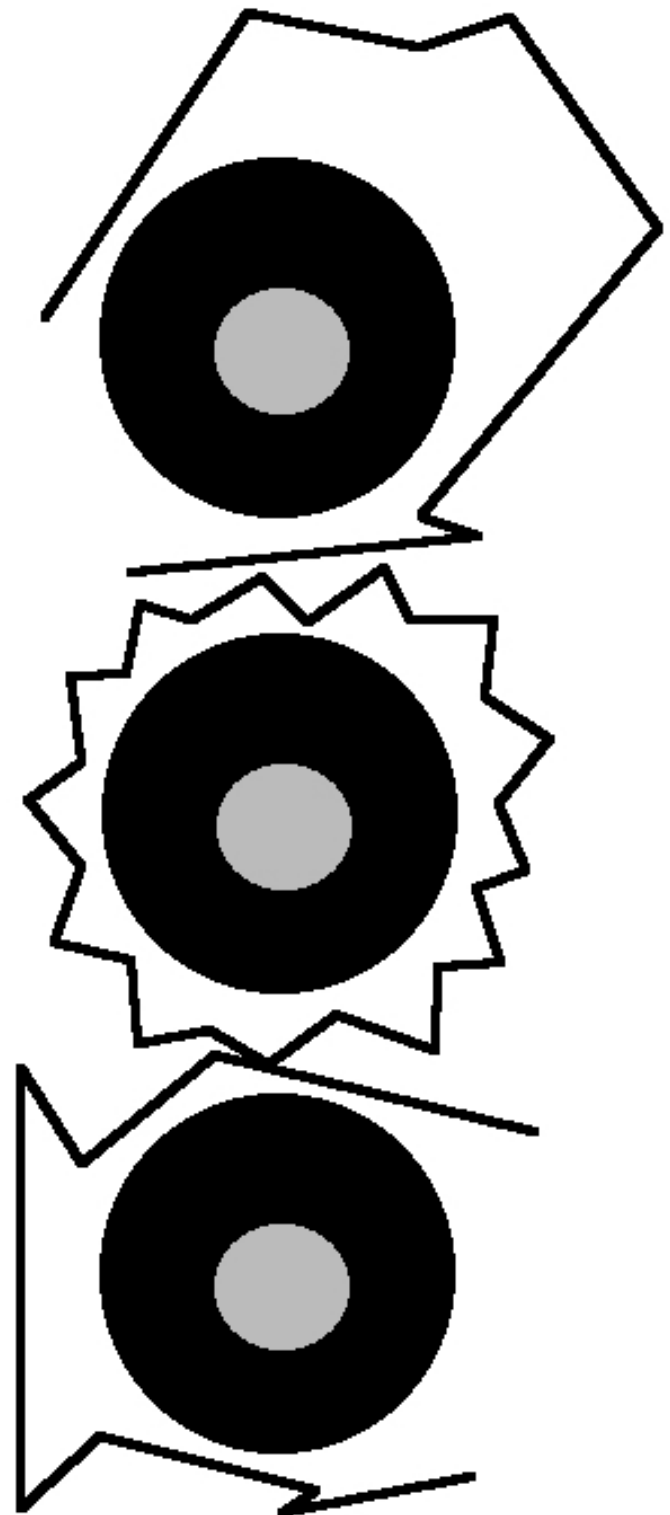
To design for animals it is essential to understand the animal’s Umwelt, and also the typical responses to important sense perceptions. While each species has a distinct Umwelt, many aspects of animal cognition and behaviour are the same for large groups of species. Concentric circles attract attention; flickering and fluttering shapes are alarming; light is attractive; low sounds are threatening and high-pitched sounds are not; regularity in time and space is easier to understand than irregularity. See Figure 1. In order for a design to succeed in eliciting a certain type of use, including efficient use, pleasurable use, or goal-related use, it has to take advantage of the animal’s Umwelt. This is equally true of design for humans. Products designed for children, the elderly, or the blind, for example, take into account those people’s particular Umwelts. While we may have an intuitive feel for the human Umwelt, we must retrain our intuition when empathizing with animals.

### **6 Communicating the functions of products across species boundaries**

In order to design for animals one must overcome the challenge of communicating the function of the product to another species. This must be done without language and without the cultural assumptions that one can rely on when designing for humans. As I discussed in Section

Three, sometimes it is necessary to communicate with the animal via some interface, such as the holes for chickens to squeeze through, in order to “ask” the animal what kind of products or environments it wants. Communicating through *things* rather than words or shared assumptions is undoubtedly a good exercise for any kind of design. Here I list some suggestions for an approach to designing for animals who share human spaces.

- 1 Develop empathy with the target animals, or an intuition about how they react to the world, by spending time watching them behaving. If this is not possible, talk to someone who already has this experience.
- 2 Learn the basics of animal behaviour and psychology. A book like Desmond Morris’s *Animal Watching* is a good place to start. There are many regularities to animal cognition and behaviour and these can be exploited when designing both for humans and non-human animals.
- 3 Find out about the specific behaviours of the species in question. Do they see in colour or black and white? Ultraviolet? Do they have an aversion to or a preference for a particular taste, smell, shape, or movement? What do the animals prefer and want?
- 4 All animals are capable of learning. Learning is facilitated where stimuli are salient (see points 2, 3) and predictable in space and time. However, a product will be more successful the more it takes advantage of an animal’s Umwelt and the less it requires learning. As an example, blue tits (a small bird) developed a tradition of peeling open the foil caps of milk bottles delivered to doorsteps in Europe in the 1940s, in order to drink the cream [23]. This “use” of the milk bottles was successful because it tapped into the tit’s automatic bark-peeling behaviour. Rather than learning a whole new way of getting food, the tits only had to learn to approach and perch on the bottles. The automatic peeling behaviour then took over. Because the milk bottles appeared regularly in the same places, finding them was not difficult to learn. Other examples can be found in [9] and [10].
- 5 Try to promote positive interactions between animals and humans rather than finding only exclusionary solutions [1,2,3,4]. Interaction is improved when the possibilities for interaction are kept few and are clearly signalled, thus predictable (see points 2, 3) [24].
- 6 Try to resolve any underlying conflict rather than eradicate its symptoms. More humane and intelligent solutions that promote positive interactions (point 5) or desired behaviours can be found, and design of interfaces and other products is a potentially powerful way to do this. Economists and policy makers tend to see patterns of behaviour as encoded through financial incentives and other market processes, and set up incentives accordingly. This does not work for animals’ incentives, and does not always work for humans either! Design can be used to create physical incentives—products that are efficient or inefficient, comfortable or uncomfortable, appealing or unappealing.



**Fig. 1** Commonalities and differences in the Umwelts of different species. Concentric circles attract attention in many species but the reactions to them differ: Concentric circles on a butterfly wing (top) simulate a predator’s eye and in birds or lizards may elicit an escape response. Concentric circles (often in ultraviolet) on a flower attract bees and elicit feeding behaviour (middle). Some tropical fish have concentric circles near their tails (bottom). These also simulate eyes, but attract the predator to the “false head” near the tail rather than the true head. To an acculturated human, concentric circles might suggest “press here to get or start something.”

## 7 Case studies and conclusion

One of my favourite examples of clever design for animals are Copper Slug Rings, Snailaway and Snail and Slug Tape [25]. Slugs and snails, though valuable for ecological processes, are the bane of gardeners. Copper Slug Rings and snail tapes are copper or silver bands that can be placed around the borders of individual plants and beds, and repel both slugs and snails by giving them an electric shock. Other nice solutions involve creating a rough and impassable surface for snails and slugs around plants [25], but copper strips may look more aesthetically pleasing to the human gardener. Inelegant solutions on the market involve luring the snails to food and then drowning or poisoning them.

The beauty of slug rings and snail tapes is that they are simple, while exploiting a behavioural property common to all animals: they move away from unpleasant stimuli. It was also clever to realize that a moist animal will feel a spark when it touches copper. This is an example of communication of function at its simplest and most direct. The design also diverts, rather than kills the animals, thus allowing humans and snails and slugs to coexist. By fencing off only micro-sites, it allows the snails and slugs to roam freely in the space between surrounded plants.

In my work as a student of behavioural biology I have had to design equipment for animals, or modify equipment that others have designed. While working with wild-caught starlings kept in aviaries, I was presented with the problem of isolating individuals and making them pay attention to the behaviour of another starling in an experimental arena. Starlings had to move from their home cages into a testing arena in a separate room, and from the testing arena into a holding cage. Catching the starlings was extremely difficult, and led to stress for both starlings and experimenter. The experiment also required two starlings to move in and out of the experimental arena and the holding cages quickly and at the right moment, without ever being in the same place together. Here, handling would also have been difficult, stressful, and would have disrupted the animals' behaviours. The best solution would allow the starling to "understand" where to go without being forced.

I solved both problems through the use of directed lighting. Starlings tend to orient and move towards light and away from darkness. By turning off all the lights except a clip lamp illuminating the area to which I wanted the

starling to fly, I was able to induce the starlings to move into the desired spaces at the desired times. An additional problem was that of closing doors behind the starlings when they moved

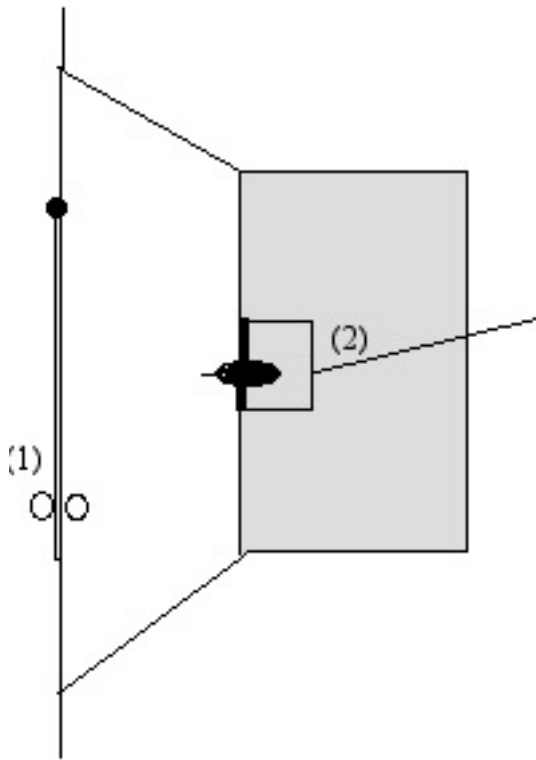
from one space to another. When the starlings first entered the experimental room, they flew through the testing arena into a lit holding cage. The starlings would wait in the holding cage while I closed the door into the arena, but then sometimes would perch in the doorway of the holding cage, effectively preventing me from closing them in until they chose to re-enter (see Figure 2). I am not sure whether this should be considered a design flaw or not, since it meant that the starlings were partly in control of the experimental procedure and the research thus had an element of negotiation, mediated by the apparatus.

Running the experiment and negotiating with the starlings via the doors and lights of the experimental apparatus required empathy in order to understand what the starlings wanted and understood, and why they were "misbehaving," as they often did. I would not claim that my design was completely successful either in providing clear alternate uses of the apparatus that would have helped me to interpret the starlings' "misbehaviours," or in channelling their behaviours in a particular direction. These difficulties piqued my interest in design for animal users.

Designing human-animal interfaces or other products for captive or domestic animals is easier than doing the same for wildlife, if only because the environment is already more controlled. To propose designing effectively for wildlife may seem over-optimistic. However, humans have a good track record of inadvertently modifying animals' behaviours, though usually in harmful or undesirable ways, such as food provisioning in trash bins, or movement restrictions in the form of roads. In

essence, the human-modified environment is read by non-human animals, but interpreted differently. The challenge is to purposefully design 'ecologies of objects' that speak as powerfully and directly to animals as current objects and infrastructures do, but with beneficial outcomes.

My own design practice for starlings could have been improved by collaboration with industrial designers, and I see scope and necessity for collaborations between industrial designers and those who work with animals



**Fig. 2** Simplified overhead view of the experimental apparatus. A starling is shown perched in the doorway between the brightly lit holding cage (shown shaded in gray) and the testing arena (to the left, unshaded). The startling flies through door (1) (a regular door) and door (2) (a flap raised or lowered by a string) towards the bright light of the holding cage. Door hinges are shown in emphasized black. By sitting in the doorway of door (2) the starling blocks the door flap and can control the beginning of the experimental session. The flap opens only into the holding cage so the starling cannot be forced inwards.

in many capacities. Ignoring the needs and activities of animals who live in the world with us, and who increasingly find themselves sharing private and public spaces in urban, suburban, agricultural, and conservation areas with humans and their infrastructures, is to ignore one of the most interesting design challenges of the present and future. Furthermore all six of the points above could profitably be applied to design for humans. After all, we are animals too. If designers are concerned about communicating the function of their products to human users, there can be no greater “back to the basics” challenge to hone their skills than designing for non-human users.

### Acknowledgements

Without support from ORSAS and the Clarendon Fund this work would not have been possible. I am also indebted to the organisers and attendees of DeSForM 2006 who helped me to see the relationship between my work and the practice of design.

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# ETree: Tactile Interactions with Light

## Abstract

ETree was developed after a study on tactility and people's physical interactions with everyday objects. The aim was to design a lamp using an electroluminescent light source, and making it playful and engaging. The designers aimed to create an object that addresses different forms of physical interaction and the resulting lamp invites the user to play and interact with the light within a three-dimensional space. Moving the strands of light changes the quality of the light itself, giving a stronger illumination when the strands are together, and a more diffuse ambient glow when they are apart. The strands of light stay in the position they were set, so the lamp retains a physical memory of the interaction creating a time-based dialogue between the user and the space through manipulating the object; these physical gestures turn the users into designers of their space.

## Keywords

Lighting, electroluminescent, tactile, interactive, ETree, haptic

## Background

ETree was developed after a study on tactility and how people interact physically with everyday objects. In this study, it was noted how people tend to interact in a tactile way with the environment around them, through absentmindedly doodling, playing with things in their hands, touching surfaces, etc. However, this type of interaction is

becoming less possible as everyday objects become more technologically developed, because these advances are driven by functional needs and by visual styling as opposed to the possibilities for physical interactions. As an example, we looked at how the evolution of the telephone has brought it from a household object to be used in a specific place, with pen and paper handy for doodling and plenty of tactile stimulation in the form of a coiled chord, handset and base, to an object that has gradually lost its chord, then its bulk, then its domestic status; it became a small fragile object that, though looking good, does not allow the same degree of satisfying physical interaction.

The predominance of sight-based design and art has a physiological basis: sight is the sense that firstly perceives the size and shape of objects [1], and eighty percent of the sensual information we perceive is obtained through sight [2] [3]. The dominance of sight determines our aesthetical ideals, but also our interest in form itself [2]; as a consequence, in design touch has usually been relegated to adding functional clues and affordances to the objects, such as grips or tactile instructions, or surface treatments that do not influence the overall interpretation of the object, such as textured fabric upholstery. Touch is used in the interface of technological objects, but it is rarely used as a determining factor in the design of the object itself.

The aim of the design process was to use tactility as a means of interacting with the technological object directly,



**Fig. 1** Speaking on the telephone

rather than mediating the experience through an interface. The literature about tactility describes two ways in which our body's haptic system can perceive an object's tangible properties, through touch and through kinesthesia. Touch is used to recognise the physical properties of small objects: by using our hands we can gather information about surface properties such as texture and temperature and properties related to form, such as shape and volume [4] [5]. Kinesthesia is used to identify movement and position of our body and limbs, and we use this to recognise and interact with larger objects, perceiving properties such as weight, balance and position in space [4] [5]. In order to create a physical interaction between user and object, we wanted to take full advantage of the tangible properties of texture, form and kinesthesia.

### Design Process

To apply the theoretical ideas about tactility and test them on a functional object, we looked at the landline telephone, because, despite the fact that its physical bulk is disappearing, it is still an object that we hold in our hands for long periods of time, and would therefore provide many occasions to incorporate physical interactions. The initial investigation involved studying how people use the landline telephone and what they unintentionally do with their hands and body during a conversation. (Fig. 1) This led to deconstructing this interaction with the telephone into three main physical activities: doodling and drawing on a separate object (on the phonebook, paper, envelopes,

wall, etc.); playing with the cable (hand movements, tangling and untangling cable around the fingers or other objects); and moving around the room (when the cable is long enough, as in a kitchen wall-mounted phone, or when the cable is not long enough sometimes dragging the phone itself on the floor around the room). These three activities are parallel to the ones described in the literature on tactility: the first two activities involve touch, and engage with texture and form, and the third engage with kinesthesia, involving movement and position of body and limbs.

We started by looking at the doodling, being the only physical activity that was not engaging with the phone as a physical object. Because most interviewed users highlighted doodling as a main physical activity while speaking on the phone, and because this activity is carried out using other tools such as pen and paper, we wanted to bring this activity back into the design of the phone itself. This could easily be incorporated into the second observed activity: playing with the cord. Out of this came the idea to have a cord which would be used for drawing and doodling, and which would hold its shape until the following interaction.

The cord was designed as a flexible rubber strand, which could be moved into any position and still hold its shape. In this way, the effect of playing with the cord and the effect of doodling would mirror each other in

**Fig. 2**  
Telephone prototype

their function of recording the state of mind of the user during the phone call. Following this, the phone was designed around the cord itself, minimising the handset and keypad and emphasizing and exaggerating the cord; the resulting phone consisted of a small wall-mounted base with a keypad, from which six cords came out, one of which contained the electronics for the phone and was connected to a speaker and microphone at the end of the cord itself, while the other strands could be slotted into the handset elements of kept loose for playing.

The original phone prototype was shown at several exhibitions, including BlindArt at the South Bank Gallery in London, and users were observed in their interaction with the object. From this observation it became clear that people were more interested in the tactile and visual qualities of the phone as an object rather than in its functionality. Because of this we continued our exploration into other areas that these concepts could be applied to, especially looking for a product that would highlight the visual and tactile aspects of the object and use them as a design element in their own right.

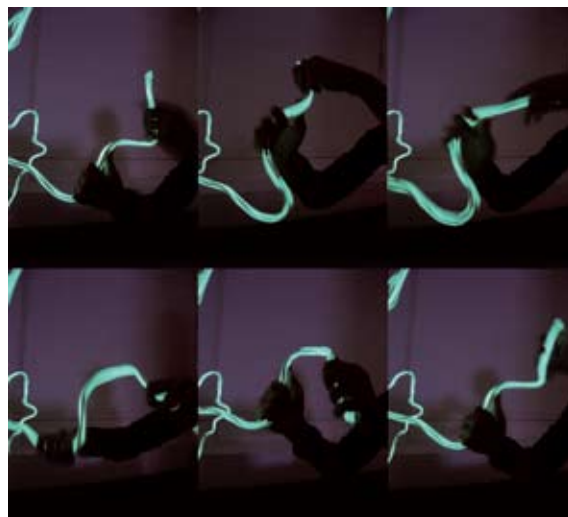
To really establish the importance of the tactile qualities of the object over the visual qualities, we looked at an area that is typically mostly visual, lighting, and decided to turn the eye-hand relationship around: while the eyes are usually the ones directing the hands towards things to be touched, we wanted to design an object in which the hands created the light to be seen. To accomplish this, electroluminescent



(EL) wire was the most appropriate technology available as it is a glow light source that has been known since the beginning of the century, but has only been used more extensively in the last ten years. Despite the fact that EL wire is not hot to the touch and is flexible, because of its visual associations with neon tubes the technology is mostly used in similar applications to neon, such as creating glowing writing or signage. EL wire seemed like the most appropriate material to use for this sort of lighting object, because by using the light source in a tactile setting we would exploit the unique nature of this material as a flexible light source. In addition, aside from the visual references to neon light, EL does not have an embedded personality yet; people do not have any particular expectations from it, so users are more open to



**Fig. 3**  
BlindArt exhibition.



**Fig. 4**  
Tactile interaction  
with ETree



**Fig. 5** ETree

**Figure 6**  
People's sketches.

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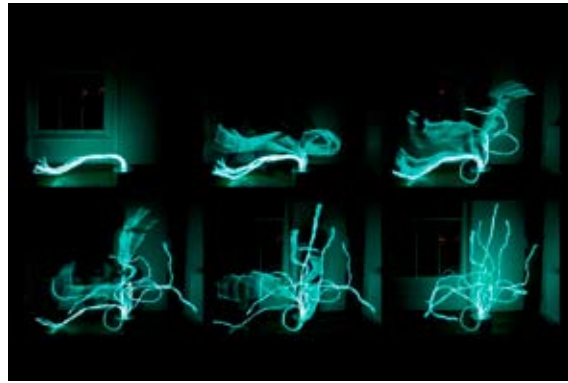
approach the lamp without too many pre-conceptions. The main pre-conception users might have towards EL lights is to see them as technological objects. Most technological objects tend to be fragile, limiting the user in their physical interaction with them, and conditioning the way the object is perceived, and as a consequence people are usually scared of touching new technology. This is a good area then to apply and maximise the possible tactile interactions, as it will encourage users to get over the initial weariness they feel towards new technology, and to interact with the object directly in a more playful and friendly setting. The direction to follow is to introduce tactile qualities to explore the physical interaction with the object rather than using haptic properties to add functionality.

**ETree**

The resulting floor lamp is formed by a heavy cylindrical base, from which ten strands of light emerge to reach almost two metres in height. The strands of light are flexible and somewhat rubbery to the touch, and can be

moved into any configuration, holding their shape. At first sight it is clearly a playful and interactive object, because the strands are not arranged in a rigid geometrical form, but are left in random configurations, giving clues to the approaching person that the lamp is meant to be touched and moved. In addition, the lamp sits on the floor, with the strands of light usually at hand height and protruding out towards the user, inviting passers-by to touch them. The strands also sway a little in the breeze or if someone passes close to them or brushes against them, again inviting the user in to a first tactile approach. When the user touches the strands, they realise that these have a rubbery texture to them, which usually indicates an object or an area of an object that is meant to be touched, thus reinforcing the invitation from the lamp to be interacted with. The effects achievable with the light strands give a sense of playfulness to the interaction, and when the prototypes were shown at exhibitions the audience was not only drawn to it at first sight, but often people stayed quite a few minutes shaping all the branches into specific drawings and spatial configurations.

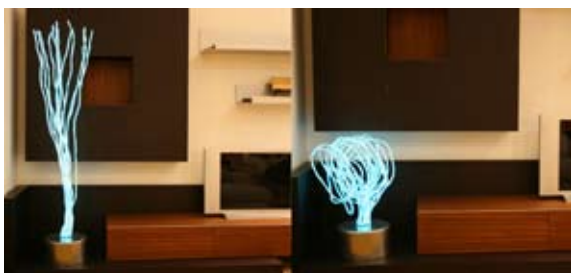
**Fig. 8** Sequence of use.



The aim of the design is to re-embodiment EL technology with the physicality of the light object. To do this, the lamp uses all three forms of tactile perception and interaction that were described, working on surface, form and kinesthesia at the same time. When approaching the lamp, most people engage with it following the same pattern: they first touch it gently and realise that the surface of the light strands is soft to the touch, inviting users to squeeze the strands and start playing with them. Then they start to engage more with the object and realise that the strands can be bent and modelled into different shapes and forms, which encourages people to use their hands to shape the single light strands into small shapes. The last step is to engage through kinesthesia with the form as a whole, using hands, arms, and the whole body to configure the strands into different structures and forms. In this way, as opposed to the trend of technological objects moving the user away from mindless physical interaction, such as doodling while on the phone, the object encourages this type of contact.

Through changing the structure of the strands of light it is possible to drastically change the amount of space that the object takes up, from packing all the strands in a space the size of a football, to spreading them out to fill a space larger than our arm span and as tall as most people. Because of this, the lamp changes the perception of the space that it is placed within, and this change takes place on two levels: on one level the physical change in volume makes us aware of the surrounding space and on another level the change in the intensity of the light, from brighter when the strands are packed together to an ambient glow when the strands are placed apart, changes the visual perception of the space and the objects around it.

ETree does not have a prescribed structure or default configuration; the user's movements create its shape. The playful interaction with the lamp is turned into a creative



**Fig. 7** Different arrangements.

experience, similar in a way to drawing, but with more tangible results; through moving the strands of light the user can create and change the design of the lamp. This puts the user in control of the design process, effectively turning the user into the designer of the final product. The creative process can have as an aim the shape of the lamp itself, or it can act within a wider context as a gesture that designs the space around it.

Because the strands of light stay in the position they were set in until the next time they are touched, a form of time-based dialogue is created between one or several users, the object and the space. The lamp becomes the language that allows this dialogue to take place: one user might try different configurations at different times of the day creating different arrangements for different atmospheres; more than one user could exchange visual messages through creating different drawings and sketches; the user might arrange the strands of light in a way that enhances its uniqueness as an object or in a way that enhances or highlights features of the space around it.

From one encounter to the other the object will remember the way it was used on the previous occasion. Because of this the lamp can act as a three-dimensional sketchbook that will record the manner and engagement with which the user interacted with the object. In a very animated interaction the user may splay the strands in one firm physical action; in a casual encounter with the lamp the user may move small bits of the strands without changing the whole configuration; in a prolonged unaware interaction the user may create repetitive small patterns throughout the strands. Through the lamp, what could be thought of as mindless three-dimensional doodling and playing will be given more importance as a physical memory of the interaction and as a memory of the user's state of mind when that interaction took place.

## Conclusions

We approached the design of the ETree starting from its tactile characteristics to end up with a highly visual product that can visually transform the space around it; this mirrors the process that the user goes through when approaching the lamp. The user will engage with the ETree in a tactile way at first, unaware of the overall visual

effect of this interaction, and will then start working more towards a visual overall effect. In a way, the ETree brings the user in to play and doodle with a highly tactile object and slowly turns the user into a co-creator of the final design outcome.

In this way, the user is starting to engage with the object in a mindless way that is similar to doodling, will play with the object and experiment what its capabilities are, without being overwhelmed by the thought that he is redesigning the object. Though the final outcome is one of consequence both for the form of the object itself and for the way this interacts with and re-designs the space around it, the user is able to approach this in a playful way and to experiment with the process rather than focus on the final visual form. ETree allows the user to interact with the design process and to create a final design which is more unexpected and spontaneous than

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# Semantics through Embodiment: a Non-linear Dynamics approach to Affective Design

## Abstract

In this paper we address the creation and interpretation of movements, light and sound from a fundamental and innovative viewpoint. Using a number of concepts from the relatively new and very promising research field of nonlinear adaptive systems, and getting some inspiration from psychophysical studies on the perception of emotion we address the study of movements and other autonomous expressions of products. The goal is to understand the semantics of movement, particularly the emotional meaning of the movement and to translate it to other autonomous expressive behavior.

## 1. Introduction

Product semantics is concerned with the creation and the interpretation of meanings associated with designed artifacts. Apart from functional aspects of meanings (“pushing this button means lowering the volume level”, for example) there are very important non-functional aspects of meaning amongst which the affective, or emotional aspects. Products express joy, seriousness, preciousness and other emotions in a variety of subtle ways. Regarding the syntax of the designed artifacts we distinguish between static and dynamic aspects. *Static* refers to the form, shape, material, color and texture of the artifact. *Dynamic* refers to behavior, in other words, the movement, light and sound, and the changes of form, shape, material, color and texture that take place over time.

However, all the mentioned aspects are non-separable, which can very well be explained with the notion of embodiment. In the past few decades there is a converging interest in embodiment from scholars in philosophy, cognitive science, psychology, linguistics, robotics, and neuroscience. Embodiment relates to semantics since the static or physical aspects of the product determine and provoke bodily interactions with the surrounding world. For simple products these interactions are rather passive and simple to anticipate. However, nowadays products are starting to behave, have autonomy and even intelligence. Autonomous products are characterized by having an embodiment with particular perceptual and motor capabilities that are inseparably linked and that together form the matrix within which reasoning, memory, emotion, language are possible. Autonomy can be expressed by far through movement sound and light, but in the future also shape could be changeable.

## 2. Types of autonomous systems

Historically, the first choice for accomplishing autonomous behaviors is the classical control theory. Its advantage is in coupling of continuously varying parameters of the real world that is required to generate stable behaviors for an autonomous system. It is a disadvantage, however, that such a system will fail to provide the necessary flexibility to generate multiple different stable behaviors depending on the dynamic change of the environment. Since design environments are never stable, talking about

embodied autonomous behavior we will consider systems that can behave within changing and possibly unknown environment. Or, in other words, the behaving system and the changing environment are equally important constraints for design.

Embodied autonomous behavior itself can have different degrees of complexity. Autonomous devices can be reactive, when their behavior is purely guided by their sensors. Compared with the living organisms, this behavior resembles classical conditioning: a low complexity sensory event triggers set of pre-wired reflexes that support basic behaviors and provoke immediate actions. Such a system can successfully be modeled by so-called Braitenberg vehicles. Braitenberg [1] describes a series of thought experiments in which “vehicles” with simple internal structure behave in unexpectedly complex ways. He describes simple control mechanisms that generate behaviors that, if we did not already know the principles behind the vehicles operation, we might call aggression, love, foresight and even optimism. Braitenberg gives this as evidence for the “law of uphill analysis and downhill invention,” meaning that it is much more difficult to try to guess internal structure just from the observation of behavior than it is to create the structure that gives that behavior.

More complexity can be added to a reactive system by introducing adaptive control mechanisms that construct representations of more complex events [2]. The adaptive control mechanism is an artificial intelligence algorithm, let say an artificial neural network, i.e. a system with many similar elements that internally have a nonlinear transfer function like Naka-Rushton function (or just sigmoid function). It facilitates representations that arise from the experience-dependent changes in the synaptic connections between the populations of neurons reflecting the combination between sensory events and internal states. Difference equations would explain the behavior of such a system.

Yet, by adding an adaptive control mechanism, the complexity of realistic behavior and emotional movement and interaction can not be reached. To cite a known example, changing from a walk to a trot or gallop requires switching among dynamical modes in a nonlinear motor control network. In the domain of motor control, modelers have used nonlinear dynamical

systems to describe not only how different movements are coordinated, but also how switches between different patterns of coordination are brought about.

To successfully accomplish a behavioral goal such as reaching for an object, two related problems must be solved: to decide which object to reach and to plan the specific parameters of the movement. Traditionally, these two problems have been viewed as separate, and theories of decision making and motor planning have been developed primarily independently. Research in neuroscience and psychology suggests that these processes involve the same brain regions and are performed in an integrated manner by many animals and by human. If multiple potential actions are simultaneously represented as continuous regions of activity, these representations engage in a competition for overt execution. These two principles of affordance of multiple actions and competition of choice are possible to be resolved by a nonlinear dynamics method, as for instance the dynamic neural fields model [3].

In this paper we shall address dynamic systems and use the language of dynamic systems theory. Clearly this makes sense when studying the semantics of movement, and can easily be extended to the semantics of light, sound or other potentially autonomous features. But many of the insights gained also apply to forms that are not moving. Many *static* aspects of meaning follow easily once we have a proper understanding of the *dynamic* aspects; for example, if we have a complete description of the movement of an object in space, it is easy to plot its trajectory. That is why it makes sense to associate dynamic and emotional terms with certain forms. We show three examples from art and design history to illustrate this.



**Figure 1** Flowing wave movement, sustained wave, and rigid meander by Itten.



First we show Johannes Itten's [4] example described as "Die fließende Wellenbewegung, die angehaltene Welle and der starre Mäander sind rhythmisch expressive Gegensätze" (Weimar 1920) [The flowing wave movement, the sustained wave, and the rigid meander are expressive opposites].

As a second example we show the post-modern jewelry by Rebekha Laskin for Formica Colorcore<sup>1</sup>. Note the strong non-linearities in the form language. Not only have the objects been made suggestively through a process of cutting, they suggest to be cutting tools themselves.



**Figure 2** Postmodern jewelry by Laskin.

This can be contrasted against the Colosseum chair and stool by Charles Jencks, also post-modern (same reference). The form language is dominated by the circular forms arcs referring to the Colosseum. It is the form language of celestial movement and arcs that withstand the forces gravity.



**Figure 3** Colosseum chair and stool by Charles Jencks

In the terminology we shall develop we call the Laskin jewelry an example of transfer-function nonlinearity. The Jencks furniture stems from transfer-function linearity.

### 3. Plan of the work

In this paper we shall argue along the following lines:

- to understand emotional aspects of meaning we must adopt a *systems view*, considering not only the artifact, but studying the joint behavior of the artifact and other systems components it interacts with; for example to understand the expression fear it is indispensable to consider the behavior of the predator or whatever causes the fear;
- non-linear dynamics is a rich and growing field of knowledge which has been somewhat undervalued; one of the reasons we suspect is that linear systems seemed to offer certain advantages from an engineering point of view (easier to understand and to analyze); but progress in non-linear dynamics has offered new terminology and theories so both engineering and design can start exploiting non-linear dynamics;
- our brains work in non-linear ways; moreover non-linear mechanisms can and will be embedded in the implementation of more and more intelligent dynamic systems; in other words: the non-linearity is all over the place anyhow;
- non-linear means several things; we have to disentangle the notions involved, both theoretically and practically;
- to move beyond the expression of anger, fear and attraction we need more concepts, notably (a) *learning* and (b) *uncertainty*.

In order to be as precise as possible, we start with disentangling the notions and meanings of the word "non-linear" first. We also illustrate what one can do with the notions thus coming to surface. Then we develop a classification scheme of behaviors, based on the linearity or non-linearity of the components.

### 3. Disentangling concepts

We divide the behaving objects with respect to their linearity to linear and nonlinear and with respect to the stream of information processing within to feed-forward and feedback.

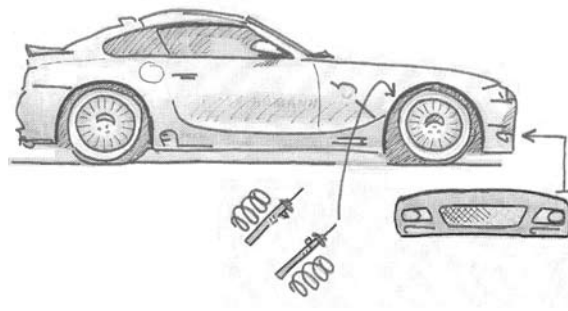
- Linear means having straight-line transfer functions, like  $f(x) = 3 \cdot x$ , as opposed to  $f(x) = x^3$ , which is non-linear; let's call this "transfer-function linearity", or just transfer-linearity or linearity;

<sup>1</sup> See Postmodern Design by Michael Collins and Andreas Papadakis

- Feed-forward means doing cascaded information processing, like in a chain sensor → preamplifier → AD-converter → decision-module, as opposed to the chain gain-control → amplifier → gain-control which features a feedback cycle. This could refer to architecture linearity in a broad sense.

Here we shall explore the advantages and disadvantages of each. Especially we have to look at the movement controllers and to the oscillators inside the agents (as we also call behaving products), because these can be viewed as the generators of movement. We look at controllers and oscillators both in living and in artificial systems. In this section we shall not do anything new, but the fact that we make the information accessible to the design community in our opinion has added value.

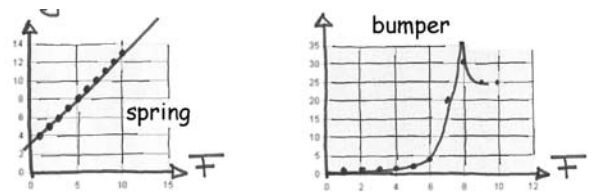
First we explain the concept of *transfer-function linearity*. We compare two different behaviors illustrated by two distinct aspects of a car, see the figure below.



**Figure 4** Linearity (springs) and non-linearity (bumper).

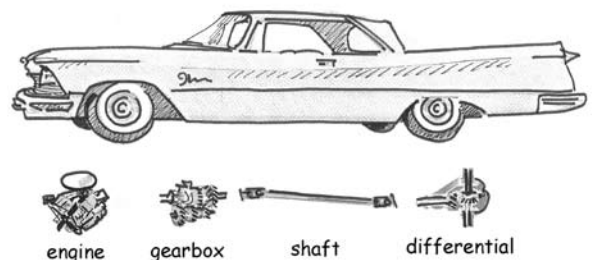
We consider the suspension springs and the bumpers. The springs allow the car to move vertically in such a way that the harder it is pushed down (or the harder wheels are pushed up by the road bumps), the further the springs are compressed. A normal spring has this very simple behavior (it's called Hooke's law). Some more sophisticated springs are non-linear, the so-called progressive springs. The bumper behavior is definitively non-linear however. At low forces the bumper behaves elastic but at a certain force it certainly opposes the force, not moving. When the car bumps against an object, the forces will act shock-wise and the bumper is even supposed to break and absorb external energy. Unlike the spring, a crashed bumper will not release that energy anymore.

The two transfer functions involved can be visualized as graphs. The  $\Delta y$  denotes a vertical displacement, the  $\Delta x$  a horizontal displacement. F means Force. Of course we are aware that the design of the real car is far more subtle than sketched here (dampers, active suspension etc.) but the point here is to illustrate linearity and non-linearity, not to engineer the most sophisticated suspensions.



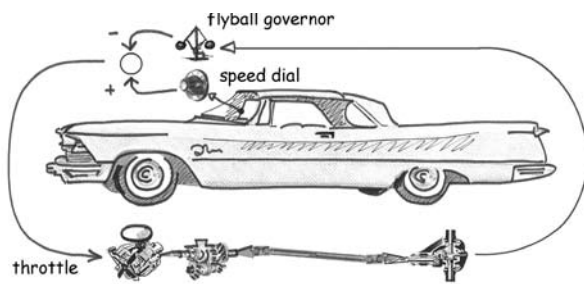
**Figure 5** Linear and non-linear transfer functions.

Next we discuss the concept of *architecture linearity* (feed-forward versus feedback). The first example illustrates the feed-forward case. Consider the power train of a car, such as the following abstract representation of a 1958 Chrysler Imperial (why we chose this car will become clear later). The flow of energy and its control is done in a straightforward left-to-right fashion. The gas throttle controls the engine. The engine delivers its power to a gear box. The gear box feeds into the Cardan shaft which serves to feed the engine's power in a flexible way to the rear axis. The rear axis is equipped with a clever device called the differential which serves to divide the available power over the two wheels while preventing slipping. We call this architecture "feed-forward".



**Figure 6** Feed-forward system (transmission).

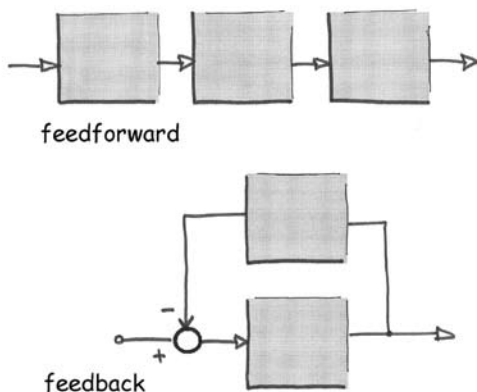
For this car an innovative extra option was offered, in those days called the automatic pilot. Nowadays we call it cruise control. The NY Times announced in 1958 as follows: “Chrysler’s auto-pilot provides a footless accelerator pedal”<sup>2</sup>. The system’s architecture is given in the figure below.



**Figure 7** Feedback system (cruise control)..

The user can adjust a speed dial and set it to a certain speed of his or her choice. The car then automatically tries to maintain this speed, independent of the wind and the road’s gradient. It works as follows: a fly-ball governor measures the actual speed of the car. The (mechanical) level coming out of this device is compared to the speed dial setting. When there is a difference, this means that the throttle is adjusted automatically: when the speed dial value is more than the fly-ball value, the throttle is opened. If the fly-ball output exceeds the desired speed, the throttle closes somewhat to reduce the engine’s power. The adjusted engine power will eventually result in a new speed value, and thus the loop is closed. We call this architecture “feedback”.

Abstracting away from the particular details of the cars with and without cruise control we arrive at the following block diagrams.



**Figure 8** Feedforward and feedback architectures.

Of course we are aware of a number of subtleties in the cruise control’s design, such as the haptic feedback given to the pedal and the integration effect built-in. But the point here is to illustrate the difference between feed-forward and feedback. Ball [5] describes the historic relevance of this innovation as follows:

The 1958 Chrysler Imperial brings control theory to the masses. First car to have cruise control: for the first time, the general public directly experienced closed loop feedback control in action – the slowdown error as the car climbs a hill, the gradual reduction of that error due to integral operation of the controller, the small but unavoidable overshoot at the top – and learned to trust and accept such systems. The Chrysler Imperial embodies the final supercession of Divine control, and today we are so comfortable with feedback control inducing stable dynamics that we barely notice how it permeates most aspects of our lives.

Note the mentioning of the term “stable dynamics”: it hints to a delicate and complex issue to which feedback systems give rise: non-trivial dynamic behavior. The gradual reduction of the hill-climbing error and the overshoot are examples. But there is also the possibility of oscillation. Imagine a control system which is too eager in its reaction: the car goes slightly too fast, speed is immediately reduced, the car goes too slow, full throttle again, more overshoot etc. Usually this is undesired, but certain technical and biological systems precisely need such oscillatory behavior.

The cruise control, a brake servo, are traditional linear feedback systems. There is a good reason why the engineers used to like transfer-linear systems and for how they used all their knowledge about feedback: they used it to exorcise the transfer-function non-linearities and hence get smooth, predictable, and non-oscillating behavior. This is what we called classical control.

Consider an artifact *A* (product or robot or vehicle or agent) meeting an active entity *B* (user or predator or resource or system component) in its environment. We use the neutral term “agent” for both. Both agents *A* and *B* have sensors, processing elements, and actuators. In other words, each agent looks as follows: sensors → processing elements → actuators.

<sup>2</sup>See <http://www.imperialclub.com/Yr/1958/specs.htm>

**Figure 9** Trajectories produced by systems with linear transfer functions and feed-forward only.

Some of the sensors may measure positions, such as the agents own position in space or its position relative to the other agent. Some of the actuators make the agents move, for example it may have legs, or a crawling body, engine-driven wheels, propulsion jets, etc.

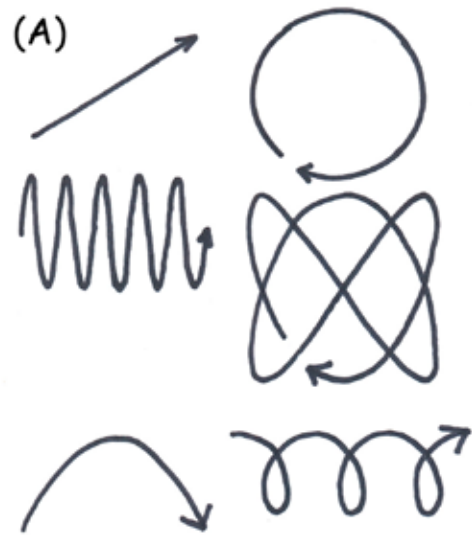
We study the behavior of a single agent first. Later we may study the combined behavior of two or more such systems. We assume it to move in some space  $S$ , for example a flat two-dimensional surface, or perhaps a higher dimensional space of position parameters, velocity parameters, posture angles, color parameters, etc. When an agent moves, its position and its measurements will change in a dynamic way.

To identify categories, we may systematically vary the properties of the agent(s), both the transfer-function linearity, which may or may not apply, and their architecture, which may be feed-forward only or which may include feedback.

transfer function	architecture	expected behavior
linear	feed-forward	straight lines or conic sections
linear	feedback	stable control or oscillations
non-linear	feed-forward	jumping and bumping
non-linear	feedback	all of the above + learning, doubt and decision making

We made a number of trajectories to illustrate typical behaviors that arise from mechanisms based on the above four classes. We call them A, B, C, and D.

Class A trajectories includes of course straight lines, but we also assume the straightforward behaviors of mechanisms such as linear resonance systems and the trajectories of circular motion such as gear wheels or and planets. Combining such movements in two directions gives Lissajous figures. We also include parabolas and ellipses, although not the graph of linear functions, they are the outcome of the linear differential equations that describe gravity.



Although they are shown as sketches, they are derived from precise Mathematica [6] formulas, see footnote<sup>3</sup>. Class B is about trajectories typically arising from classical control systems. For a system with certain eigen-frequency, the behavior may have a tendency to oscillate, but the oscillation fades out. That is what a stable control loop does. Alternatively, the system may oscillate and the oscillation grows without bounds. In control theory, that is considered poor oscillator design (also think of the Tacoma bridge disaster). We give the formulas of class B<sup>4</sup>.



**Figure 10** Trajectories produced by systems with linear transfer functions and feedback.

Class C is about systems with non-linear transfer function but with feed-forward only (no feedback loop). Adopting the non-linearity of a bumper, the trajectories include multiple bouncing, truncated oscillations, bouncing-ball parabola and the chaotic behavior of a ball on a circular billiard. We also give the formulas of C<sup>5</sup>



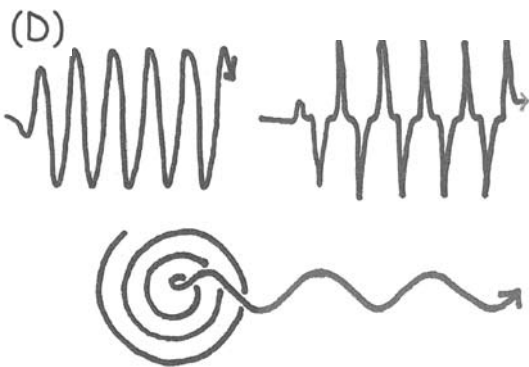
**Figure 11** Trajectories produced by systems with non-linear transfer functions and feed-forward.

<sup>3</sup>Top row: ParametricPlot[ {Sin[u],Cos[u]}, {u,0,6 Pi}], Plot[.5 t,{t,0,10π}], Middle: Plot[Sin[t],{t,0,10π}], ParametricPlot[{Sin[2u],Sin[3u]}, {u,0,2π}], Bottom: ParametricPlot[ {u,-u^2},{u,-1,1}], ParametricPlot[ {3u+.7Sin[u],Cos[u]}, {u,0,6π}]

<sup>4</sup>Plot[e<sup>-u/10</sup> Sin[t],{t,0,10π}], Plot[.1e<sup>-u/10</sup> t/10 Sin[t],{t,0,10π}]

<sup>5</sup>ParametricPlot[{u,If[Mod[u,6]≥3, 2Mod[u,6],2(6-Mod[u,6])]}, {u,0,6π}], Plot[If[Sin[t]≥.5,1,-1],{t,0,10π}], Bottom: ParametricPlot[{u,-2(Mod[u,1]-.5)^2},{u,0,4}] (billiard not as formula)

Finally, Class D trajectories are produced by systems with non-linear transfer functions with feedback. Essentially anything can happen (including A,B and C). Shown below is an oscillation which grows but stabilizes gradually, and another oscillation of the latter type processed by a non-linear transfer function. Certain systems can even show sudden changes of the mode of oscillation.



**Figure 12** Trajectories produced by systems with non-linear transfer functions and feedback.

The formulas of the top row trajectories are included (the bottom one is just a sketch). The two given formulas describe specific solutions of the famous Van der Pol equation, found by the Eindhoven scientist Bathasar van der Pol in the 1920s<sup>6</sup>

### 5. Exploiting the power of non-linear systems

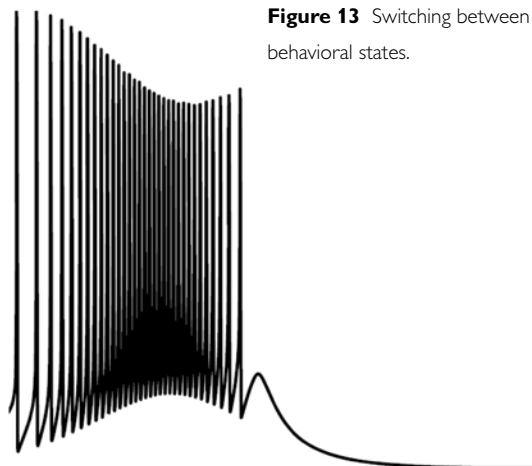
As it has become clear so far, the complexity of a behavior that can be produced with the different systems gradually increases with adding transfer nonlinearity or feedbacks. Along with the taxonomy we have suggested a heuristic that the behavior produced with different types of systems can be associated with particular emotional or behavioral state. In this section we will suggest the type of behavior that can be produced by different well established nonlinear dynamics paradigms i.e. systems that include both, nonlinearity and feedback and show initial attempts to apply scientific approach to relating behavioral trajectory and emotional content.

By intuition we may suggested that linear systems can produce smoothly changing patterns which we associate with peaceful and constant mood. Damped or excelling oscillations that are characteristic for the feedback systems with linear transfer elements are associated either with increase of amplitude and can be mapped to emotions like excitement, or anger or with relief in the

emotional state for the damping oscillations. Feed forward systems with transfer nonlinearity, for instance multilayer perceptron networks, are universal approximators, as shown in [7], i.e. behavior with any functional dependency can be produced with such a system. We have shown examples of behavioral trajectories that result in repetitive, edgy, or bumping movements. So our intuition is that the produced behavior represents aggression or fear. These intuitions are to find more ground since recent psychophysical studies on the perception of emotional gaits reveal that the emotion-specific components derived from the kinematics analysis of motion data match features that have been described as fundamental for the visual recognition of emotions from gait [8].

Nonlinear feedback (dynamic) systems are capable of producing all of the varieties of behaviors, mentioned so far. In [9] it is argued, that the two most elementary behaviors of a nonlinear dynamic system are point attractive and limit cycle behaviors, corresponding to discrete and rhythmic movements. Dynamic systems have been used for movement pattern generators in neurobiology [10] pattern generators for locomotion [11], potential field approaches for planning of movements and as approaches for limb movement [12].

In addition to the behaviors that the previously listed systems in our taxonomy are capable of, a system with such a complexity can not only show a smooth, edgy or repeating behavior, but also can naturally give rise to a completely novel behavior, and an emotional state. An example of complex behavioral trajectory that changes from an oscillatory to exponentially calming state in time is shown below:

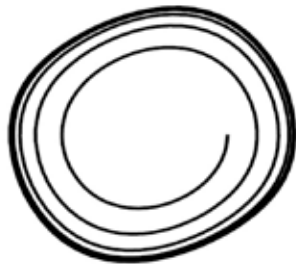


**Figure 13** Switching between behavioral states.

<sup>6</sup> polmin=NDSolve[{u'[t]-1(1-u[t]^2)u[t]+u[t]==0, u[0]==0.1, u'[0]==0}, u, {t,0,80}] Plot[(Evaluate[u[t]/.polmin]),{t,0,40}], polmin=NDSolve[{u'[t]-1(1-u[t]^2)u[t]+u[t]==0, u[0]==0.1, u'[0]==0}, u, {t,0,80}] Plot[(Evaluate[u[t]/.polmin])^2,{t,0,40}]

A point attractive dynamical system is designed such that the behavioral tasks are stable fixed points or attractors. The basic idea is to map the behavioral state of the system onto the mathematical state of a dynamics described by an appropriate differential equation. In the case of a point attractive dynamical system, the behavior is a discrete movement. A trajectory can be generated by integrating the dynamical system in time, as for instance proposed by the dynamic neural fields approach [3]. In this approach behavioral trajectory is formed by setting the dynamic parameters of the neural field such that the peak of activation on the field moves within the field in the direction towards the behavioral target.

For rhythmic movements, the attractor is not a single point but a trajectory, as shown in the following figure, which actually represents the Van der Pol equations (see Section 4, Fig. D) in the state space:



**Figure 14** Attractor for a rhythmic behavior.

Nonlinear coupled oscillator models as another example of nonlinear dynamical system show this type of dynamic attractors, i.e. a range of rhythmic behaviors can be produced with this models. A nonlinear dynamic system can have a combination of more than one point attractor (associated with discrete movement) and more than one limit cycle (responsible for rhythmic behavior).

Let us go back to the example from Section 2 referring to changing from a walk to a trot or gallop in a horse movement. The reason for that could be an external influence, or a spontaneous behavior of a horse. The switching among dynamical modes in a nonlinear motor control will happen suddenly but smoothly, without visible collision or stress reaction. The change can be explained with a highly nonlinear dynamic system, (a realistic model for the mammal brain) inside which a bifurcation occurrence, observed in the outside by a qualitatively

novel behavior. Their combination can explain complex behavioral patterns as accurate reproduction of almost arbitrary human movements [13] but also more abstract behavioral processes or predicates as short term memory, and decision making.

Besides the purely computational considerations, multiple brain research studies imply the relation of the emotion to movement and behavior. The amygdala has been consistently implicated in emotional functions (see [14,15,16]). Among all the weapons of contemporary science, only nonlinear dynamics methods and statistical methods have shown the potential for realistic modeling of brain functions and the resulting behaviors.

One may conclude that indeed the nonlinear dynamics methods would be good for creating complex and emotional behaviors, but this is probably beyond the skills and the knowledge of a (present-day) designer. On the contrary, Omlor and Giese [8] show that the following nonlinear generative model will approximate emotional movement trajectory:

$$x_i(t) = \sum_{j=1}^n \alpha_{ij} s_j(t - \tau_{ij})$$

Where the  $x_i$  is the  $i$ -th trajectory and  $s_j$  is the  $j$ -th source signal,  $t$  is time and  $\tau$  signifies delay (feedback parameter). Using these nonlinear equations and the followed analysis, Omlor and Giese [8] conclude that anger in walking is characterized by increases of the amplitudes of many joints, while sad walking is characterized by decreased arm movements. These results match closely with dynamic features that have been described in psychophysical studies on the perception of emotional gaits, which have extracted salient features from perceptual ratings.

## 6. Conclusions

Although the examples of Sections 2 and 3 may appear somewhat naive and technologically-inspired, the results and insights of Section 5 strongly indicate another and deeper connection: our movements are generated and processed by non-linear dynamic systems (in the brain). Next to the motivations of Section 2, additional motivation was triggered by early psychological studies [18,19] which has been illustrated with the animation

available at <http://www.cs.brown.edu/people/black/Movies/heider.mov>. Moreover, multiple brain research studies imply the relation of the emotion to movement and behavior.

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# Experiential Bodily Knowing as a Design (Sens)-ability in Interaction Design

## Abstract

This paper develops the notion of experiential bodily knowing as a designer's (sens-)ability to reason about movement and responses to movement as part of the process of designing movement enabled interaction with artefacts, products and spaces. We arrived at this notion by reframing the practice of interaction design as a discipline of movement practice. We then conducted a study of the coming to know of bodily skill as a way of better understanding the nature of experiential bodily knowing and understanding generated through experiences of the moving body. From this study we suggest how this could translate as a designer's ability to understand how people might experience movement-enabled interaction.

## Keywords

Experiential bodily knowing, design materials, design sensibility, interaction design, movement.

## 1 Introduction

*"If one truly likes to design for movement-based interaction, one has to be an expert in movement, not just theoretically, by imagination or on paper, but by doing and experiencing while designing"* [1, p.677]. The research presented in this paper is motivated by this statement by Hummels et al. and other researchers who share similar sentiments. We are also motivated by the fact that interactions with technology now are taking place with a range of different bodily movements as the ability of technology to detect

and respond to interaction through movements is evolving. We can enable interaction through mere presence in a location, but also through different movements and to some extent by the way in which we perform movements (e.g. fast/slow, smooth/erratic movement in Nintendo® Wii™ [2]). This has seen the development of several design approaches that advocate explicit and focused bodily involvement by designers as part of the design process, for example [1], [3], [4], [5], [6] and [7]. In our own work we discovered the usefulness of moving and re-enacting as an essential and necessary part of the process of analysing movements enabling interaction with a computer game in a previous study (see e.g. [8] for details on the procedures and outcomes of this study).

While we, similar to the authors mentioned above, find an active body appropriate in investigations for the design of movement-enabled interactions, we were interested in exploring further the nature of knowing and understanding potentially generated while doing so. This paper is about how we framed our inquiry to address this. We start by describing how different approaches in interaction design have introduced bodily engagement into both design practice and research. We then present how we conducted the empirical work for this study, the relevant findings, and finally we reflect on some of the methodological challenges we faced. From the empirical findings we develop the notion of experiential bodily knowing as a designer's (sens-)ability to reason about



movement and responses to movement as part of the process of designing movement enabled interactions. That is a designer's ability to reason about how someone else could experience the use of a design, and being able to design based on this understanding.

The work presented here is part of larger project with the overall aim of extending our understanding of bodily aspects of technology interactions. See [9] for an account of the *feel dimension* of technology interaction – an articulation of the role our kinaesthetic sense play in experiencing technology interactions, another outcome of this specific

### 1.1 Related Work: Moving while Designing/ Designing while Moving

Djajadiningrat et al. [3], Hummels et al. [1], Jensen [4], Klooster and Overbeeke [5], Moen [6] and Schiphorst and Andersen [7] are all designers, design researchers and design educators who advocate and practise bodily involvement in the design process of movement enabled interactions. *Choreography of interaction*, developed by Klooster, illustrates this with the design of a vase from the movements involved in flower arranging. The final design of the vase is based around four principles that developed when experimenting with arranging flowers [5].

Djajadiningrat et al. [3] are working from ideas of building specific bodily skills, akin to skill development in crafts traditions, playing an instrument or sports. They see skill building not only as a potential outcome of a movement enabled interaction, but skilled action as a way of thinking about designing interaction with products. This necessitates thinking in terms of enjoyment of the experience of use (learning), rather than just ease of use. Jensen [4] is working from the same ideas, using the *metaphor lab* and *Video Action Wall* as ways and activities through which qualities of movements are identified and kept present throughout the design process.

Moen's [6] Kinesthetic Movement Interaction (KMI) uses theories and methods from modern dance. Her BodyBug® concept was developed from the experiences of a group of people participating in a movement/dance class. Similarly, Schiphorst and Andersen developed *whisper*, a wearable public installation, using performance-based methods such as improvisation, props and phantom partners. "The goal of the workshops was to model experience that could be replicated, re-enacted, and re-played in the

context of a public art installation using wearable computing technology," they said [7, p.2]. Hummels et al. [1] have developed the *Attending Theremin*, among other tools for designers to explore what they call the 'expressive power of gesture'.

Common to these approaches is a focus on explorations through moving of the interaction and movements used to enable interaction first, before explorations of form and appearance of the technology.

## 2 (Re)Framing Interaction Design as a Movement Discipline

In a paper describing "Choreography of Interaction" Klooster and Overbeeke say, "We realize that theoretically describing this approach is a nearly impossible venture. In fact, only through movement, through practicing it, the idea can actually be grasped" [5, p.23]. We agree with the inherent challenge in verbally articulating issues of moving as a way of knowing; however we felt that further investigation could help us better understand and further inform our ability to reason about movement. Two topics crystallised for our inquiry, the first i) to explore the nature of experiential bodily knowing and understanding generated through experiences of the moving body, that is the coming to know of bodily skill, and secondly ii) to explore what this could mean as a type of understanding and knowing in interaction design.

In our inquiry we decided to address this by reframing interaction design as a movement discipline, and then to study movement practices as a strategy for furthering our understanding of the coming to know of bodily skills. What brings a movement discipline forward is improvisation and skilful interaction that push the edges of the current rules and styles of a discipline (e.g. the Fosbury flop in high jump). Reconceptualised as a movement discipline, it is not a big "leap" then to consider movement as a material for interaction design, and the study of movement "in its own right" as appropriate for interaction design. By approaching the domain this way we were hoping to come to understandings of how, when we learn movements, it allows us to do what we want to do when we move, that is perform movement, improvise movement and play with movement.

In developing our study we looked for tools and techniques for studying movement experience both

within the discipline of design as well as the many fields that study human movement (e.g. anthropology, medicine, philosophy, dance and performing arts, sport, ergonomics, physical and somatic therapy, biology and anatomy) to understand how our study best could be carried out. As a result we combined a number of methods from design, anthropology and HCI in the design of our study; we outline these in the next section.

## 2.1 Background to the Study

*When artists, designers, architects and engineers build an understanding of the properties of a material, they often study it by creating a structured collection of basic examples that explore different aspects and properties of the material. A basic understanding of the properties of, e.g., wood, paint, concrete, as materials for design, can perhaps only be achieved by working with them in practice. More systematic studies of the material are then used to map out the design space of possible expressions.* [10, p. 195]

As Hallnäs et al. say, in the process of designing, designers make use of many different ways to reason about, reflect and conceive of ideas for a design [10]. Both in design education and design practice, there are spaces for experimentation and exploration in the design process. A design process is often highly material, ideas and activities are made visible and tangible by means of different physical materials, and the materials for design are interrogated as part of the process. The corollary, when it comes to materials for movement enabled technology interactions, is that movement becomes one of the materials for design, (the others being sensors, input and output devices and so on).

For an inquiry into issues of knowledge and understanding in design, Donald Schön's [11] notion of a "reflective conversation with materials of a design situation" is of course relevant. However, movement as a material for design is still an under theorised area within movement interaction design. We see our empirically-based theorisation as part of this paper's important contribution.

In both human-computer interaction (HCI) and interaction design there is an established and influential tradition of reframing issues of technology design within theoretical frameworks new to the field at the time they were introduced; for example Suchman (cultural

anthropology/ethnomethodology [12]), Ehn (participatory design, [13]), and Anderson (semiotics [14]), all grounded their research in empirical findings. In HCI it is now very common to study practice in order to better understand issues of technology design and use.

Our theoretical understandings of movement are influenced by current trends in anthropology, where studies of human movement, arguably, are moving from observationist views of behaviour to a conception of body movement as dynamically embodied action [15], and to more participatory-based embodied approaches for data gathering and analysis. Participatory approaches tend to emphasise the "how" of movement, rather than the "what" and "where". That is, participatory approaches tend to focus and allow fuller understanding of an experience by focusing not just on how it looks ("the arm moved"), but also on how it might feel to do the movement or interact with technology ("how the movement is experienced"). Hence, the nature of our inquiry was determined by the perceived importance of experience, experiences of learning, understanding and knowing as central to the inquiry. As such we decided on a phenomenological perspective informed by Merleau-Ponty [16], because he is widely acknowledged, also in interaction design, as a phenomenologist focusing on the lived, perceiving and moving body [17].

## 2.2 Experiential Bodily Knowing: A Study of Coming to Know

In this endeavour our challenges became to find ways of engaging our participants in movement experiences and triggering reflection about these experiences that would enable the participants to articulate these experiences, as well as finding ways of capturing data about the experiences. We drew on Gaver et al.'s *probes* [18], Paulos and Beckmann *interventionist techniques* [19] and Oulasvirta et al.'s *bodystorming* [20], to some extent in the way in which these design researchers use different techniques for triggering reflection in study participants. Our study design further led us to consider different movement practices where we, the researchers, could get involved in becoming skilled movers; this was based in thinking that increased understanding of movement in oneself would enable us to understand the movement experiences of the study participants better. We were also looking for practices with a "reflective component," that is practices that acknowledge that knowing can be constructed

through experience of the body. We settled on Pilates, yoga and Capoeira.

The objective of our study was not to come to new understandings of the disciplines of Pilates, yoga and Capoeira per se, but to study the experience of learning in these disciplines. As such, a number of different activities could have been chosen for this study. Pilates, yoga and Capoeira were chosen for a few different reasons mentioned below. Each of these movement disciplines brings about different ranges of movement. There are differences in the extent to which the whole body vs. parts of the body are engaged, and the speed of the movements and the movement quality considered appropriate for each discipline differ. These are also activities with some (though to varying degrees) degree of bodily contemplation, that is the extent to which there is deliberate use or encouragement to direct attention inwards as part of the practice. There are also different aims for the movements and different purposes for the objects used. We briefly introduce core aspects of each the three movement practices here.

Pilates is a system of mental and physical conditioning focusing on trunk stabilisation. In Pilates, the *Reformer* and *Cadillac* shape the execution of many of the core exercises. These two pieces of equipment consist of various adjustable parts that provide resistance and/or assistance to varying degrees in exercises for the core abdominal muscles, spinal flexibility and the shoulders in order to strengthen and stretch the body. This is achieved through restricting or aiding movement in certain directions for a full range of movement in different exercises. Other important aspects of Pilates are the emphasis not only on the performance of movement, but on how the rest of the body behaves while the movements are being performed, and the use of mental focus to improve movement efficiency and muscle control.

The physical aspects of yoga involve the performance of different poses, the asanas. The Iyengar tradition introduced the use of props; blankets, blocks, bolsters, straps, pillows, chairs and ropes are now widely used. The purpose of the objects is to assist in attaining ideal alignment in the poses, even if the body is not yet flexible or strong enough. However, the overall aims of yoga are of balance and unity of mind, body and spirit, and more about spiritual wellbeing than physical activity.


Capoeira is an Afro-Brazilian acrobatic martial art game. The game is played by two capoeiristas (players) with the remaining capoeiristas forming a circle while singing and playing instruments. The two players try to outsmart or trick each other by demonstrating flair and mastery of movement. Objects used in Capoeira are the uniform, the music, the instruments and the other capoeiristas.

### **Method of Analysis**

In our study we were interested in data that could give prominence to experience and awareness of the body itself. The coming to know was explored in relation to both kinesthetic experiences and external feedback involved in the learning of movements in Pilates, yoga and Capoeira. The resulting study employed an ethnographically inspired field study approach. Sixteen interviews with thirteen participants (practitioners and instructors) were conducted. These interviews were both video and audio recorded; in addition observation and participant observation were used to gather data for understanding the transformation of the lived body as skills were acquired. The participant observation part of the study consisted of the researchers trying out movements demonstrated by interviewees, as well as attending classes in the interviewees' practices over a period of time before and after the interviews. This means that we, in this study, claim to study *experience*, *movement*, *experience of movement*, as well as *experiencing movement*. Hence we are studying *experience*, we are experiencing, and we are becoming experienced in movement in the hope that it will inform our ability to reason about movement.

It should be noted that this study is by no means a proper ethnographic immersion, although it is heavily ethnographically inspired and borrows in its approach to collection, analysis and interpretation of data. It is a dip into a particular setting that was entered with some specific ideas about what we wanted to explore. By attempting to trigger exploration and reflection in our participants about movement experiences, it is a study about movement practice; it is also a study about reflective practice and interaction design practice as our overall perspective in this project is one of informing technology design.

In our analysis of the data, we transcribed the interviews, viewed the videos multiple times and re-enactment movement both in training session and while writing up the study (in our offices). Researchers, who have

Where it is happening	What it looks like	How it feels
<p>Neutral spine is the natural position of the spine when all body parts are in good alignment. When the spine is in neutral, the natural curves of the cervical and lumbar spine are maintained.</p> <p>While on all fours, neutral spine is achieved by moving the pelvis up and down (and sometimes sideways), and finding a point where the practitioner feels balanced and the instructor confirms.</p>		<p><i>I just love the feeling of straightness that you get, and the feeling that your body is... moving through a...</i></p> <p><i>It's that whole...you know you are sitting in a chair and all of a sudden you notice that you are sitting very straight and you can feel how your body is in alignment and I love that feeling of...sort of... I don't know what to call it.</i></p>
Researcher's articulation of shape and spatial path	Practitioner's bodily articulation	Practitioner's verbal articulation

**Table 1** Neutral spine

in Pilates

written on the use of video data in ethnography and ethnographically inspired research, stress the importance of repeated viewings in order to uncover and understand the issues being investigated (e.g. [21] and [22]). We see our repeat viewing of the video data, re-enactment, ongoing involvement in the disciplines and discussions with practitioners as a similar approach, which at the same time allowed us the opportunity to obtain another perspective on the analysis as well as refine and check our analysis. In the analysis we were looking for articulations of the experience of learning and experience of performing movement, articulations of what helped people learn, and what aspects of instructions they focus on and so on.

In the next section we present articulations related to knowing how to do a core movement in each of the three disciplines, namely *neutral spine* in Pilates, *downwards facing dog* in yoga and *armada* in Capoeira. We will use these three as samples to show different articulations of knowing constituted in practice. The splitting up of the elements and essentials of experience is artificial, but it is convenient for the communication of the experiences in this paper.

### 2.3 Findings: Experiences of Learning, Experiences of Doing


In the coming to know or learning of a movement discipline the fundamental challenge becomes mastering *knowing how to move* in the different situations one finds oneself in as a practitioner in that discipline. When we analysed the three core movements *neutral spine* in Pilates, *downwards facing dog* in yoga and *armada* in Capoeira we found quite different articulations of the *knowing how to move* emerging.


In Pilates, *neutral spine* is one of the fundamental poses, awareness of neutral spine alignment is emphasised throughout all exercises, and one which all Pilates practitioners in the study performed. See Table 1 below for descriptions of knowing how to do neutral spine.

In yoga, downward-facing dog is one of the basic poses, and one all our yoga practitioner performed. It is a versatile pose in that it incorporates elements of standing poses, arm balancing, forward bends and backbends. One of our participants used the expression "the garlic of all poses" when describing it. See Table 2 below for descriptions of knowing how to do downward-facing dog.

**Table 2** Downward-

Facing Dog, in yoga

Where it is happening	What it looks like	How it feels
<p>The palms are positioned shoulder width apart with the fingers spread and the middle finger facing forward. The shoulder blades are worked flat on the back, the collarbones are broadened. While pressing the palms into the mat, the arms, side chest and waist are extending to lift the sitting bones to the ceiling. The heels are extended towards the floor while lifting evenly through the ankle, knees, thighs to work the legs straight. The head is encouraged to hang.</p>		<p><i>In this pose the knowing that I'm doing it right means a feeling of energy flow, there is an ease in pose, you are not sweating, the body is not hard, and there is no pain and the effort is evenly distributed.</i></p>
Researcher's articulation of shape and spatial path	Practitioner's bodily articulation	Practitioner's verbal articulation

Where it is happening	What it looks like	How it feels
<p>From the base movement, Ginga, a straight back leg is brought forward, up and around in a sweep-like motion. The upper body moves back and the arms swing around to counter the weight of the leg moving forward, up and around with speed. The moving leg is placed back down behind while the arms return to the Ginga position.</p>		<p>The feeling of achievement if you've done it well is that you are completely set up to keep moving.</p>
<p>Researcher's articulation of shape and spatial path</p>	<p>Practitioner's bodily articulation</p>	<p>Practitioner's verbal articulation</p>

**Table 3** Armada; a basic standing spinning kick in Capoeira

Armada is one of the basic standing spinning kicks in Capoeira. See Table 3 below for descriptions of *knowing how* to do the armada.

The different articulations of the data suggest that the knowing required and involved in doing neutral spine, downward facing dog and the armada is a knowing how and that this knowing is felt and achieved through moving. The performance of the bodily practice is the way you display your knowing experientially. This mutual constitution of knowing and doing rather than knowledge as a given, is resonant with Polanyi [23]. Experiential bodily knowing as talked about in this paper is a form of tacit knowing.

#### 2.4 Findings Abstracted

Our findings suggest that experiential bodily knowing is felt and achieved through moving. The different articulations of the movement experiences; articulation of shape and spatial path, bodily articulation and verbal articulation helped us discover this, as such working with these articulations (or representations) became a tool that helped us reason about movement. Our findings also enabled us to distinguish further characteristics of experiential bodily knowing, these are *continua of knowing*, *a distinction between bodily knowing and understanding*, and the *recognition of knowing* in self and others, all of which we believe could be useful notions for interaction design.

The development of the continuum of knowing enabled us to make a distinction between bodily knowing and understanding. In the study our participants described how they over time have come to a certain level of knowing in their practice, this is the ability to do movements as well as the ability to *recognise* knowing and ability to perform. Over time they have developed a capacity to perform or act in particular circumstances in their practice, though there are still times when they do not perform at that capacity. This might seem reminiscent of Dreyfus and Dreyfus [24] stages of skill acquisition,

novice – expert. However, in the context of this paper, it allows us to make an experiential distinction between bodily understanding and bodily knowing, which is about how we at different times at the same level of skill, not always perform consistently and what the experience of this is. We illustrate this with a quote from one participant describing a continued struggle with the Armada, the Capoeira spinning kick, as *floating in and out of knowing*.

...it is like that... like the difference between knowing it and knowing it totally. It becomes a mental thing, I can't access it again...until it becomes completely embedded in my... where I don't have to access it mentally. Soon as I have to start thinking about, right, where should my foot...and then I think not far enough around – it's gone, it is totally totally gone. Unlike some things where if I don't think about it, I do it, it comes back to me. Absolutely this one I sometimes have to go ask someone, I've almost developed bad habits when I'm trying to figure out what the problem is. With some of the double kicks I know, I know why. While with this one I still don't know why ...why am I coming off balance? So I feel like I float in and out of knowing how to do it.

From this and similar descriptions emerged the *continua of knowing*; the continua describe our participants' articulations of *degrees of knowing*, *ways of knowing* and *access/location of knowing*. The continuum of knowing is detailed below (Table 4) with representative quotes. The connections between the different continua are outlined below the table, though they will evolve over time. These continua are not exhaustive or exclusive, they both overlap and interact.

At different points along the continuum (Table 4) a practitioner is able to perform with increasing degrees of awareness, recognition, and understanding of well-executed movement in *oneself* and *others*. This includes the experience of performing consistently, and being able to perform with poise and flare. Another Capoeira

Not knowing how to move...	Knowing how but not being able to move...	Not knowing that I know how, but being able to move...	Knowing how to move...	Knowing how to move completely
	<i>Sometimes can't just do it or think it, I have to actually look at the body parts to remember how to do it.</i>	<i>I remember this one time, I just couldn't think or imagine how to do that pose (an inversion), so figured I just had to do something and see what would happen. It got me into the pose!</i>	<i>Yes that is what it is supposed to feel like. So I feel like have experienced once the feeling what it is to know, what it is to do it properly.</i>	<i>Skill is just there to use</i>

**Table 4** Continuum of Bodily Knowing

practitioner expressed striving for *knowing how completely* this way, “*I have accumulated all this knowledge, now how do I use it to master expression of moves?*”

The experiences presented in the continuum of bodily knowing suggest that for experiential bodily knowing not only might it make sense to experientially differentiate between degrees of knowing, but also between *knowing* and *understanding*. That is how on a continuum of knowing, one can be able to bodily understand, but not yet perform, yet also perform without explicit bodily understanding. This is illustrated in Table 4 in the middle quote, “*I remember this one time, I just couldn't think or imagine how to do that pose (an inversion), so figured I just had to do something and see what would happen. It got me into the pose!*” (yoga practitioner). This relationship between understanding and knowing is probably best understood in terms of the meaning making that takes place in our ongoing movement dialogue within the particular circumstances in which we act, e.g. neutral spine, downward facing down or armada.

*Awareness and reflection* in this movement dialogue is key to being able to benefit from understandings that can be generated this way. Our participants spoke about awareness and making conscious the movement experience as important for increased knowing. Awareness could emerge through affirmative movements, e.g. moving in relation to external (vision, hearing, touch) and internal (kinaesthetic sense) points of reference, as well as injury.

These characteristics of experiential bodily knowing, *continua of knowing*, the *distinction between bodily knowing and understanding*, and the *recognition of knowing* in self and others, are dimensions we believe could be useful for interaction design.

### 3 Experiential Bodily Knowing in Interaction Design

In the previous section we outlined the findings from our study. In this section we articulate the notion of experiential bodily knowing in interaction design that is what it means to reason about movement in interaction design. We articulate this from a position as design researchers and technology designers, and we see our work to be tools for design in the sense that they help

articulate and make available a particular kind of thinking, and might eventually generate particular kinds of design representations.

#### 3.1 Design (Sens)-ability and Movement as a Material for Design

In their paper Hallnäs et al. [10, p.195] describe how “...artist, designers and architects and engineers build an understanding of the properties of a material...” and that “...a basic understanding of the properties of, e.g., wood, paint, concrete, as materials for design, can perhaps only be achieved by working with them in practice.” The notion of being able to do without explicit bodily understanding is central to how one could think of using and coming to an understanding of movement as a material for design. The designer/mover can interrogated and reflect on movement by moving, doing and performing with movement. Though as pointed out by our study participants the moving/doing/performing needs to be guided by something that focuses or triggers the designer's/mover's attention and awareness. Suchman said that “...the quality of our thinking, depend to a large extent on the appropriateness of the representational resources that we can use in our thinking... [25, p.1]. If one agrees that experiential bodily knowing is felt and is a knowing how, this means that meaning is produced in and through movement. For interaction design this is a recognition of that the only way we will have access to or know certain things are through moving, in which case interaction designers should move as part of the process of designing – it is about production of meaning in and through movement.

Gaver et al. said about the Cultural Probes that the probes are to be used as resources for “inspiration, not information” for designers [18]. We see the exploration of movement as material for interaction design as a similar resource, that is to develop a sensitivity to issues of movement as a material for design. Though at the same time we believe, based in the understandings we have developed during this research and the approaches reported on at the beginning of this paper, that methods could be developed that would allow designers and users ways of designing, exploring and evaluating movement enabled interactions. That is given an ability to recognise one's own movement experiences, an ability to reason about how someone else would experience the use of a design and eventually being able to design based in

this understanding. Similar to how data gathered from a one-off heuristic evaluation is different from a usability testing session with a participant where one can watch (and talk to the user about what they think), a movement exploration might allow you to observe, explore and engage at (an experiential) level with how it might feel to carry out the interaction.

Our suggestion that experiential bodily knowing is felt and achieved through moving further implies three things directly relevant to the design of movement enabled interaction. First, that what something looks like and the accomplishment of something (bodily speaking) are or can be different experiences. For interaction design this makes available different ways of thinking about movement for interaction, for example by considering aspects of an experience in terms of *as looking good, feeling good and getting it done*.

Second, it suggests the incompleteness of verbal articulation of this type of knowing. Though not the focus of this paper, this highlights a major challenge for the design of movement enabled interaction. That is, the choices we as designers make about how to represent movement, as well as what aspects of movement to use for representation both in the design process and as input for sensing technology.

Third, it is not only about how or what movements the technology make you perform in order to enable interaction, but also about how it sets you up (or not) for what is to happen next. This point was also made by Benford et al. [26], they say "...a moment of interaction is actually embedded in an entire gesture that determines its timing and feel..." this inspired by Bowers and Hellstrom's [27] discussion of "expressive latitude" when designing and using electronic instruments.

### 3.2 Designing both *from* and *for* the Experience of Moving

Schön's [11] notion "conversation with materials" is part of current design practice. Designers draw and gesticulate (among many other things) as part of the process of reasoning, reflecting and conceiving of ideas. In the design studio, ideas and activities are made visible and tangible by means of physical material. A design process is often highly material, and the materials for design are interrogated as part of the process, as knowing through

making. Our proposal is that movement should explicitly be interrogated, reasoned about, reflected on and explored in a similar fashion.

Here we look to Gibson's [28] ecological theory of perception. Gibson said that the world unfolds itself in potential for action; we perceive the world in relation to what we can do with it. Thus, the world is inherently meaningful for our body and by moving we can gain access to that meaning. Artefacts, products and spaces engage with our physicality, and movement is the material in which we engage in a dialogue or conversation with these artefacts. Because interaction creates meaning and meaning generates understanding and knowing in action, it can inspire designers to explore and design useful, usable and enjoyable interactions. Hummels et al. [1] mention "sensation, dynamic character, story, interaction style, experience, emotion, function, form and semantics" as some of the aspects they have explored. As a designer, an appreciation of movement as a unique material in technology design suggests developing a sensibility for movement that is an ability to recognise one's own movement experiences, reason about how someone else would experience the use of a design, and being able to design based on this understanding.

Our object of inquiry in the work reported here is deep understanding of experiences of moving. As a method for studying relations of technology design and use, it implicitly highlights the aspect of perspective. This should be apparent from Tables 1, 2, 3 where we present descriptions and articulations of visually observable aspects of movement alongside attempts at capturing experience/experiencing.

Others can observe what I am experiencing, but not my experiencing per se. Having an experience while performing a movement does not necessarily determine what the action I am trying to perform is. It is not that the experience determines the action, but that the context determines not only the character of the action, but also the character of experience. Swinging my leg around would not amount to an action in Capoeira or the experience of it without the context of the game. Hence to focus solely on the experiencing as that which explains the character of an action is not adequate either. Experiencing cannot be regarded as distinct from what is experienced. Also, even if it looks the same, it does not mean it means the same.

How do we reconcile these issues methodologically? Human movement can be described from many perspectives, e.g. anatomical, functional, semantic and kinaesthetic, some of which are “easier” for technology to capture and interpret. Our perspective is one of phenomenologically-motivated design research. We propose conceptualisation for technology design based on phenomenological accounts of experience. As such, in addition to employing methods that enable us as designer to think about and around the body, we should also use methods that enable us to think *through* and *from* the body, and equip ourselves to design based on the understandings we generate. Our methods must encourage intertwining and the development of a rich and subtle understanding of experience and awareness of both the potential user and designer/researcher. Also, even though experiences of movement can differ, developing greater sensibilities for recognising one’s own movement experiences strengthen one’s ability to recognise other’s experiences, as well. Our perspective is one of wanting to contribute to the dialogue about the physicality of both users and designers within the field of technology design.

#### 4 Conclusion

Merleau-Ponty [16] said that our skills are acquired by dealing with things and situations, and in turn they determine how things and situations show up for us as requiring our responses. Using Merleau-Ponty’s claim, we have, in this paper, looked at how our participants articulate how their relation to the world is transformed as they acquire skills. From this study of three movement practices, we have sought to contribute suggestions on the nature of experiential bodily knowing and understanding, and movement as a material for design. We did not aim to contribute a particular method, rather this is meant as a conceptual tool to present ways of thinking about knowing and understanding in design practice, specifically aimed at interaction design, but also, potentially relevant for product design and architecture.

At the moment we are exploring further the notion of what it means to *perform movement practice as a professional or trained mover*. Other activities we are considering include developing and testing relevant and specific ways of incorporating bodily engagement into design processes and work practice, and methodological and theoretical ways of grounding this type of movement imagination and reflection.

Experiential bodily knowing is felt. When becoming increasingly familiar with movement as a material for the design of technology interactions, we come to new understandings and nuances of understanding of the material. The focus then becomes to understand the conditions under which this knowing and understanding is more and less likely to be enacted. As a method, activities that make designers and researchers move and perform movement with prototypes and artefacts while designing can open up for insights into how interaction with new products, environments, or interface may feel to use, in addition to how it may look.

In this paper we have investigated how empirically-based descriptions of the nature of experiential bodily knowing and understanding can be transferable to, and useful for, interaction design. We suggest that the successful design of movement-enabled interactions relies on a designer’s ability to reason about movement and responses to movement in an interaction; that is their ability to understand how people might experience an interaction of this kind.

Our aim here has been to provide a theoretical contribution based in and developed from empirical data. Like Klooster and Overbeeke [5] we hope that this research will engender further discussion on the role of movement in design. We believe the way forward in this important area needs to combine verbal discussions and physical explorations. This is probably also the way to evaluate theories like this one – through moving, exploring, discussing and designing.

**Acknowledgements.** We would like to give sincere thanks and respect to our study participants for their time, effort and insights. We would also like to thank our research colleague Penny Hagen for generously providing sincere and constructive feedback which helped us make significant improvements to the presentation of our work.

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# Edge Services: Designing for Inconspicuous Consumption

## **Abstract**

This paper deals with issues of privacy and intimacy in the design of services. It is based on theoretical developments that emerged from a recent, large-scale public sector design project, *Design and Sexual Health*, commissioned by Designs of the Time 2007. Specifically, it introduces the concept of *inconspicuous consumption*, and the related notion of *edge services*, product-service systems that are designed to be inconspicuously consumed. First observations of a design approach to this area are considered, illustrated by some observations from the DASH project. The concepts presented here are currently being explored further through practice-based research as part of a PhD programme at the Centre for Design Research, Northumbria University School of Design, and the paper concludes with an exploration of some of the questions inconspicuous consumption and edge services raise for designers.

## **Keywords**

Privacy, intimacy, social innovation, service design, conspicuous consumption, inconspicuous consumption, edge services

## **Introduction**

Trust, privacy, and intimacy play a vital role in the formation of social relationships, whether a given relationship is predominantly defined by their presence or their lack. But these dimensions on interpersonal interaction are largely

at odds with a traditional design approach that (implicitly or explicitly) embodies the values of conspicuous consumption. Investigations into this area within interaction design and human-computer interaction have raised many questions about how increasingly pervasive networked technology can support these values, both from critical and more pragmatic perspectives [e.g. 1,2].

However, much interaction and service design implicitly embodies notions of conspicuous consumption, particularly the idea that the display of consumption of a good (be it a product or service) is at least neutral. But this is not always the case, especially when we consider designing to support intimacy, etc., which are fundamentally predicated on *selectiveness* about display of some aspect of one's self. How, then, can we restructure design processes to accommodate such values?

Within this paper, I will counterpoint a traditional focus in the interaction/service design community on conspicuous consumption with an alternative framework, based on the early stages of a doctoral research programme at Northumbria University's Centre for Design Research. The purpose of this framework is to move towards articulating an alternative value system around which design processes relating to socially complex interactions can be structured. The core concept introduced is that of *inconspicuous consumption*, and the related concept of the *edge service*, a form of service designed to be inconspicuously consumed.

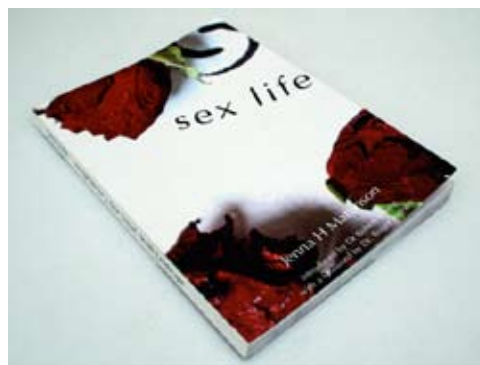
By introducing these terms, I am attempting to *lemkinise* complex emerging phenomena – i.e. make them tractable by associating with them a broad definition that allows them to quickly be comprehended and concisely expressed [3]. It became evident that this would be useful during a large-scale, multidisciplinary public-sector project to create a sexual health service: *Design and Sexual Health (DASH)*, commissioned by *Designs of the Time 2007* in the UK, on which the author was a senior member of the design team. The design of this service required a consideration of the subjective, experiential dimensions of a wide range of interactions through a variety of media, and how the design team could reduce the likelihood of, or at least ameliorate, often distressing situations that could potentially arise from these interactions. As will be described, the design team initially approached this project from a traditional, commercially-focussed orientation typical, perhaps, of many in the design industry. But during the course of the project, certain implicit, deeply held assumptions about how designers could work to develop a service that was on the edge of social acceptability were challenged. While the design team was highly familiar with critical and reflective work within interaction design in particular, most of these approaches seemed to emphasise ambiguity for aesthetic reasons [e.g. 4], or to explore these issues as they relate to a particular product or service [e.g. 5]. This paper is not a criticism of the value of such approaches, but rather an attempt at articulating a ‘bridging structure’ between relevant theoretical work, mostly drawn from cultural theory and sociology, and design. These concepts used to do so therefore act as a kind of organising principle for a certain type or style of interaction/service design practice.

To contextualise the concepts presented in this paper, I will begin this discussion with a brief overview of the DASH project; more general and extensive accounts of the project are available elsewhere in the public domain [6,7,8].

### The DASH project

Sexual health (SH) issues are markedly stigmatised in UK society, which is reflected in the nation’s poor standing in comparison with other countries of the Global North on relevant indices (rates of sexually transmitted infection, unwanted pregnancy, etc.). The DASH project was initiated by one of the few thorough explorations of how a better

UK SH service could be designed, published as *Sex|Life: An Agenda for a New Sexual Health Landscape*, and authored by a senior member of the DASH design team [9]. *Sex|Life* re-envisioned SH services as fully incorporated into mainstream culture, on an equal footing with the products, services and media output that situates sex as central to a glamorous lifestyle.



**Figs 1 & 2** The *Sex|Life* book and an image demonstrating one method of ‘mainstreaming’ sexual health issues in public environments.

From this basis, the DASH project involved a design team (mostly with backgrounds in product and service design) working in collaboration with social scientists from Marie Stopes International and members of the National Health Service to create a progressive (yet functional) SH service for the Gateshead, UK area. The design of the service was to be centred around the experience of the people who would use it, and by applying the same level of attention to detail to this as would be expected by a commercial enterprise, to make the service highly visible and accessible to the people of the area, and help destigmatise access to it.

Approximately 1200 people were consulted during the course of the project, from local residents (i.e. potential users of the service) to professionals in the medical and voluntary sectors. The multidisciplinary nature of the DASH project was reflected in the breadth of methods used in this process, which ranged from relatively traditional approaches based on social science methodologies (e.g. questionnaires, semi-structured interviews) to more design-led approaches such as cultural probes, which were particularly effective in engaging more ‘hard to reach’ at-risk groups such as young offenders and sex workers.

Space does not here permit an exhaustive dissection of the results of this consultation. With respect to the theoretical issues discussed in this paper, the single most important finding from this process was that, in the view of the public, the DASH service needed to be designed to help people conceal their use of the service. Concealment from *whom* ranged from partners and family to school and work communities to ‘passersby’, strangers present during more public interactions (calls to/from the services in public places, for example), depending on the individual. Given the subject matter of the DASH project, the design team had been sensitive to issues around privacy, intimacy and stigma from the outset. But what need concern us here is the fact that while the service was to have a high profile in the cultural landscape of the area, the act of access to it needed to be concealed, and this brought the project into direct conflict with the notion of *conspicuous consumption* that is integral to most areas of contemporary design practice.

#### Issues Arising in the DASH Design Process

The use of a service, as with the possession of an object, expresses something of who we are, both in our own and in others’ eyes. The term *conspicuous consumption* to describe aspects of this process comes from Thorstein Veblen’s classic study of consumption as a means of connoting social status rather than for utilitarian reasons [10]. In Veblen’s original formulation, conspicuous consumption indicated one’s place in the social hierarchy simply by making evident one’s income. A more contemporary interpretation of this process, which accommodates the symbolic and communicative nuances of consumption, is to consider products and services a *live information system* through which cultural meanings are conveyed and contested [11]. Consumption, when displayed, thus helps to convey social categories, rather than one’s position on a one-dimensional axis of social success. The design industry is profoundly implicated in the functioning of this system.

Sex|Life had envisioned sexual health services promoted as central to a desirable lifestyle, as something to be conspicuously consumed. Use of a service *implies a social category* about the person using it, in this case a negative social category from which the majority of people would want to distance themselves.

The DASH service centred around the stigma of sexual health issues. In a culture that stigmatises sexual health issues, access to an SH service, when conspicuous – i.e. when the interactions between the service and the person using it are *displayed*, even if inadvertently – implicates the person using it as a member of a *negative social category*, one from which most people would want to distance themselves. Designing the service to be conspicuously consumed, as per Sex|Life, may indeed have worked. But the issues of intimacy, privacy, local culture, family relationships and many other complex value systems with which the DASH design process intersected made this seem inadvisable. Instead, the DASH design team were forced to shift towards designing a service intended to be *inconspicuously consumed*.

#### Inconspicuous Consumption and Edge Services

Inconspicuous consumption is not to an alternative to the concept of conspicuous consumption, nor an outright negation of it. It is, rather, an extension of its logic. If the consumption of a good is unacceptable within a particular social context, it would logically follow that for the individual, it would be beneficial if consumption of that good were inconspicuous. Inconspicuous is not a synonym for secretive, but rather private, in the sense that privacy is “...the power to selectively reveal oneself to the world” [12]. To design for inconspicuous consumption is to accommodate an individual’s desire to control who is aware of that act of consumption; and to *incorporate that facility within the design process*, rather than relinquish responsibility for it to the individual, to be achieved by whatever tactical manoeuvres that individual sees fit.

To clarify this point it is worth elaborating on how designers might apply the logic of inconspicuous consumption within the design process. Design for inconspicuous consumption has different ramifications for the design of products and for product-service systems. Both are consumed through their use, but the use of the former is generally based on *ownership*, and that of the latter on *access* [13]. If someone considers a product they own to connote their membership of a social group that they believe others will perceive as negative, they may go to some lengths to conceal their possession and/or use of it. Were the designer of that product to accommodate this, they would do so more easily by advising the customers, through whatever medium, of good concealment strategies, but this would most easily take

the form of a service, not an integral part of the product. The points at which the owner of the product would have the least control over to whom their relationship would be displayed would be at points where it comes into and out of their possession (buying, sharing, disposing). These exchanges are the formal material of service design. The centrality of a series of interactions through time (and often space) in the design of services implies multiple potential 'points of disclosure' on which the logic of inconspicuous consumption can be brought to bear.

I use the term *edge services* describes services which are destined to be consumed inconspicuously, and designed with this in mind. In order to constrain interpretations of this definition, I propose two theoretical constraints to distinguish edge services from a more general set of social practices and exchanges that could be interpreted as involving consumption of an inconspicuous kind. Firstly, edge services are legal, although situated on the margin of social acceptability. Secondly, edge services are deliberately and consciously designed with the acknowledgement that their fate is to be inconspicuously consumed as a central tenet of the design process.

### Relevance to Interaction and Service Design

How, then, might a design approach be structured according to these concepts? And how might the products of such a design approach differ from those of a more traditional design process? At this point in the ongoing research programme, it would be inadvisable to proffer a definitive framework. However, here I posit some initial observations, drawn from the DASH project.

The objects and systems that play a role in edge services must be designed to acknowledge that familiar, everyday scenarios are the inescapable stage on which interactions

with such a service occur. Be it at home, alone or in the presence of family or friends, in the workplace, in the street, and so on, interactions with an edge service produce more or less fleeting evidence of a relationship with the service. This might be expressed through a phone conversation that might be overheard, an Internet search history that another might browse, an unusual item on a credit card bill, or in many other ways. Therefore a key consideration for the design of an edge service, or a product within that service, is that almost all spaces and contexts of use are at least potentially public; even the home, traditionally viewed as a space of retreat, must be considered 'semi-public'.

There are two avenues by which designers can approach this juxtaposition of edge service interactions and everyday scenarios. The first is to consider how existing means of consumption [14] of services can be redesigned to accommodate the necessity of inconspicuous interaction. One way of doing this is to provide information that changes a person's familiar, everyday relationship with the use of an object that plays a part in the service; this is particularly relevant with respect to information technology. For example, the DASH project design team felt they could not neglect a website as a vital intermediary between the service and the people who used it, despite our finding that undetected access to such a website would be quite difficult for the majority of the members of the public we consulted. The two main issues were risk of discovery (while accessing the site, through the search history, etc.) and regulatory difficulties (blocked searches on terms implicated in sexual behaviour from many workplace and community locations). The final website included various measures against this – an innocuous name and instructions on how to delete search histories, for example.



Figs 3 & 4 Samples from the DASH project.

Other factors come into play when designers develop new products and systems *ex nihilo*, specifically for the service. If objects related to the service are to exist in everyday spaces, they need to fit into that landscape and not draw attention to themselves. DASH provides two examples, operating at very different scales.

In the case of physical materials taken away from the service, such as appointment cards – which could easily act as incontestable material traces of a relationship with the service – we recommended they be created with the relevant information in a field of other information – advertisements, contact details for other services, etc. – a form of service camouflage that could be seen as incorporating a kind of ‘functional ambiguity’ into outcomes of the design process. The techniques of camouflage, of ‘hiding in plain sight’, present a promising resource for how objects might be designed that can exist innocuously within the everyday landscape yet play an integral role in the design of an edge service. An example is the use of mimicry – creating objects and interactions that are superficially familiar, everyday and unremarkable, but in fact have a hidden purpose. One example is a suggestion within the DASH project that text messages between the service and the user might be encrypted in everyday language, appearing to come from a wrong number (abandoned for reason of its complexity, in this case); another example is Jon Ardern’s ARK-INC Radio, which conceals short-range, two-way functionality, activated by its owner’s key [15].

The same approach, at a very different scale, was represented in our approach to the design of clinical spaces. Such spaces were unavoidable within the service for the purposes of medical consultation and testing, but entering a service-specific site emphatically declares a relationship with the service to anyone within sight. We proposed the DASH service to run temporary sessions across a number of sites, medical and non-medical (gyms, schools, community centres, etc.), supported by a mobile laboratory. There no longer was a ‘visit to the clinic’ to explain, only a visit to a seemingly neutral place. This was extended in our recommendation for a ‘clinic in a suitcase’ that would allow visits to homes or other discreet places, temporarily and inconspicuously converting them into spaces in which the service could operate.

As can be seen from these examples, the alterations in the design of the products, interactions and spaces for the purposes of inconspicuous consumption are subtle, and this is perhaps unsurprising; they are inconspicuous, at home in the everyday landscape but serving a different set of values. While it may seem a conceptual shift towards inconspicuous consumption is not represented in a sufficiently dramatic alteration of interaction/ service design practice to warrant much attention, the impact of edge services on social relationships may be considerable, as will be described below. Likewise, in the cause of contemporary interaction design’s emphasis on the emotional qualities of interactions, inconspicuous consumption can be thought of as an organising principle for design-led research and practice that aims to engage certain spheres of emotional experience that, with a few notable exceptions [16], are relatively unexplored by designers as yet. Therefore, while the ramifications of these concepts as a structuring mechanism for design processes are formally subtle, they represent an important expansion to the field in linking broad – perhaps intractably broad – concerns such as trust, intimacy, privacy and so forth – with practice without resorting to concentrating on very limited explorations of how these values can be embodied with a single product or system.

### Future Directions

This paper has presented an interpretation of a single, albeit large-scale, design project according to a new theoretical framework; but the concepts put forth, obviously, need to be extended to other domains and refined through this process if the ideas are to gain greater validity. Some key questions being explored through a related programme of practice-based research at the Centre for Design Research involve extending the understanding of how consumption can be made inconspicuous, as well as exploring social and emotional aspects of designing edge services.

In the most immediate sense, design practice of this kind can be informed by a wealth information detailing of tactical appropriations and misuses of existing objects and environments, drawing on criminology, surveillance of various kinds, and the practices of various underground groups and services brought to visibility via the Internet, such as services that provide alibis.

In addition to the formal aspects of design for inconspicuous consumption, the social and emotional aspects of edge services are of particular importance. Giving a person who uses an edge service the ability to selectively display that use to others raises complex questions about the role of designers in mediating relationships. We must ask what types of interpersonal relationship might be enabled, supported or compromised by edge services. Decisions whether to share involvement with an edge service with a significant other might intensify or dissolve an intimate relationship, for example; or we might ask what kinds of 'user communities' they might foster.

In terms of the emotional dimensions of edge services, the current research programme is looking beyond the fear and anxiety with which the DASH service aimed to engage and instead look to other experiences edge services could support. The work of criminal sociologist Jack Katz, who has written extensively on the 'sneaky thrill' of embarking on a concealed personal mission within an innocuous everyday environment (for example amongst amateur shoplifters and trespassers) is inspirational in suggesting an aesthetic richness to edge services that design rarely approaches [17].

In conclusion, the twin notions of inconspicuous consumption and the edge services that support it provide a vantage point to combine design research into issues of trust, of privacy, and of intimacy and community. It helps to identify a body of relevant knowledge from other disciplines pertinent to the kinds of questions many designers, especially those working within the fields of networked technology and social innovation, might face. Importantly, it presents a mechanism by which this extra-disciplinary knowledge can be linked to design practice. The development of these concepts goes towards a refinement of our understanding of humanistic approaches to an increasingly always-on, connected world; simultaneously, it offers a rich aesthetic space to be explored on the fringes of conspicuous consumption.

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# Autonomy + the Aging Population: Designing Empowerment into Home Appliances

## **Abstract**

Designing consumer products for an aging population requires detailed descriptions of the attributes that define the “product” experience and purposeful planning of visual language, interactions, and behaviors organized to support real life scenarios. Historically, products for the aging population are “assistive” in nature, embodied by poorly conceived forms that stigmatize the user as being deficient. These products must be designed to shape behavior and interaction to best connect their functionality with the user’s abilities, environment, and living practices. Through the careful scripting of product interactions empowered by visual form language, products can shape new experiences to improve user confidence in daily life. This paper introduces emerging themes and approaches in product design, highlighting challenges and opportunities in designing empowerment into products to sustain autonomous living. Examples are drawn from a two-year body of design research through the School of Design at Carnegie Mellon University sponsored by General Electric’s Appliance Division.

## **Keywords**

User-Centered Design/Human-Centered Design, Elders, Design Planning, User Experience, Product Design

## **1 Introduction**

As the baby-boomer generation in the United States grows into mature adulthood, our society will be forced

to recognize that it will become the oldest population in recorded history. By the year 2014, all baby-boomers will have celebrated their 50th birthdays, received their AARP cards, and become more aware of their inevitable health decline. The upper tier of this generation will have celebrated their 68th birthdays, and may be transitioning to age-restricted/age-friendly communities or patio homes. Currently, there are an estimated 83 million people over the age of 50 in the US alone; the average age to move into Continuing Care Retirement Communities (CCRC) is 83. The median age has risen from 35.3 to 35.9 since the 2000 Census, an indicator that: 1. the aging population in the United States is rising and 2. people may be living longer with debilitating physical impairments. Currently, only 5% of elders live in institutions [1]. Elders living independently as well as those in nursing homes and assistive care facilities are subject to physical, emotional, and cognitive changes that result in the need for increased support. Facilities that provide this support currently cannot meet the increase in numbers of those in need – a reality that will continue to worsen [2]. This scenario presents three immediate challenges for design: 1. to synthesize the attributes, qualities, and values of an aging population into viable product systems that address their specific and changing needs; 2. to develop approaches to empower this specific user group/generation for autonomous living avoiding stigmatizing them as a population marked by cognitive and physical deficiencies; and 3. to include broader product appeal toward younger (transgenerational) audiences.



This paper discusses emergent themes, challenges, and approaches for product designers in developing empowering product experiences for the aging population with a specific focus on major home appliances. The ubiquity and duty that these everyday objects serve in our lives often goes un-noticed as people tend to take them for granted. Microwave ovens, washing machines, dishwashers, refrigerators, and stoves each play important roles in facilitating autonomous living. When elders can no longer cook for themselves or address their basic needs, assistance is required. Therefore, if essential home appliances can be physically easier to access, visually clearer to understand, and can be integrated into the lives of elders in more meaningful ways, they may serve to empower elders through the many changes and challenges during this critical time in their lives. The main obstacle today is that consumer home appliances do not address these needs and often exemplify an opposite scenario in usability (Figure 1).

The industry-sponsored research project referenced in this paper included user studies and participatory design to guide designers in creating an exhaustive list of design criteria and a series of physical prototype appliances for validation, testing, and feedback to guide industry professionals toward creating more empowering appliances. The emphasis for this body of work was to shift focus from designing products for market segmentation toward designing products that enhance user experience and change the contemporary relationship with these necessary products in our daily lives. The “universal” or “inclusive” appliance concepts presented are highly usable

for a broad range of users, but were developed according to methods that address the physical, cognitive, sensorial, emotional, and social characteristics of current elders with particular projections for the aging baby boomer population.

This research project, titled “Autonomy and the Aging Population: A Universal Approach to Appliance Design,” was sponsored by GE Consumer and Industrial/GE Appliances based in Louisville, Kentucky and was coordinated on their behalf by Marc Hottenroth, leader of Industrial Design Operations. Research and conceptual development was coordinated by Mark Baskinger, Assistant Professor and Bruce Hanington, Associate Professor in the School of Design at Carnegie Mellon University along with a small team of interaction design graduate students and undergraduate students in the communication design and industrial design programs. This project built upon previous research, also sponsored by GE Appliances, that focused on narrative appliance interfaces and appliance design for the visually impaired conducted by Mark Baskinger with his students in 2002/2003 when he taught in the graphic and industrial design programs at the University of Illinois at Urbana-Champaign.

User studies were conducted primarily in the Pittsburgh area with supplemental email exchanges, phone conversations, and surveys gathered from participants in Canada, New Jersey, New York, Pennsylvania, and Kentucky. Design and development occurred on the campus of Carnegie Mellon with support from GE Appliances in Louisville, Kentucky. Beginning in August 2004, the two-

**Fig. 1** A combo washer/dryer unit with copious small text and graphic treatment, washing machine interface with small type and low contrast color demarcation on a reflective background, and an elder attempting to reach into a refrigerator to grab a lost item in the back.





year research project concluded in August 2006 with a series of white papers, internal reports, and presentations. The research continues to receive informal feedback from industry and target user populations.

### 1.0 An Opportunity to Shift from Assistive to Empowering

There is a disconnection between contemporary approaches in creating transgenerational products and in designing specifically for the aging population. Too often, visual styling is used as the surrogate in connecting to a broad user base where modern-retro trends and novelty are used to capture the perceived spirit of an era, as shown in cars like Chrysler's PT Cruiser or Chevrolet's HHR (Figure 2). Conversely, products that are designed specifically to address the debilities of the aging population often look overly engineered, generic, medical, or scientific. These forms, visually speak to their assistive nature and strongly suggest that the user is infact, inferior (Figure 2). This polarity among approaches may indicate other external forces in shaping the design (economics, marketing, trends) however, it indicates that there is a clear need to develop assistive products with appropriate visual language that expresses utilitarian and functional excellence to empower usability and inform interaction yet simultaneously address the emotive qualities of products as owned possessions. In this sense, assistive considerations for the aging population must be transparent; a challenge to designers to use form language as a leveraging approach to support universal application across generations and abilities.

The ubiquity of major appliances affords the opportunity for a socially responsive change in thinking in design. Since the inherent multi-functionality and complexity of appliance interfaces can alienate elders who may lack the visual acuity, cognitive reasoning, or manual dexterity to operate them, the next obvious step for appliance manufacturer's must be to develop an inclusive strategy to allow for such disparities in abilities between younger and elder populations. There is fertile ground for investigation into the specifics of product design and interaction design including: capabilities/functionality, materials,

**Fig. 2** Three different contemporary approaches in designing for an aging population. The PT Cruiser employs retro-modern styling to create nostalgic feelings, the walker device looks more like scientific apparatus, and the Good Grips brand of kitchen tools that exemplify a more neutral appearance with assistive qualities transparently built in. Images courtesy of chrysler.com and oxo.com

typographic information, iconography and visual support, mapping, physical dimensions, sequencing etc. Establishing parameters to accommodate elders can enable new product visual language and visual forms that can include and appeal to a broader, transgenerational audience.

### 2.0 Designing Products and Interactions to Shape User Experience

In the current social climate, people expect great things from their products. Value is not only associated with materials, styling, embedded technology, and functionality, but also in the ability of a product to connect with, define, and engage its user. This trend requires a shift in thinking from the design of products and objects to the design of engagement and experiences with products; focusing on the activity more than the product itself [3]. Therefore, a challenge exists in the ability to accurately identify the key attributes of potential users/customers and to create a structure that enables individualized product experiences. This thinking may involve the consideration of a product being identified as a service provider rather than merely a possession; thus the emphasis shifts from the feature-centric object to one with the ability to perform its duty in relation to its context and social framework of the user.

While GE had formerly engaged in visual brand unification across appliance types, results were often lacking in commonality of interaction. User studies revealed that common activities, sequences, and steps for different appliances would be a necessary part of the team's exploration toward empowering elders and developing competency. The team often discussed the commonalities and differences in automobile dashboards. Critical actions, like turning the key or engaging a turn signal are consistently positioned in all cars, regardless of make.

However, secondary actions such as engaging the parking brake, windshield wipers, or tuning the radio, can greatly differ even within automotive brands. As a result, the established design criteria became guiding considerations toward designing for the user experience with appliances as emphasis shifted from designing the product forms to designing to shape the broader user experience. An experience strategy emerged to integrate the person and appliance into the activity within context. The team shared a belief with GE designers that the product or appliance form was not to be the absolute focus; rather it should serve as a cast member that enables someone to accomplish a goal. Therefore, the team designed toward specific moments during interaction and structured the physical form of the appliance and the graphical form of the interface accordingly. Quiet and appropriate, yet respectfully dynamic when active were the desired characteristics. In the current appliance market, consumers tend to purchase appliances based on price, visual appeal, or bells and whistles. Quite often, consumers can fail to investigate how the appliance actually works and its ability to perform its job before making a purchase. Therefore, GE hoped to capture peoples' attention by presenting a "beautifully simplistic" interface that invited them to play with and investigate.

### 2.1 Experiential Semantics

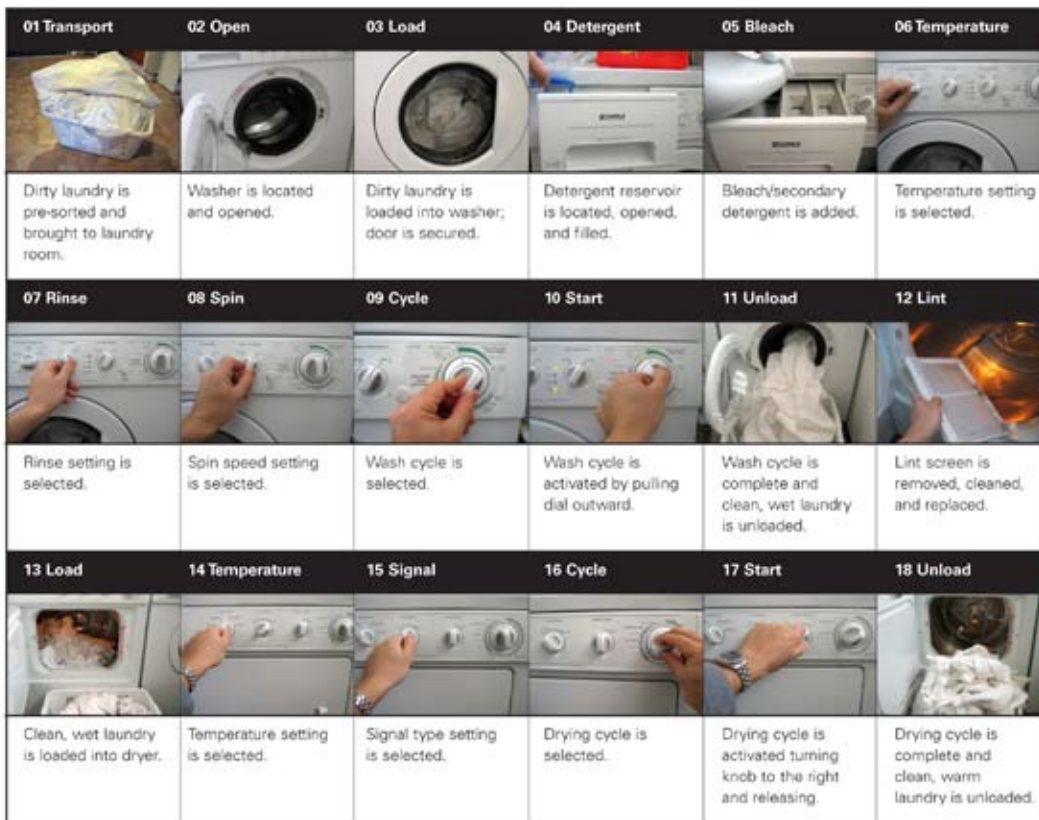
Experiential semantics, defined by John Rheinfank, is the design of meaningful experiences through the production of an emergent and evocative integration of both form and action. Derived from traditional linguistics and communication, the insights of semiotics (the study of meaning), product semantics (the expression of meaning through form), and situation semantics (the expression of meaning through action) provide a framework where meaning in design is not merely the built-in sense of the object, but also the quality of sense-making that objects have and can produce, especially with respect to their context. Therefore, design can be more than making meaningful objects, it is crafting an appropriateness about objects that enables them to participate in the creation of meaningful experiences [4]. Experiential semantics is concerned with making objects that have radically more appropriate substance and collaborative qualities that allow them to integrate with the experiences of those who use them. Designers can incorporate this approach through a deliberate consideration to the properties of the object that contribute to the creation of experiences

and to the emergent properties of objects in the context of the abilities that people have to interact with objects and each other [4].

The anatomy of a designed experience is rather simple as it employs attributes of the following criteria: it is based on an activity, it engages a user in that activity, it elicits an emotional response, it can include others, and it can be "inged." While almost anything can be appended with the "ing" suffix, there are common activities which serve as taxonomies that include aspects of movement, time, input, output, and transformation. In fact, by designing experiences, the emphasis shifts from the "noun" to the "verb" [3]. When applied, the design of a laundry washer can espouse the activity of washing laundry with an emphasis on human interaction with the process and task-based outcomes rather than focusing just on the attributes of the visual form or the "productness" of the washer. In other words, designing for interaction to create the experience, rather than designing novel products.

### 3.0 Shaping Interactions + Experiences with Narrative Structures

Incorporating a narrative structure into product interaction can enrich the greater experience through provision of a running visual dialog of information, processes, and events over time. Some of the most compelling and engaging narrative experiences are organized across a linear sequential continuum with key markers for beginning (to attract the user and provide an understanding within a context), middle (the interaction that engages the user in an activity with the device) and end (the conclusion that draws the experience to a close). For example, storytelling, a form of narration, is one of the oldest experiences known to humankind and remains powerful because it organizes information in a way that allows the participant to draw personal meaning. The most important characteristics of successful narratives, like stories, are that they are authentic and relevant to the audience in a "voice" (verbal, written, or visual) they intuitively understand. Therefore, these narratives incorporate a particular, and often personal perspective to portray a sequence of actions relative to the real time scenario around an experience. In this sense, narratives can serve as vehicles to make difficult concepts, instructions, or information more accessible by visually depicting a glance at the entire episode as well as sequential steps and events along the way.



**Fig. 3** A series of photo images of key moments in the laundry sequence starting with dirty laundry, progressing to wet clean laundry, and finishing with dry clean laundry. Each of these moments can be designed for in terms of mapping, information visualization, behavior and feedback.

### 3.1 Markers and Moments in Sequential Design

Designing for key “moments” creates touch points for the interactive sequencing to help clarify the experience. Moments can be described as particular interactions and episodes within the greater product experience that can be isolated, categorized, designed and analyzed (Figure 3). With sequential structures, linear and non-linear, there must be a reference or connection of past, present and future actions. A narrative structure can provide the scaffolding which can simultaneously demonstrate macro and micro views of the experience, the markers or cues are set in place to acknowledge or indicate the moment in the sequential continuum.

In terms of the macro picture, the narrative structure will answer such questions as: What can this appliance do? What can I do with this appliance? What must I do to engage it? With respect to illustrating the time continuum of the experience, this structure can also enable the user to formulate the following appliance-specific questions and provide concrete feedback about: What did the appliance do? What is the appliance doing now? What will the appliance do next? Furthermore, narrative structures can help to address user-centered assessment during the experience: What did I do? What am I doing? What must /should/will I do next? Realizing that the capabilities of the aging population are wide and varied, creating a simple plan of key moments can help to clarify and inform interaction through a cause and effect relationship – *If I do this, the machine will do that*. Like chapters of a book or bullet points in a list, these moments serve as the touch points for interactive sequences that both remind an

elder of their position within the large process and enable forecasting for their next move. Staging sequences and markers within the greater experience and throughout product interaction will distinguish actions of the user and actions of the appliance. Therefore scripting and designing specific moments into product interaction through cause and effect sequences can provide a more effective series of smaller interactions throughout the product experience.

### 3.2 Linear vs Non-linear Sequences

While the majority of narratives follow a simple linear progression, many of the most engaging narrative experiences play with this sequence in novel ways. All experiences that are constructed to be interesting, engaging, entertaining, or informing must be structured to initiate action, and have a flexible nature that allows the participant to react and interact on various levels. Focusing on the major actions in an experience provides the most fertile ground for design development; again, thinking of the “ing” rather than features or the product form itself.

There are many common experiences in which we move about in a non-linear manner where we have choices of how and where to proceed along the way. Driving or walking in a city context, web navigation and even some displays employ non-linear sequences that, when appropriate, often encourage a sense of participation that can be more satisfying. Brenda Laurel outlines five basic structures that relate to narrative flow in her book *Computers as Theater: Single Thread* – no choices, traditional linear sequence; Single Thread with Minor





**Fig. 4** Haphazard mapping of controls during sequential interaction, like this parking garage paystation interface, is often confusing and is not considered “exploratory.” Here, additional signs attempt to cue interaction to encourage effective operation. Clear mapping of controls using the geometry of the machine and a logical reading order would support the sequence of interactivity and encourage usability.

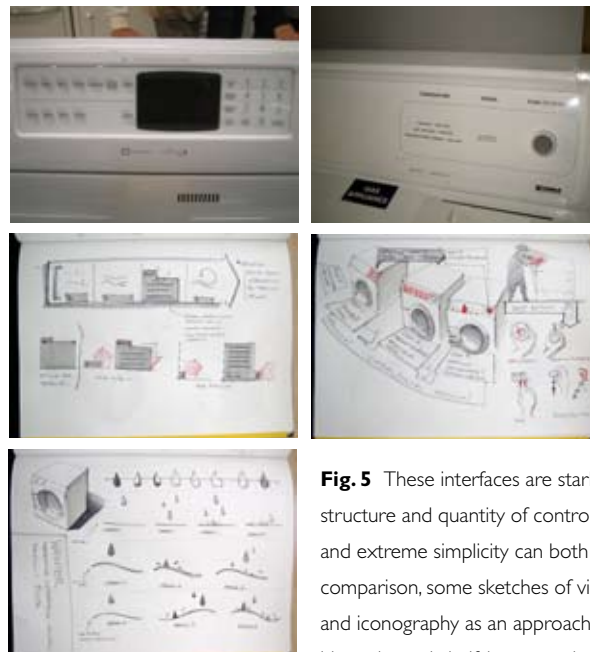


Detours; Multiple Threads with Preset Choices; Multiple Threads with Unprompted Choices; and Exploratory – non-linear, flexible, customizable [5]. In the exploratory structure, the non-linear nature of the user’s navigation and unique sequencing that results enables the user to become a true participant and engage a product in a way that connects directly with their imagination and how they envision particular activities, interaction, and experiences. Although non-linear sequencing may appear to be overly complex to structure, building a narrative schema with established markers along the continuum of interaction can create a greater sense of a beginning, middle and end. The key advantage of a non-linear sequence is that it permits discovery and for the user to engage with a system in more familiar or personal ways. When designing for an aging population, the flexibility of an interface to change from exploratory to a single thread can serve to empower an elder who experiences loss in cognition or some form of visual impairment. The ability for an appliance to present an appropriate level of information, choices, and sequences as a user’s abilities and needs or preferences change, presents an incredible opportunity for designing empowering experiences.

### 3.3 Towards More Informative Feedback

A well-structured experience that tells the participant something about itself tends to feel more interactive than an experience that communicates little about its status. A common problem with current appliance interfaces is the lack of meaningful feedback, generally only a small illuminated light or a position marker on the panel. Whether the feedback is a simple explanation about why you are waiting, a reaction to a user initiated action, or a detailed account of system performance, most participants expect systems to acknowledge their actions in some way. There is a fine line between providing too little information that under-informs the participant and too much information that can frustrate and distract (Figure 5). Achieving the proper level of feedback for a product experience may rely more on assessing variable thresholds of information at each moment or marker rather than assigning a base level across the entire episode. Since

appliance interaction can become a complex informational exchange between viewer input and machine output, it becomes imperative to achieve this balance by scripting informational exchanges at each decision point to avoid visual “noise” and miscommunicative features [6].



**Fig. 5** These interfaces are starkly different in their structure and quantity of controls. Extreme complexity and extreme simplicity can both fail to communicate. By comparison, some sketches of visual information display and iconography as an approach to creating information hierarchy and clarifying controls and input devices.

Through contextual inquiry, the research team observed that many elders had difficulties successfully navigating interaction with microwave ovens, washing machines, and dish washers due to the number of cycles and settings offered or the cryptic meanings behind terminology. The small type and lack of meaningful graphic imagery complicated readability and promoted second guessing. Thus, a decision was made to explore a larger information display system that relied on pictographic representation to support and clarify text-based communication. Since more typographic information could be crammed into a smaller space than graphics, many concepts investigated adaptive interfaces that only presented pertinent information at decision points. For example, a contemporary washing machine interface shows all of its cycles and settings to a user all the time; even newer digital interfaces load the screens with choices, pathways

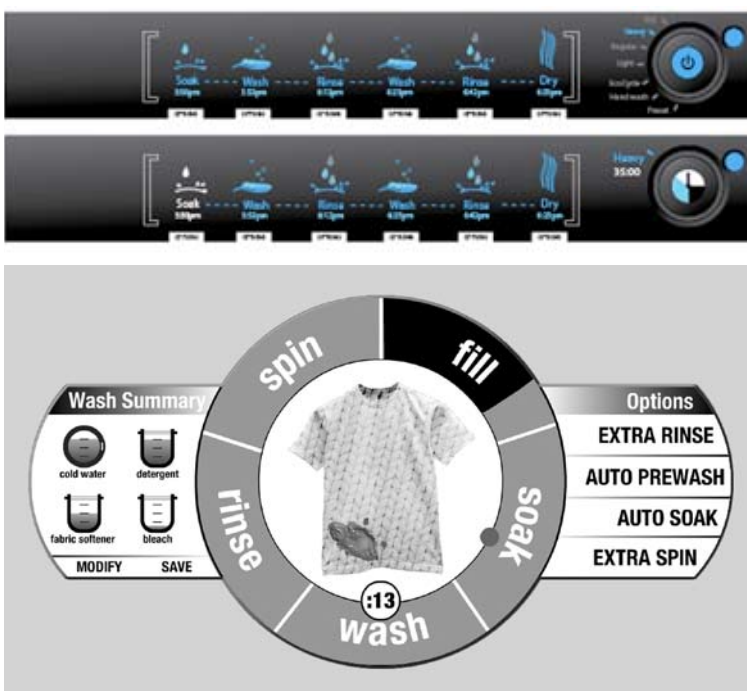
and settings that require learning, if not a clear manual and available help line. Thus, the research team made another commitment to sequence physical and digital interaction in such a way that the first decision, generally the major setting, was selected in a more mechanical way through physical movement; settings and modifications to that selected would then be offered through digital interaction as they would change in fidelity and variety based on the first decision. Finally, the appliance would be actuated to begin its work cycle through physical interaction again. The combination of digital and physical interaction elicited positive feedback from participants and provided a plausible approach for GE designers to make a greater commitment toward integrated digital interaction.

### 3.4 Control, Creativity and Improvisation

Users expect to have some degree of control over their product experiences. This control usually makes them feel more comfortable and empowered and is directly linked to age, aptitude, and abilities. Having control over the rate of interaction, the sequence of steps, the type of action or features, and how much feedback to obtain will enable the participant to better customize their product experiences and gain proficiency. The anxiety that many people can experience when confronted with unfamiliar tools can be lessened by utilizing techniques such as recommendations, guidelines, help, advice, or actually performing the operation. If there is an opportunity for a

participant to make “something” in an experience, then it is likely that the participant will both value the experience more and regard any artifacts that they create with fond memories. Since the primary service of a major appliance centers on changing the state of an object through cooking, warming, cleaning, cooling, etc. then its product experience inherently support notions of creativity and productivity. Artifacts that result from these processes then become necessary components to productive or creative experiences as they serve to remind people of their experience. Thus, the artifacts themselves often have more than just emotional or mnemonic value as they are linked to the greater product and brand experiences that rendered them into their current state. Many of the elder participants in the research study, placed value on certain appliances that performed well and said that they would never consider purchasing a different brand.

Experiences that seem to adapt to the interests and behaviors of the participant always feel more sophisticated, personal, and valuable. Customization is one form of adaptivity that allows users to choose options to tailor an experience to their current needs. In framing an adaptive context, customization is developed through a finite set of controllable features and relies on a narrative structure with multiple threads and preset choices. Personalization requires a more sophisticated level of interaction and planning, as choices and options cannot be anticipated. This type of experiential schema allows users to create more unique experiences that are adapted even more to their desires and needs. In certain product applications, it is possible for interaction sequences to adapt to participants and change based on the behavior of the user, time of day or year, and location. In participatory product experiences, users might expect product systems to respond accordingly. In an increasingly digital world, the baby-boomers show a marked acceptance of and interest towards purchasing products with some “smart” features. In a very basic way, many appliances can already store pre-set cycles and user preferences; however, the future may illustrate a scenario where the appliance can



**Fig. 6** An early sketch by Robert Hirsch for a graphical narrative interface that leads the user through various wash cycles and visualizes washing preferences (left). Narrative interface concept (right) by Mark Baskinger developed for GE to illustrate wash cycles with simple linear animations and to clearly communicate the various steps in the wash sequence

coach a user through interaction or be able to understand the cognitive and visual limitations of the user and adjust itself. Realizing that users tend to create their own path through a product experience, evaluating the constraints and practices of improvisors can lead designers to forecast actions to provide more interesting experiences. Improvisors tend to view every action or statement as an opportunity to create more opportunities for interaction where every action, position, movement, etc. serves to continue the possibility of more action. Experiences that allow changes of status among participants, often create interest and tension [3]. The status level of the system or experience in relation to the user or audience is often critical in determining how the experience is understood and considered. Structuring appropriate ways of resetting these levels can determine the success of the experience. Product systems that can adapt or improvise and respond to the actions of the user can enable more meaningful experiences by addressing the changing abilities of users from novice to intermediate to expert users. These experiences require systems to develop consistent exchange with participants in an immediate manner that appears seamless and transparent.

#### 4.0 Designing Interactivity for Elders

Interactivity is a somewhat nebulous concept that encompasses how the actions of people and products exist in a reciprocal relationship during an experience. In an interactive medium such as appliances, it would seem that interactivity and the user experience would be priority issues; however it seems that most manufacturers emphasize more concrete issues of production viability and novel cosmetic features. It is apparent that in today's

cultural climate, that interactivity is a differentiating advantage of product experiences. Apple, Volkswagen and others carefully consider the way a user works with, interacts with, and gets information from their products. This consideration has manifested into products that have a very brand-loyal consumer base. Key touch points, information displays, behaviors, sounds, images etc combine to create richer, more rewarding experiences. On a conceptual level, interaction is the process of continual action and reaction between two parties, human and/or machine. In many ways, it can be considered a dialog between the user and the device. Richer, more rewarding appliance experiences rely on crafting interactions that engage the participant in a meaningful way to enable comprehension and proficiency and position the appliance to have a greater role in the user's daily life.

#### 4.1 Understanding Interaction from an Elder's Perspective

Research team members participated in "geriatric sensitivity training," offered by a geriatrician who consulted on the project, to better understand interaction from the target user's perspective. The goal with this training was to build empathy for the physical and sensorial changes one experiences with aging. This training was extremely important in preparing the group for contextual inquiry, where the team observed individuals in their own homes. Physical and visual abilities were limited using devices such as yellow-tinted glasses, goggles that distorted vision and padded gloves as the team members attempted to sort pills, open cans, and brush their teeth, which simulated the physical and sensorial realities that many elders experience. Additional exercises included

**Fig. 7** These video samples depict multiple camera angles at one moment in time. Here, the participant is referencing a cookbook while chicken and vegetables simmer; and bread bakes in the oven. In addition, an image of participatory design in the form of a Velcro modeling exercise and an elder providing a guided tour of her appliances illustrate other methods used.



restricted mobility and hearing and smell deprivation. Field research was conducted with members of the elder and late baby-boomer communities in their own homes to understand the challenges elders face in everyday living. The research team visited numerous elders and baby-boomers in their homes and in assisted living facilities, and completed additional interviews by telephone and email. Field research consisted of conversational interviews, based on a framework of questions targeting past, current, and possible future appliance use, and preferences. Interviews ranged from 45 minutes to two hours, and included a videotaped tour of appliances simulating typical use, while participants identified positive and negative features. Appliances were photographed, and brands and models were noted. Telephone and email surveys were conducted with a smaller sample of additional members of the community, following a similar set of guiding questions.

Video recording, guided appliance tours, direct interviewing, photography, field notation and subject journaling were part of the data collection process. Video recording proved to be most effective as multiple cameras were installed in numerous locations to capture activity simultaneously from various perspectives. There were “whole room” views – cameras located at the boundaries of the kitchen space, appliance views – cameras mounted above each appliance to capture the immediate area around the appliance, and user perspective view – a web cam mounted on a helmet that each participant wore during their recorded session. Ultimately these various views were synchronized and formatted into a matrix to show at every given moment what the participant was doing in relation to the context, the activity, and the appliances (Figure 7). This form of observational study revealed that many subjects made claims like “I know where everything is in my kitchen.” or “I know exactly how my microwave works.” Although recorded video proved that they did not in fact, know how their microwave worked and often had difficulty with their own organizational schemes. When the video was played back to the participants, they were very surprised and offered suggestions for how they might make changes to appliance interfaces and kitchen configurations to be more effective.

#### **4.2 Using Participatory Design Methods to Design Interactivity**

Participatory design methods were used to better understand preferred appliance configurations from both

current elders and baby-boomers. The research team conducted one-on-one sessions with members from each population during home visits, after guided appliance tours were given. The guided appliance tours enabled participants to openly discuss their appliance experiences which primed them for envisioning potentially more beneficial scenarios through Velcro modeling exercises. These tours disclosed daily routines and appliance relationships which enabled the research team to gain a better understand of real-life scenarios. Conducting these session in-situ were key to obtaining unfiltered and more honest opinions. Each participant was given a kit of parts to assemble appliance interfaces and was asked to discuss their reasoning behind mapping of controls and selection of features as they constructed the model (Figure 7). Interesting conversations followed that revealed a preference for controls to be upfront and easily accessible with larger knobs and more surface area for interfaces. There were additional differences among members of each population; elders preferred fewer features while boomers preferred more features, including novelty features of popcorn buttons and baked potato settings for microwave ovens. Dialog with each participant reiterated the design team’s assumptions that current elders prefer more control during food preparation, while boomers tend to like pre-set functions and automation. Some conclusions drawn from these studies include: 1. boomers tend to place more trust in their appliances and prefer pre-set options in dishwashers, microwave ovens, and washing machines; 2. elders expressed a desire to have more control during food preparation or clothing/dish washing and tend to keep watchful eye on appliances while in cycle; 3. elders and boomers had varying opinions on physical vs digital controls which aligned with their acceptance and proficiency toward digital technology. Through these sessions, the researchers formed relationships with community members who continued to participate in the project.

#### **5.0 Using Form to Empower Interaction**

Design research and user studies provided a firm foundation to develop a conceptual suite of appliances to illustrate principles of usability and designing to shape an elder’s experience in carrying out daily activities. This concept for a full suite of kitchen appliances plus laundry was driven by three major themes: 1. empowering older adults by considering their physical, cognitive, sensorial, emotional, and social characteristics; 2. making projections



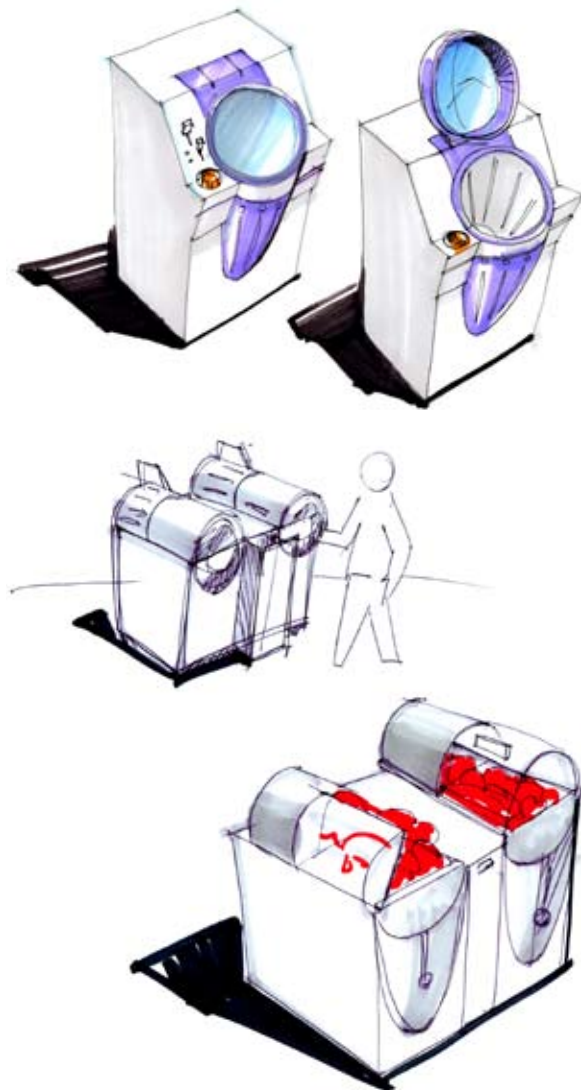
toward the aging baby-boomer population particularly focusing on emotional and social characteristics; and 3. extending toward a broader and more universal audience through simple, purposeful innovation. GE designers and the research team chose to innovate within contemporary kitchen cabinet standards so that all dimensions for appliances complied with the standardized 3" increment scale. However, to increase access for all appliances, the researchers used a 30" width standard for all appliances, which allowed for wider doors, increased interior space, shared components, and uniform interface panel. Since kitchen architecture and layout varied so greatly, the research team chose not to create optimal configurations for installation or to re-invent the work triangle. Therefore, much consideration was given to preserving the counter line and creating additional work surfaces at the point of interaction through the appliance form itself.

### 5.1 Form Language: Hidden in Plain Sight

Appliances spend much of their life in a "ready" state waiting to be used. Therefore, a key issue the researchers and GE designers tried to resolve was relationship of the product forms to their context. A strategy was developed to design the appliance forms to express their functionality and behavior in a more overt way. Radical departures from conventional appliance forms resulted which warranted an aversion from participants. Thus, the team re-defined the strategy toward "contemporary minimalism" and focused on more volumetric representations to honor the appliances as devices, rather than furniture. By reducing the visual "noise" and "aggressiveness" popular today in product forms, a more subdued presence was achieved to balance the visual presence of each appliance with the visual presence of other elements in context. The forms were envisioned to be seen, but not dominate the visual landscape and detract from the interior design of a given environment. This was a key departure from contemporary strategy in appliance design where manufacturers try to draw attention to their products in show rooms and homes.

### 5.2 The Strike Zone

Designing within current standards of kitchen and cabinet architecture, the researchers focused on physical reach limits and optimal working spaces around each appliance. With the goal of preserving the counter top as the major work surface in the kitchen and maximizing access around and into each appliance, the "strike zone" concept was



**Fig 8** Sketches of expressive appliance forms and appearance rendering of a volumetric appliance suite.

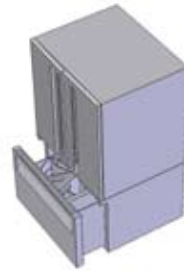
created. This optimal vertical area of 17" from floor to 30" above the counter top was determined to best minimize excessive stooping, bending and reaching. In addition, each appliance was configured to extend no more than 13" into the walking path in their primary open configuration to promote greater access for assistive devices like walkers and wheelchairs (Figure 9).

Testing of volumetric models with representatives of a wide range of ages revealed certain advantages that would improve appliance experiences for all. For example, the drawer dishwasher concept that has a turn-table style or lazy Susan dish rack, enables access from three different combinations of movement: 1. the drawer can be extended to full 13"; 2. the lid can be lifted and stowed below the counter line to allow 13" of access from the top only, and 3. the drawer can be extended 13" and lid opened fully to give 26" of access (Figure 10e). Most participants found the increased access at counter line more preferable than bending and stooping over a large door below knee level as in most conventional units. Thus, an advantage created specifically to enable an elder with poor balance and limited mobility provided convenience for more able-bodied users.

### 5.3 Accessibility, Uniformity, and Movement

This appliance suite includes appliance configurations that share basic box/shell construction, door fronts, and hardware but includes unique features that promote access, readability and usability. The goal in form generation was to establish a unified appearance with consistency of handles, knobs, controls and similarity in behavior of moving parts. This unified approach not only helps to establish a consistency in the brand image, but

greatly simplifies effort during interaction. In all concepts (Figures 10a-f), the counter line is emphasized through the positioning of appliance doors and features that combine to promote sliding and minimize awkward lifting, bending and reaching.

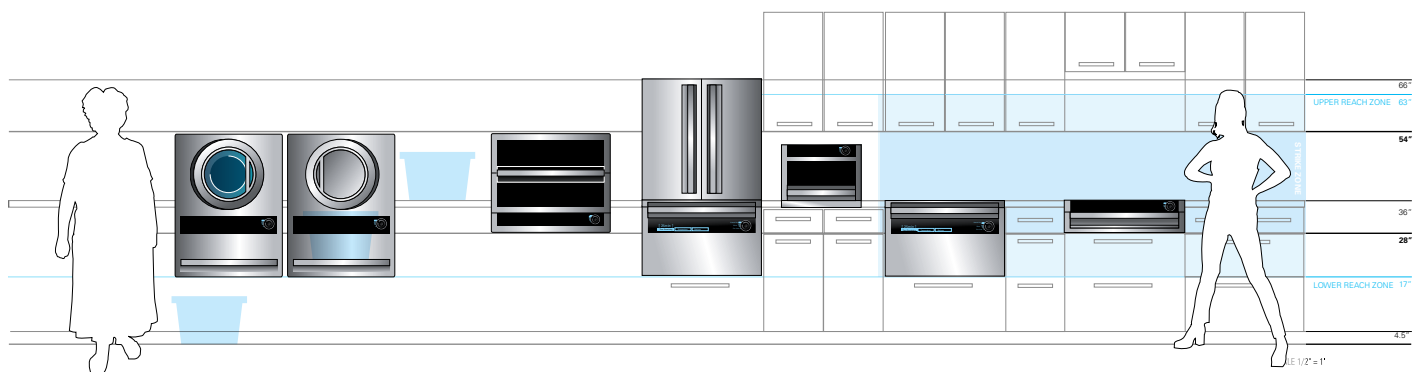


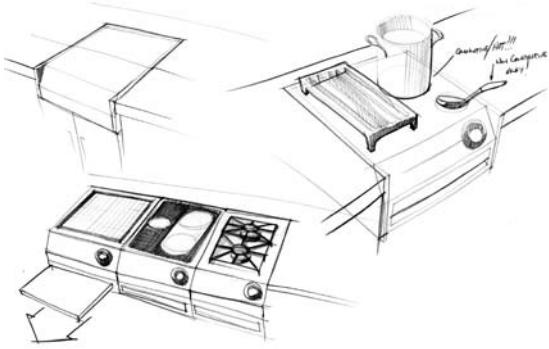
**Fig. 10a** Refrigerator: a counter depth fridge unit above the counter line, and a separate counter line beverage center with lazy Susan turntable storage puts heavy gallons of milk and beverages close to the counter line to limit lifting/carrying distance. The beverage center can convert to cold storage by removing the lazy Susan turntable and can also convert to a freezer unit if desired.



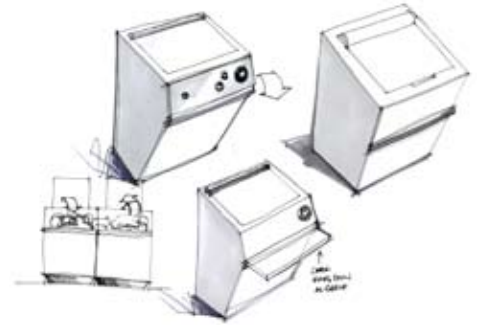
**Fig. 10b** Wall Oven: a split folding door enables hot surfaces to mate and minimize reach-over length. This can reduce accidental burns and would provide a surface at counter line to slide out hot cookware.

**Fig. 9**  
The "strike zone" is a term adapted from the game of baseball which delineates an optimal space for both pitcher and hitter. In the context of a appliance configuration within the kitchen, the "strike zone" defines an optimal vertical workspace to place most activity and interaction within a range that limits excessive bending and reaching for most adults

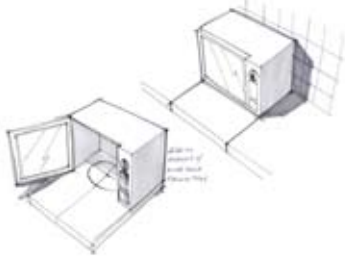




**Fig. 10c** Cook Top: a flexible system that enables multiple configurations of induction, electric and gas units. These units would be located flush to counter surface to enable a user to slide pots off the cooking surface to the counter thereby eliminating excessive reaching and lifting of heavy, hot cookware.



**Fig. 10f** Laundry: 30" wide units at counter depth with wide diameter shallow drums to promote easy reach and access through larger front-loading doors. Configured to break the counter line to place doors at optimal height to limit bending and stooping.



**Fig. 10d** Microwave: a slide-in unit into the counter surface where the turntable is at counter line enabling arthritic hands to slide hot dishes and liquids safely from within the microwave to the counter surface.



**Fig. 10e** Dishwasher: a 19" tall x 30" wide under counter pullout drawer, with lazy Susan style turntable dish rack and counter level hide-away lid. All dishes are accessible through the top lid or the drawer can be pulled out a few inches to gain further access.

### 5.4 Visual Language, Not Styling

Developing a system of visual language, rather than styling, shifted thinking to the design of product experiences [6]. This required an understanding of how appliances are understood and used by a particular group, to address their unique and specific abilities, and to create appliance forms that resonated with them on a more visceral and intuitive level. The approach was to design clean-lined appliance faces with large digital information displays. Simplicity of appearance and interaction drove the form development so that the visual presence of each appliance expressed its functionality through the configuration of elements and the careful organization of touch points. The large flat panel display incorporates a physical knob with touch screen digital interaction. The rectangular proportions enable digital information to be displayed in a linear and sequential visual organization to create a visual narrative or pictographic story. The simple graphic language in conjunction with the simple product form give a "quiet" presence to each appliance and enable users to focus attention on the active interfaces and their own activities. Using the "quiet" geometric product form as the ground to situate the dynamic interface proved important in focusing attention during interaction and building in subtle behaviors of visual elements to encourage readability and user competency. This approach seemed to be in direct conflict with contemporary industry practice.

### 5.5 Design Advantages

While the designers and researchers used designer terminology like "narrative interfaces", "decision points" and "experience", participants responded in direct language that the concepts exceeded their expectations for home appliances. The following four areas summarize the design concept based on user feedback and participant survey: *Performance*: Cooking, cleaning and storage tasks for the user are improved through this specific appliance suite configuration. By locating the primary activity areas at the counter line (strike zone concept), users can experience more efficient performance with minimized bending and stooping and may use the counter top as an integral part of their working process. *Comfort*:

Larger, integrated grips and handles promote access and control for hands with limited dexterity. The handles are integrated into the door face of each appliance so that bar ends do not protrude into the walk areas and pose no risk for bumping or snagging loose clothes. *Ease of Use*: Larger openings, the ability to slide cookware across surfaces onto the countertop; the strategic location of physical activity at the counter line provide for a more beneficial scenario for elders (and everybody) where bending and stooping are reduced and awkward lifting of heavy or dangerously hot objects is minimized. *Safety*: Large integrated handles at counter line can double as grips and rails if vestibular senses fail. Visual information displays show the complete cooking/cleaning process at a glance to enable the user to know where they stand in relation to the whole process. Visual and auditory alerts become prominently displayed as “narratives” on the large information panels. *Access*: Uniquely articulating doors and drawers as described above promote access to heavy, awkward objects.

## 6.0 Conclusions and Key Findings

Shifting the emphasis to create experiences rather than products implies a fundamental shift of thinking to “appliances as service providers” within an experiential corporate brand. The meta-level experience created through product interaction can be enriched with a flexible model that looks beyond the immediacy of products and consumers and strives to position the brand in such a way that the appliance becomes the mechanism through which the brand experience is delivered locally; realizing that an interaction with an appliance is really an interaction with an appliance company and a physical manifestation of the brand identity, values, and character. Furthermore, a shift must occur in design approach from appearance and functionality to usability, universal/inclusive design, and transparency of technology. This methodology must involve a shift from designing a single product to designing product families where each member shares common characteristics and interaction styles. This platform approach can make the products easier to use as similarities of interaction can promote competency, especially for elders. Moreover, a family of products creates a stronger market presence and more unified brand identity.

The concept of user-orienting products acknowledges that people are inclined to make mistakes and that designing a fool-proof appliance may misplace emphasis on technology or functionality. Usability can be promoted by providing alternative scenarios or paths through interaction where user mistakes can become learning opportunities. In this regard, how easy it is to remember what to do and when to do it, most impacts functionality. Experiences that are memorable tend to be easier to repeat, perhaps another way to promote competency in elders. These experiences also tend to reduce errors as well as raise confidence and satisfaction for the user. Easy error recovery is another consideration that can increase competency and decrease fear and frustration when errors do occur. Easily recovered errors are those that do not end the experience, do not require it to restart from some prior point, nor require previously finished work to be redone. Thus, enabling an elder to make a mistake and get back on track quickly can promote success. Perhaps the roadblock to people being successful in any appliance experience is not that they do not understand how to navigate through the entire episode of interaction, but rather they do not understand what to expect from it or why it might be valuable to them; that is, the macro view. Therefore, the product form and interface configuration becomes an obvious intermediary step in connecting the user with the greater system and sets the primary boundaries for the experience to occur.

Designing visual language, rather than styling, shifts thinking to the creation of optimal experiences of use through the design of product form and interaction. This implies a change of thinking from designing appliances to designing how appliances are understood and used by a particular group. Again, the product identity is the conduit through which an experience can be conducted; not the absolute focus of the experience. For an elder, expressive form language of a product can promote clear focus on activity, working process, and decision points, rather than being purely aesthetic and potentially distracting. Through a focus on inclusive usability or designing universal experiences, product forms can become evocative and evolutionary artifacts that play important roles in shaping people’s lives.

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# Videotaped Activity Scenarios: A new way of evaluating design

## Abstract

One problem faced by designers is how to communicate the concept of a new artefact or product to the ordinary citizen. Our research has demonstrated that Videotaped Activity Scenarios (VASc) can be scripted from interviews or detailed discussions and used very effectively to promote focussed discussion. This method reveals user attitudes, experiences, ideas and opinions about a particular product and can help in the design process. This paper documents the development and use of the VASc method.

## Keywords

Design process, Videotaped Activity Scenarios, Activity Theory

## 1 Introduction

One problem designers often face is how to communicate the concept of a new artefact, product or service to the ordinary citizen or understand problems users have. We need to acknowledge one issue is that real life interactions take place in situated context not in laboratories [1]; therefore it seems apparent when considering design an approach is needed that puts this context at the heart of the design process. This paper describes and documents the development of a tool i.e. Videotaped Activity Scenarios (VASc's) that places the user at the heart of the process rather than solely as phenomena against which artefacts and products are evaluated. We developed

this approach in 2003 as an evaluation tool for existing public-space technologies. Over the past few years other researchers have adopted similar approaches to inform the early stages of design [e.g. 2].

We have now successfully applied the VASc method to two large research projects. One investigating attitudes towards the use of automated teller machines (ATMs) in public spaces and the other to an ESRC E-society project related to trust, privacy and identity permissions for ambient intelligence. The use of scenarios in both projects proved valuable in generating design requirements for existing as well as future systems.

### 1.1 Background

Scenarios have been used in various research areas since the 1980's e.g. Design, Human-computer interaction (HCI). Burt & van der Heijden [3] state scenarios help us perceive reality as they use actual contextual information. Different methods can be used such as storyboards, video and other media to develop and discuss scenarios. This in turn through focused discussion provides rich descriptions of activities a user might employ while undertaking a particular task in context [4]. Videotaped scenarios have been used by several researchers in the HCI community [5, 6]. Generally users are videotaped using a device or system and designers or researchers watch the video and discuss any problems, issues or implications for future design. According to [6] videos are powerful tools that

can be used throughout the design process from initial observation of users to system evaluation. However, can such tools be as potent when trying understanding existing problems for users or to portray new products and ideas?

Designers need to observe and understand how people interact and use products but often this creates bias or is not ethically possible. In certain contexts video recording an individual using a computer in the workplace may be acceptable. However, there exist several ethical concerns over video use in other areas [7]. Ethical issues in research need careful consideration in particular when dealing with behaviours that generally are considered a very private and personal activity. For example, trying to capture a detailed and unbiased interaction between individual's and different technologies used in public places is difficult. Ethically we cannot videotape this interaction without the individual's knowledge nor make assumptions regarding any details pertaining to it. Asking someone to be videotaped may cause embarrassment or bias in how they react. To fully understand any interaction a detailed account is needed that includes a rich contextual description of internal and external influences on behaviour.

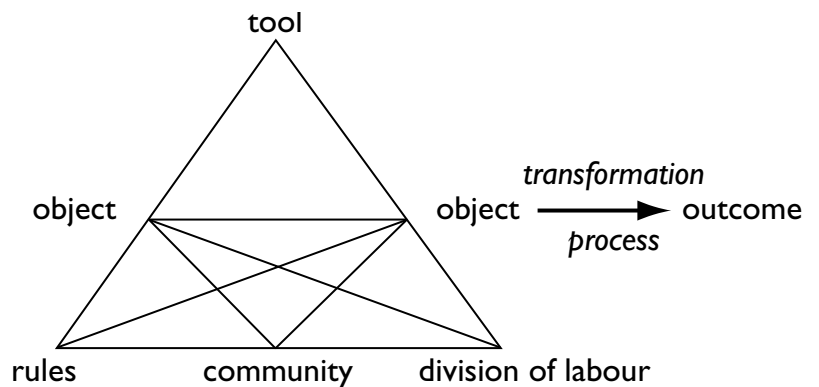
## 1.2 Activity theory

A conceptual framework that incorporates the importance of internal and external influences on human behaviour is 'Activity Theory' (AT). To date AT has been applied to various research areas e.g. use of technology in higher education [8]; work practises [9]; alarm telephone adoption [10].

A core theme in AT is that an individual's actions are rooted in their socio-cultural context and therefore cannot be understood independently of it [11]. A central concept in AT is that an individual's internal activities (thoughts, emotions) and external activities (interaction with others or artefacts) can influence an individual's behaviour or their behavioural intention. The importance of internal/external processes in AT highlights the dual nature of human activity and that no boundaries exist between the two. One cannot fully understand internal activities without considering external activities. AT considers that when an individual undertakes any form of activity, their behaviour is not just a simple reaction to surrounding factors that may influence it but is part of a

whole mediation process that includes tools, rules and structure. All components within the system dynamically and continuously interact with other components, thus AT considers all of the components in an activity system not separately but in terms of the dynamic whole.

Vygotsky [12] stated human interactions with their environment are mediated by the use of tools and signs. He proposed a basic mediation process: subject  $\rightarrow$  tool  $\rightarrow$  object. Engeström [13, 14, 15] expanded Vygotsky's activity system to include all mediating artefacts that may influence an individual's activity, in particular the use of technology. The elements in the system illustrate the socially distributed nature of human activity. Figure 1 illustrates Engeström's model of human activity.



**Figure 1** Engeström's Activity System Model [14]

The central theme in Engeström's activity system is the idea of contradictions or tensions that exist between or within the elements. In Engeström's model three mutual relationships exist subject, object and community. Subject and object are mediated by tools, subject and community are mediated by rules, subject and community are mediated by the division of labour. The subject is the person carrying out the activity, and the object is the target of the activity. The community refers to the immediate environment, other users and people in that particular vicinity. A tool can be anything that is used in the transformation process. Rules refer to the implicit/explicit norms and social convention within that particular community. The division of labour refers to implicit/explicit organisations, management's etc. associated with the system. All elements can influence the transformation process of the object into the outcome.



### 1.3 Videotaped scenarios and AT

When analysing scenarios using an AT approach breakdowns or focus shifts are highlighted within the activity system and consideration is given to aspects of the activity such as what the user was doing and why [5]. The central process in activity theory is to break down the data that has been obtained from the research, conceptualise it, resemble the data and look for contradictions or problems between the elements or mediating artefacts in the activity system. Finding contradictions generates the influences the different elements have on each other and therefore the user and their goal. Breakdowns arise if artefacts or systems behave in a different way other than expected e.g. a computer crashes. Focus shifts are shifts in attention on to something else e.g. a friend walks through the door while you are using a computer. Mackay, et al., [6] videotaped expert users at work and used the videotapes in focussed discussion with designers providing evidence that video recordings of users can affect the re-design process of a graphical editor. However, the majority of work related to videotaped scenarios focuses on existing products, populations that are easy accessible, where no ethical constraints emerge and evaluation tends to be by designers or researchers with little or no input from the end user. We have developed VASc, a method and tool that includes the actual user in several stages of the evaluation process. VASc's are a very effective, practical and convenient tool for use with discussion groups. The method is also very effective in the elicitation of social rules and user attitudes [16].

### 2. VASc Development

Two main approaches are used in the development of VASc: one for existing products and the other for emerging.

For use with existing products in-depth interviews are used with participants who are aware of the product or experienced users. Participants are asked to recall and fully describe two scenarios related to the last time they used the product and another time that was different to the first description. Participants are asked to include in their descriptions when the activity took place, where, why, what happened and where they were going/doing afterwards. Asking participants to give a detailed account of their activity helps build a conceptual description for each individual activity rich in emotional detail. An

interview guide is used and relates to concepts from the activity theory checklist proposed by [5]. The checklist involves concepts such as what, where, how, why (see Table 1).

Artefact Class	Example of Characteristic
What	What did you do to achieve your goal?
Why	Why did you use that particular product? Why did you need too?
How	How did you carry out the activity?
Where	Where did this happen e.g. location?
When	When was that e.g. day, time?

**Table 1** AT checklist related used in interviews

The interviews are transcribed and read and analysed using Engeström's framework of human activity. Using Engeström's framework to interpret the data gives a full description of how contextual constraints influence product use. This in turn highlights how the user is affected by both internal and external factors.

From the original interview and the AT analysis a VASc can be developed that portray different context, issues, advantages and disadvantages of the user. Actors are employed and need to read the initial interviews, consider the activity system and talk to the research team so they can conceptualise the full activity and all contextual information. Actors then act out in context the different types of activity taking place.

A slightly different approach is used for emerging or future products. Instead, stakeholders are interviewed and asked to contribute in the development of a detailed set of scenarios illustrating the ways the product might be used in the future. Stakeholders include relevant user groups, researchers, developers, businesses and government departments with an interest in the development of the product.

The elicited scenarios are then given to a writer to produce detailed scripts for all scenarios. The elicited scenarios are scripted, acted out in context and the scenes videotaped to develop VASc. The production is overseen by both the producer and the research team to ensure correct interpretation.



**Figure 2** Example of script from a VASc

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"A TRIP TO THE HOSPITAL"

FADE IN:

INT.OFFICE - DAY

Bob is sitting at his desk surrounded by paperwork. He's
wearing earphones and talking on his Personal Digital
Assistant

                BOB
So you think planning permission
will be granted unless I get this
report in.
                (pause)
Ok, when do you need it by? A week
on Monday? Will do.

He puts the phone down and enters his deadline in the PDA

                (VOICEOVER)
Bob uses a Personal Digital
Assistant, or PDA, as a cellphone,
diary, note taker and for various
other purposes. The PDA can
communicate with Bob through text
message, a beeper or even voice
message to alert him to urgent
information, deadlines or
appointments for example.

He puts the PDA down and re-orders some papers on his desk
while he is doing this the PDA beeps, Bob glances at the
reader and starts to prepare to leave

                (VOICEOVER)
With a PDA he need never miss a
lunch appointment again. He
doesn't even need to tell people
where he's gone as they can track
him through the device. The PDA
will even take account of his
location and automatically switch
to vibrate mode if it needs to
communicate with him and he is in
a theatre or cinema

                CUT TO:

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## 2.1 Focus groups and VASc

Participants from the target population are invited to take part in a focus group session. At the beginning of each group session the moderator gives an explanation and description of the product. After the initial introduction the first videotaped scenario is shown. Immediately after watching the scenario each group is asked if they thought there were any issues, problems, advantages or disadvantages they could envisage if they were using that product. The same procedure is used for any other videotaped scenario shown to the group. Once all videos have been viewed an overall discussion takes place and participants are asked to generate a set of rules that could be related to the use and design of the product. Groups are asked to pretend they are designers and needed to develop a set of rules to reduce or eliminate the problems they have highlighted within their discussions. They are asked to consider the environment, the user, the product, the task and other people whom maybe around at the time.

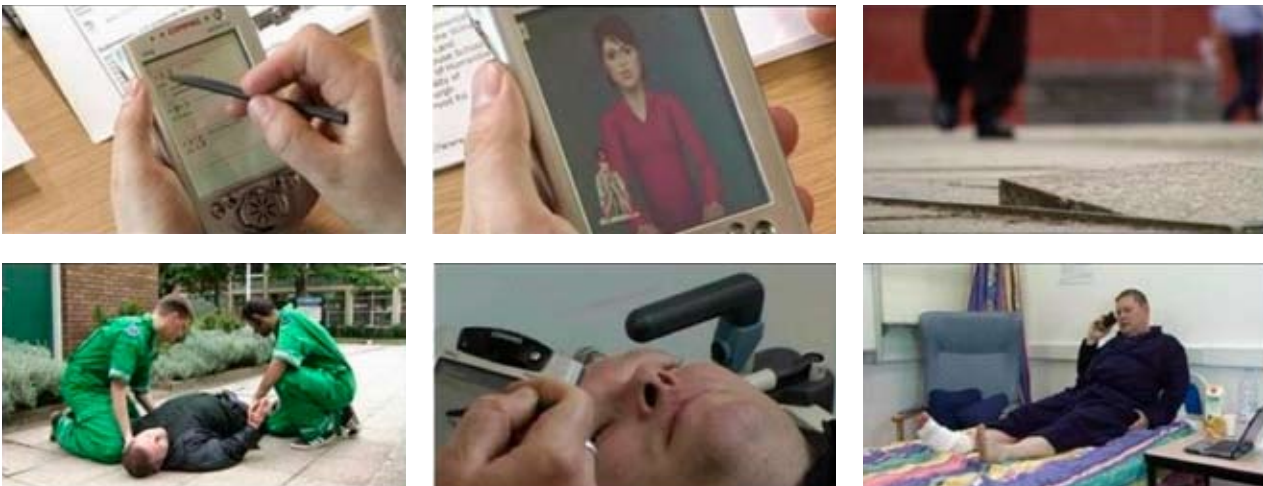
## 3. Discussion

The novel methodology described in this paper has shown that VASc can be scripted from interviews or detailed scripts and be used very effectively to promote focused discussion around the topic of interest at very little cost. The method itself is very useful in generating group discussions which are richly detailed and tightly focused around the key areas of interest. After watching the videos groups can be asked to generate a set of rules that they consider important related to the design of the product. The rule discussion can lead to ideas in fixing

current problems that exist for users or future users of the product. For example in our research into ATM use many different rules were discussed for example the introduction of 'cash only ATMs' thus helping to alleviate the problems associated with queuing and perceived time pressures. The rules generated showed how design and placement of ATMs requires careful consideration so that the problems for users can be reduced if not eliminated.

Although feelings and emotions from the original interviews and discussions with stakeholders cannot be portrayed on screen in our research we found it was easy for the groups to discuss such issues by reflecting on their own experiences and concerns. After watching the VASc's groups also had a wider discussion about context, culture and temporal effects.

**Figure 3** Screen shots taken from a VASc



We believe VASc's are a valuable tool that can be used to promote discussion with experienced, non-experienced or potential users to generate a rich pool of problems, issues, concerns, advantages and disadvantages that exist in different real world contexts. This method is effective for the study of existing, as well as those artefacts, products or services in early development or future systems. The method can be used successfully as a verification tool for previous qualitative research. This is a very important aspect as qualitative research can suffer from poor interpretation and lack reliability.

In conclusion, this paper has discussed how VASc's can be used to verify and develop an understanding of problems inherent in the design and research process. Our findings highlight context plays a major role in product use and must be included in the design process to be able to fully understand user interaction with products and services.

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# Product Character: A Semantic Differential Analysis of Automobile Design

## **Abstract**

This study aims at visual evaluation of automobile design through semantic interpretation. From a linguistic point of view, usage of adjectives was considered to attribute characteristics to product form and particular design elements. A semantic differential survey was conducted with 62 participants who rated four representative cars by using 15 adjective scales. The aim was to gain information about product character which is embodied by form language and which may match the user's identity, independently of the brand or cultural identities. Useful information was found to compare the user perception with the characteristics of cars that were intended by designers or manufacturers. Quantitative data was extracted from the adjective scales used in the questionnaire and statistically analysed. Data was used to draw charts for the semantic interpretation with respect to gender differences. Significant findings on adjective scales were interpreted and attributions of characteristics to design elements were discussed. The representative cars in the same category were comparatively illustrated due to their different characters. The results not only clarified the resemblances and differences in user perception between genders but also verified that impressions can be conveyed to users through particular design elements constructing the form language.

## **Keywords**

Product Character, Semantic Differential, Automobile Design

## **1 Introduction**

User satisfaction is the major determinant in design strategies of today's markets. Beyond modernist mottos, current products are appraised in a larger context to the extent that social, environmental and technological values adds to creativity, production and marketing [1]. As the abundance of products grows in markets, the challenge seems to be differentiating similar products [2] whilst symbolic meaning is a way to differentiate products.

According to Holt et al. [3], satisfying user needs depend on the proper values that users appreciate. These values are affective values pertaining to emotions stirred by the use of product, symbolic values referring to self-image and status which the product holds for user, and finally character values relating to the personality of the product. Dittmarr [4] suggests that products carry two different kinds of symbolism. The first one is self-expressive which relies on the user's identity and second is categorical as an expression of group membership, social position or status. As another type of symbolism, Krippendorff [5] indicates brands and corporate identities which do not emerge from individuals but from producers, corporations, etc. and also depend on the loyalties of consumers.

Since studies on the subject of identities in social and cultural aspects were started by Veblen [6] or Levy [7], they have been profoundly kept by Barthes [8], Baudrillard [9] and others. This study is aimed to involve with neither brand and corporate identities nor group membership that constitutes social or cultural identities. Instead of such an extent, the study is intended to be a semantic inquiry towards individual identities. Previous studies by Jordan [10], [11], Govers, Mugge [12] and Govers, Schoormans [2] revealed that consumers can perceive product identities or, in other words, personalities which are independent of brand or cultural identities. According to Govers and Schoormans [2], consumers in sophisticated markets want to express their own individuality so “desire products and brands that fit with their unique individual style and preference.” Here, the nature of the product itself is the point because it is as important to the self-concept of the consumer as the personality of the brand [2].

Jordan [13] indicates a hierarchy of consumer needs as functionality, usability and later pleasure. Further, products must mean to users more than mere tools as *‘living objects’* that users can attach besides their functional properties. In this manner, Karjalainen [14] states that products are perceived as having a character, in a metaphorical sense, with a relation to the social and self-expressive aspects. This character is said to be a constitution of characteristics which can be attributed to product appearance. In other words, products, metaphorically, speak to consumers by using the ‘form language’ [15] as cited study suggests a style profile consisting of a set of polar adjective scales, being parallel to Osgood’s semantic differential method [16]. Within this profile, stylistic attributes corresponds to given values on the scales and can be grouped into six categories. These categories are said to be form elements, joining relationships, detail treatments, materials, colour treatments and textures. Obviously, using semantic scales is a useful way of measuring attributions to product appearance. Adjectives are the ways how people interpret product characteristics. Products endure with usage of the language by which people always judge the qualities.

Probably, the outstanding industry in which symbolism plays a major role is the automobile industry [17]. Heskett [18] indicates the classic example of our age as automobile that combines both utility and significance.

Besides carrying people and luggage, automobiles are said to be extensions of ego and personal lifestyle. So the purpose of the current study is to gain information about product character which may match the user’s identity and which is embodied by the form language in automobile design. By using this language, designers can communicate to users. The results of a study [19] suggests that designers can create a product personality that consumers understand. Therefore, this study also aims at extracting information about the overlaps between the user perception and personality characteristics that are intended by designers or manufacturers.

The following study is short version of the semantic research that constitutes two chapters of the Msc. thesis named “Product Character: A Semantic Analysis on Visual Evaluation of Automobile Design” which was formed in Istanbul Technical University in June 2007.

## 2 Method

Having reviewed the literature on product appearance relating to dimensions of aesthetics, semantics and symbolism, a semantic differential survey was conducted by the author. Osgood’s semantic differential was chosen as the method because of its effective and time saving implementation. Survey had been prepared with the photographs of four representative cars and a table of descriptive adjective scales. It was intended to collect data through representations of selective automobiles and then extracted data was evaluated to compare the perception of participants with the intended characteristics of representative cars. The questionnaire was considered as a pleasurable form which can be enjoyed by the automobile enthusiasts and can be easily filled by marking the scales.

### 2.1 Stimuli

According to Osgood et al. [16: 76], the concepts and scales used in a particular study depend on the purpose of the study. Here, the term “*concept*” is used in a general sense referring to stimuli. Thus, the stimuli are determined by “*good judgment*” as Osgood et al. [16: 77] suggests the investigator “try to select concepts for the meanings of which he can expect considerable individual differences, since this is likely to augment the amount of information gained from a limited number of concepts.”

As the aim is to compare the output of survey with the characters of representative cars, the stimuli were

searched by assessing the characteristics of cars which were said to be intended during the design process. These characteristics are generally stated through the manufacturer's own channels such as official websites and announced by designers or judged by stakeholders through the media. At the end of the searching period, four cars were determined because of their distinctive design elements as noticeable characteristics. For the appropriateness of the visual evaluation, the cars were especially selected within the same category. Each of them can be regarded as MPV (Multi Purpose Vehicle) that describes a class of family cars. 3 of them are all new models that are difficult to be familiar in Turkey and last one is a concept car that is unknown in the market. Because unfamiliarity is critical to assess the stimuli without prejudgments. These representative cars are as follows:

Seat Altea represents the new generation of Seat's automobile design. It is said to be the stylish design which offers both performance and safety [20]. Thus, the form of the car may be seen as a reflection of the promised agility and power. It has longitudinal pointed head-lights from which the dynamically flowing side-lines stems and extends to the back wings. The side-line is a distinctive element which, as it is said, flows like water across the car and so embodies a dynamic look. The unobtrusive wipers are subtle details which supports the compact nature of the car. "Altea was conceived as a harmony between aggressive, flamboyant styling and intelligent, innovative use of space" [20]. Altea XL is the larger version of Altea with an extra 18.7 cm of length and 123 litres of space that yields a bigger boot. Its dimensions are 4.47 m length, 1.77 m width and 1.58 m height. It is acute to assess Altea XL as compact family car with a distinctive sporty character. Seat Altea XL was officially announced in 2006 Paris Motor Show and has been on the market since January 2007 but not in Turkey. "The XL certainly catches the eye, with distinctive slashing crease lines that run across the full length of the vehicle, plus the shark eyes of the front headlights and a tight, curvy rear end." [21]

Mercedes B-class is introduced as an extra-ordinary car in the manufacturer's website and it is added that "the longer you look, the more your fascination grows" as to be appreciated because of the blend of contemporary design and traditional Mercedes-Benz values [22]. Mercedes B-class is said to have an aggressively styled bonnet, a

striking rear, a wide wheelbase and sculptured wings all of which add up to sporty and dynamic whole [23]. In addition to all these favoured elements, it has also a significant side line which starts from the front wings, passes along the doors and ends up complementing the rear lights. It is declared to be a versatile compact car with improved safety because of its higher sitting position and large panoramic windows that enhances all-around visibility. Its dimensions are 4.27 m length, 1.77 m width and 1.6 m height. Mercedes B 150 has been on the market of Turkey since 2006 but it can rarely be seen on the roads because of its high price.

Citroen C4 Picasso is the latest model that was presented in the class of compact MPV's. It was officially unveiled on January 5, 2007 and has not been on the market of Turkey. As its unique style is easily differentiated in the category, Gibson [21] claims that C4 Picasso is "without doubt the best-looking people carrier on the road." The unusual wide-angle windscreen and unprecedented slim A-pillars expands the visibility exceptionally at the front of the car. Large side windows and sunroof add up to the visibility to the extent that C4 Picasso ensures the largest glazed area (6.2 m<sup>2</sup>) in its class. So the cabin is airy and has an outstanding panoramic view. In addition to this airy effect, its dimensions (4.47 m length, 1.83 m wide and 1.66 m height) yields the widest elbow room and considerable spacious interior. As well as its front design, the manufacturer indicates its dynamic and bold rear design because of the distinctively shaped lights which are split between the body and the sloping tailgate. This bold personality is said to emerge from the dynamic front bumper and oversized air intakes covered in racing-style black mesh. It may also include chrome-stripped fog lamps, depending on the model. In the manufacturer's website, it is stated that "cleanly drawn body lines create a powerful impression from every angle, the basis of its outstanding aerodynamic performance." [24]

Probably the most interesting one of the selection is Lotus APX which is a concept car by the manufacturer but it is said to be a feasible prototype close to production. The car is a sporty crossover vehicle but with "coupe styling and MPV practicality" so ensures a versatile character in the niche market. As it seems a family car with its seven seats (5+2), extra two seats are in kid's size, it features a V6 engine producing an output of 300 hp and 245 km/h as a powerful sports car. Its body is totally made of aluminum

and is approximately in same size of Citroen C4 Picasso except APX's extra 20 cm in length and width. The chief designer states that third row of seats cause a rather high roofline which is dealt with by adjusting flanks to make the car look low and sporty [25]. The oversized wheels also give a sporty look. "The exterior is stretched seamlessly over the mechanicals, hinting at the power underneath, as a fusion of speed, dynamism and fluidity. The design also exudes those intangible elements of beauty and excitement" [25]. So these intentions produced "the V-shaped lines starting from the bonnet and continuing as two converging curves along the flanks to lighten the volumes." This continuity ends up as V-shaped shield-like tailgate. This shield concept was said to be the result of design team's intention to produce a true sports car, offering high performance and a prestige image, but also a protective environment for the driver and the family [25]. So as this shield motif is clearly visible at both the front and rear, a strong sense of protection was said to be developed around the cabin, with long, dynamic lines and muscular arches [25].

The photographs were obtained to represent cars from 3 different angles as front, rear and side views. The different views were intended to ensure the perception of cars as a whole and help to visualize every characteristic of cars. Photographs had been clarified and converted into grey scale which is preferred to avoid the effect of colour on participant's perception. The brand names and related marks were also erased to avoid the participants' prejudgments about the brand image. Then the photographs were placed to cover one page in the questionnaire. Every page including 3 different views for each stimulus was followed by the table of scales and so 8 pages of questionnaire were established for 4 stimuli. The representative cars; Seat, Mercedes, Citroen, Lotus, in order, were identified with the letters; A, B, C, and D.

## 2.2 Adjective Scales

Osgood et al. [16: 78] indicates the criterion in scale selection as the relevance to the concepts being judged but it is, however, added that irrelevant scales can be used to mask the purpose of a study. Another criterion is described as "semantic stability" of the scales for the concepts and subjects in a particular study. It is exemplified with "high-low" scale that can be expected to be stable across a set of sonar signs but not across a set of social concepts. Additionally, Osgood et al. [16:

79] states that scales should be linear between polar opposites, in other words, bipolar adjectives should be obviously opposite to each other. Thus, the adjective scales were judged and selected by these criteria to be defined by familiar and common opposites.

The survey was prepared with 15 bipolar adjective scales. Adjectives may be factor analyzed within vast amounts of words to extract generic descriptive scales in some studies [16], [26] however, on the basis of prior studies [2], [5], [11], [16], [27], [28], [29], bipolar adjectives scales were selectively determined by assessing their generic descriptions and convenience according to aim of this study. For instance, with regard to effect of "cuteness" in automobile design [30], [31], 'aggressive-friendly' is assisted with 'sober-cheerful' and 'insolent-charming' that replaces "cruel-kind" [27] or "kind-unkind" [11] both of which embraces "serious-minded-light-hearted", "cynical-naive", "violent-gentle" [11], "humorous-serious", "irritating-lovable" [28] or "cold-warm" [2]

Table 1 is arranged as it was used in the questionnaire with corresponding adjective pairs in participants' native language. Each adjective pair was established in a five step-scale middle of which can be considered as "neutral" state. Nearby boxes were rated due to the degree of intensity that was indicated for the participant in the introduction of questionnaire.

**Table 4** Adjective Scales

Slow						Fast
Sober						Cheerful
Weak						Strong
Usual						Unusual
Passive						Active
Deceptive						Honest
Old						New
Boring						Pleasurable
Aggressive						Friendly
Ugly						Beautiful
Cheap						Expensive
Insolent						Charming
Mature						Youthful
Dangerous						Safe
Masculine						Feminine

The adjective pairs were intended to be placed into the table by considering their objectivity and subjectivity because some adjectives are seemingly objective and potentially measurable in quantitative terms [5: 158]. So the table was arranged by regarding to a subjective adjective scale that followed an objective one. Besides, assisting scales were arranged not to be close to each other on the table because assisting scales in nearby rows are supposed to reduce the effective responses. In this manner, 'active-passive', 'aggressive-friendly' and 'insolent-charming' scales were separated on the table. The "sober-cheerful" scale was also separated both from the previous group and from "mature-youthful" scale. The scales of "usual-unusual" and "boring-pleasurable" seem to assist each other so they were separated too.

### 2.3 Participants

The questionnaire was delivered in the participants' native language. A section of questions was placed in order to extract demographic information about participants. These questions are, in order, towards participant's occupation, age, gender, driving licence and automobile if there is one, marital status and number of children if there is any hence the stimuli were representatives of family cars.

The questionnaire was mostly delivered by e-mail to ease the participation and to reach the target group that can be regarded as who have rather interest in cars and who are car users as potential buyers. The e-mail named 'to *automobile enthusiasts*' and included the questionnaire as an attachment. The response address was specified in the last page of questionnaire. A second set of questionnaire was also prepared by replacing the order of stimuli to reduce the order effect [32], [33] but cars A and B were always kept before cars C and D thus the stimuli of second questionnaire was arranged as B, A, D, C. The first two cars were always kept because of their higher possibility of being familiar cars. Thus, more innovative cars, C and D were intended to present a comparison with prior cars to the respondents.

Two sets of questionnaires were delivered through different channels. Intentionally, no questionnaire was sent to designers' mail-lists in order to avoid designers' participation. Hsu et. al. [34] states that "many differences exist between designers' and users' perceptions of the same real objects and their interpretations of the same image-words." For this reason, any participant who were industrial designers or pursued a related degree

had been excluded from the survey. All participants are holding college, university or higher degree of education. Participants with an uncertain occupation and educational degree had been excluded. Two participants who claimed recognition of the brands and a participant who employed by one of the manufacturers had been also excluded.

The amount of responses from female participants was not sufficient so a third set of questionnaire was delivered by hand in the Faculty of Architecture, Istanbul Technical University. 2 male and 10 female participants had filled the questionnaire face-to-face. Positive feedback has been gained from the participants about the unfamiliarity of brands and the enjoyment of survey.

A total of 62 participants comprise 29 females and 33 males between 24-55 years old had been involved in the data analysis. All of them have driving licences and 43 of them have own cars. 31 of them married, 13 of them have one child, 8 of them have 2 children and one participant has 3 children.

Data was extracted from the total of responses (N=62) and statistically analysed. Numerical data was used to analyse correlations between the adjective pairs and to yield the graphical demonstrations for the semantic profiles of stimuli.

In the case of this study, there are 15 adjective pairs which count more than two variables, so correlations between every pair can be arranged into a correlation matrix. As the first step, the correlation analysis was performed for all the participants in the survey and resulted in a general matrix. The strong correlations (correlation coefficient > 0.5) are highlighted according to interpretation of Cohen [35] and these can be regarded as simultaneous correlations that prevails among both genders. Later, a second analysis was performed by separating males and females as it is seen in table 2. If you compare this with the general matrix, simultaneous correlations are highlighted in the lightest tone, characteristic correlations are highlighted in grey and discrepancies are highlighted in dark grey. Characteristic correlations only appeared strongly due to gender difference and they are weak (below 0.5) in the general matrix. On the other hand, discrepancies indicate weakness in some correlations whereas total correlation coefficient is above 0.5 for the same adjective scales in the general matrix.

**Table 2** Correlation Matrix According to Gender

	adj1	adj2	adj3	adj4	adj5	adj6	adj7	adj8	adj9	adj10	adj11	adj12	adj13	adj14	adj15
F adj1	1														
E adj2	,070	1													
M adj3	,570	,010	1												
A adj4	,488	,223	,374	1											
L adj5	,568	,209	,481	,530	1										
E adj6	-,065	,214	,197	-,036	,079	1									
adj7	,415	,250	,300	,509	,411	,150	1								
adj8	,352	,375	,344	,466	,530	,250	,511	1							
adj9	-,208	,304	-,016	,073	,018	,557	,119	,303	1						
adj10	,203	,319	,341	,309	,367	,475	,321	,698	,511	1					
adj11	,640	,045	,526	,510	,456	-,013	,527	,438	-,080	,357	1				
adj12	-,184	,486	-,109	,002	,025	,552	,057	,277	,716	,497	-,074	1			
adj13	,166	,448	,137	,453	,421	-,032	,464	,493	,183	,362	,254	,233	1		
adj14	-,046	,166	,289	-,042	-,004	,563	,102	,110	,464	,328	,157	,435	-,017	1	
adj15	-,339	,316	-,281	-,044	-,208	,344	-,001	,187	,478	,280	-,170	,476	,062	,213	1
M adj1	1														
A adj2	-,155	1													
L adj3	,618	-,239	1												
E adj4	,513	-,138	,550	1											
adj5	,640	-,219	,655	,692	1										
adj6	,059	,016	,229	,171	,133	1									
adj7	,481	-,081	,425	,639	,551	,164	1								
adj8	,431	,003	,451	,520	,588	,259	,536	1							
adj9	-,356	,150	-,416	-,210	-,372	,133	-,151	-,143	1						
adj10	,374	-,077	,458	,399	,466	,313	,494	,595	,015	1					
adj11	,406	-,122	,510	,575	,505	,032	,382	,314	-,101	,373	1				
adj12	-,217	,230	-,183	-,222	-,315	,283	-,016	,031	,538	,149	-,184	1			
adj13	,334	,069	,106	,205	,327	-,103	,309	,302	-,182	,104	,199	-,085	1		
adj14	-,113	-,233	,123	,103	,033	,383	,029	,031	,068	,190	,018	,121	-,390	1	
adj15	-,511	,317	-,503	-,315	-,510	,087	-,270	-,201	,486	-,256	-,308	,293	-,169	,054	1



**Fig.1** Car A (Seat Altea XL) and semantic profile by genders



On the basis of the general correlation matrix that derives from adjective scales of all the stimuli, there are strong correlations between adj1 (slow-fast), adj3 (weak-strong), adj5 (passive-active) and adj11 (cheap-expensive). These relations are significant as they complement each other. Here “weak-strong” scale must be generally perceived as a representation of automobiles’ powerful disposition to move fast. However adj11 seems generally less strong, female participants had strongly related “cheap-expensive” to “slow-fast” scale. Such a discrepancy also occurs in the relation between adj3 and adj5 that male participants had strongly related “weak-strong” to “passive-active” scale while females did not. Besides, male participants tend to correlate masculinity with the faster, stronger and more active ratings while female do not.

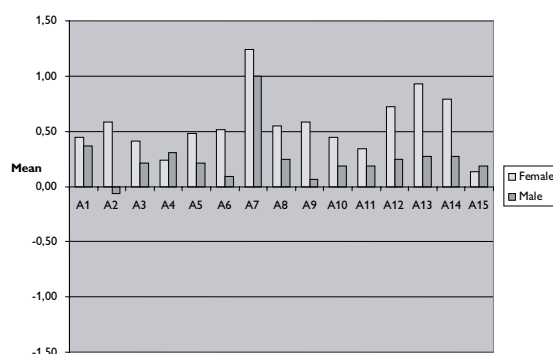
There is no discrepancy relating to adj4 (usual-unusual) as it strongly correlates with “passive-active”, “old-new” and “cheap-expensive”. There is also a strong correlation between “passive-active” and “boring-pleasurable” so “passive-active” was likely to be rated as a general judgment by the participants. Interestingly, adj6 (deceptive-honest) was strongly and positively correlated by only female participants with more friendly, more cheerful and safer ratings on the scales. Inevitably, adj7 (old-new) was related to nearby “boring-pleasurable” scale by both genders but additionally, it was related to “cheap-expensive” scale by only female participants. There exists another strong correlation between adj9 (aggressive-friendly) and adj12 (insolent-charming) whereas there exists significant differences between genders. Female participants were likely to assess the scale as friendly with relation to charming, rather than male participants. On the other hand, females strongly connected being friendly to being beautiful, instead of males. Such a characteristic of correlation was also appeared between beautiful and charming on the scales rated by females.

The aim of correlation analysis is to investigate the interpretation of adjective scales with respect to gender differences. Hence it is critical for visual evaluation of the same stimuli. From this point of view, each stimulus is going to be examined by taking account of gender differences in further sections.

### 3.1 Car A

Seat’s new style of compact form (Fig. 1) seems to be perceived by the viewers according to the analysis of

the responses. Because most rated characteristic was obviously ‘newness’ on the 7th adjective scale. It was strongly rated by both genders (Fig. 2). Its distinctive headlights combining with the flowing side line must have a positive effect on the perception but not the way as it was claimed by the manufacturer. Seat Altea XL is far from appearing as an aggressive and powerful sporty car from a semantic point of view. As it is seen from the analysed survey data, the adjective scales of A1 (fast-slow), A3 (weak-strong), A5 (passive-active) were all lowly rated. Another indicator, A15 (masculine-feminine) which can be considered as a representation of the sporty character, especially, for car design was also rated in the opposite direction. The cause might be the overall body design which tends to be perceived higher and narrower than it is. The bluntly curved rear design of the car contributes to its perceived high body and weakens the dynamic effect of headlights and side lines. This bigger look of the body may be the explanation why the car was lowly rated by male participants and it was positioned close to neutral. The car may be perceived as a family car rather than a sports one. It also received the poorest ratings on the “usual-unusual” scale (A4) from male participants. Due to correlations with all these scales, the car had the lowest rating on the “cheap-expensive” scale (A11).



**Fig. 2** Distribution of Mean Values on Scales for Car A

Although the car has an overall body which looks big and passive, it looks compact and safe. It had received an outstanding rating on the “dangerous-safe” (A14) scale, especially from female participants. Females had assessed the compact body with the highest ratings on “sober-cheerful” (A2) and “insolent-charming” (A12). Females had also considered Seat Altea XL second friendly and youthful car on the scales of “aggressive-friendly” (A9) and “mature-youthful” (A13). In general, females had the impression of a warmer car while males preferred to stay

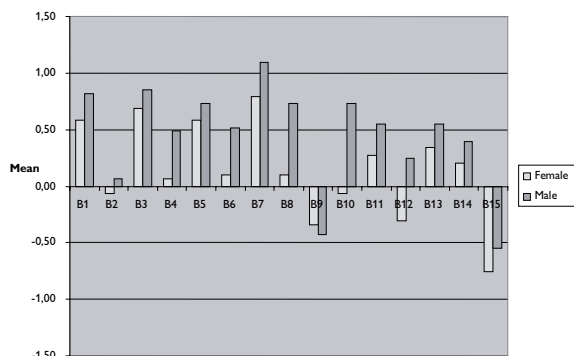
'neutral'. So the car was interpreted with reference to a feminine character on the last scale (A15). This is the major result of soft and curvy transitions through the whole body.

### 3.2 Car B



**Fig. 3** Car B (Mercedes B-Class) and semantic profile by genders

First of all, the sober nature of Car B (Fig. 3) must be pointed out on the “sober-cheerful” scale (B2) in figure 4. All the participants rated the car as the most sober one of the stimuli. Besides, the car relatively tended to be mature on the “mature-youthful” scale (B13) Both of the scales indicate how the participants’ recognition appear evidently parallel to brand manifestation of Mercedes cars. Nonetheless B-Class strongly differs from Mercedes product family that has mostly circular twin head lights in front of a long bonnet. As stated, the car is not an ordinary Mercedes product because of its short bonnet, longitudinal head lights and distinctive side view. For this reason, the car can be regarded as a good example of how strategic communication should be conveyed through semantic interpretation of the gestalt design, not only the distinctive design elements. The statistical result is the evidence of manufacturer’s statement about the car’s contemporary design and traditional Mercedes-Benz values.



**Fig. 4** Distribution of Mean Values on Scales for Car B

A question arises from the recognition of traditional values in order to verify whether it is because of the recognition of the brand image. In addition to personal feedback that the brand recognition is a low probability, the rating on the “cheap-expensive” scale (B11) verifies that recognition may be independent of brand image. Car B was positioned moderately on this scale, not highly as it is on the market. However, the rating on the “usual-unusual” scale is slightly differs from that of Seat Altea (see table 3). This result still keeps in mind the possible familiarity of two cars in the market.

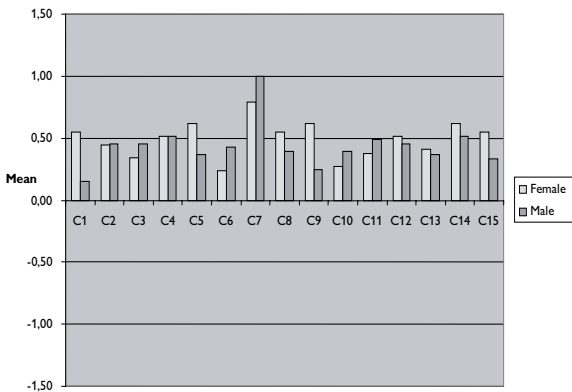
Whether it is independent of brand image or not, the distinctive design elements of car B point to the manufacturer’s statements. The car looks aggressive and sporty because of the intensely sloping side line, carved-look doors and the sculptured wings all of which provides a strong dynamic side view. Thus the car had been rated strongly and positively on the scales of “slow-fast” (B1), “weak-strong” (B2), “passive-active” (B3). Besides, the car was negatively positioned on the scales of “aggressive-friendly” (B9) and “masculine-feminine” (B15). It has a slightly negative rating on the “insolent-charming” scale (B12) although it was relatively perceived as the second insolent car of the stimuli. This scale was oppositely rated between genders as females found the car more insolent. Females also considered the car rather ugly on the related scale (B10). In general, car was likely to appeal to male participants while females negatively appraised several characteristics.

**Fig. 5** Car C (Citroen C4 Picasso) and semantic profile by genders



### 3.3 Car C

Car C (Fig. 5) was perceived to be the most cheerful, most friendly and most feminine car of the stimuli as it positively received the highest ratings on the scales of C2, C9 and C15 (see table 3). Besides, it was positioned as the most charming and safest car on the scales of C12 and C14 but the mean values are slightly different from Seat Altea (see table 3).



**Fig. 6** Distribution of Mean Values on Scales for Car C

The cleanly drawn body lines of Car C were likely to create a strong impression from every angle but not the way manufacturer pointed out its power and aerodynamic performance. What else may be the explanation for why the car was perceived as the slowest one? Car C was lowly rated by the male participants on this scale (C1). (Fig. 6) It was also the second weakest and passive car on the scales of C3 and C5. The reason may be the large glazed area which provides the airy and spacious interior but also entails the fragile look of the entire body. This characteristic is adequate to be considered a total family car. Besides, it is the second unusual car (C4). The car might be perceived to be vulnerable in the context of Turkey. It is difficult to explain why the car is relatively older than others (C7). Females rated the car lower than Seat Altea on this scale as well as on other scales. In comparison with Seat Altea, the ratings of females had generally regressed to neutral while the ratings of males positively diverged. So the car was the only stimulus which was similarly perceived by both genders. From this point of view, Car C is the most convenient car of the stimuli.

### 3.4 Car D

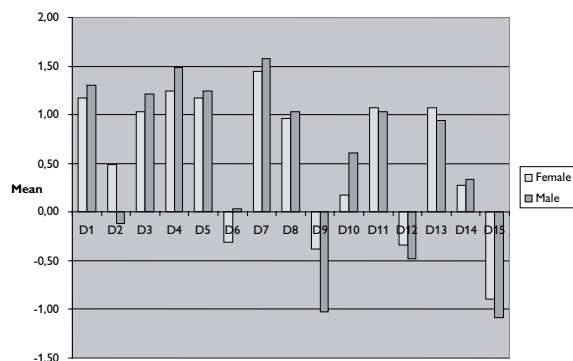
Car D (Fig. 7) was undoubtedly perceived to be the most appealing character of the stimuli, especially, by the male participants. Females had lowly rated the car on the “ugly-

beautiful” scale (D10), however, the car appeared most beautiful with a slight difference in the mean value in table 3. Although aesthetic preference differs between genders, there is consistency on the other scales.



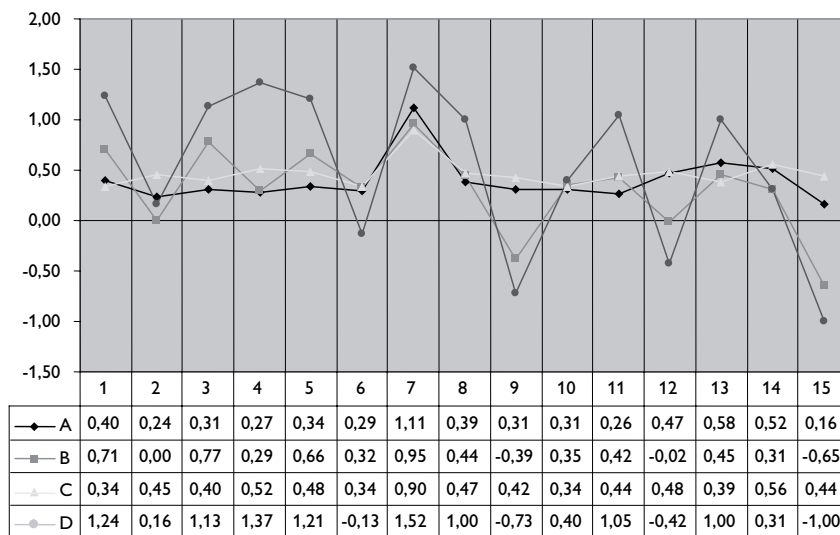
**Fig. 7** Car D (Lotus APX) and semantic profile by genders

Car D was considered fastest, strongest, most unusual, most active, newest, most pleasurable, most expensive and most youthful car of the stimuli. It was negatively rated as the most aggressive, most insolent and most masculine car as well. Interestingly, the car was rated not more than Mercedes B-Class on the “aggressive-friendly” scale (D9) by female participants whereas male participants had strongly rated. (Fig. 8) Additionally, female participants appraised the car as insolent as Mercedes B-Class but both genders had interpreted it as the most masculine car. On the “sober-cheerful” scale (D2), males had found it slightly sober while females had rated as cheerful as Citroen C4 Picasso.



**Fig. 8** Distribution of Mean Values on Scales for Car D

It is obvious that most interesting result appeared on the “deceptive-honest” scale (D6). None but Lotus APX was perceived to be a deceptive car with a negative rating (see table 3). So this result has been raising doubts about the shield motif that had been announced in the name of design team [25]. As stated, the shield concept was intended to produce a sports car offering performance



**Table 3** Mean Values of Adjective Scales for the Stimuli (Car A, B, C and D)

and prestige as well as a strong sense of protection around the cabin. Nonetheless, this statement was not verified according to the statistical result. Lotus APX and Mercedes B-Class received the same lower rating on the “dangerous-safe” scale (D14). Furthermore, it was rated as a slightly deceptive car by receiving the lowest ratings from both genders on the scale. The exaggeration of the shield motif on the tailgate may be the explanation for this result. The shield-shaped tailgate might be interpreted as a fantastical element rather than a sense of protection. So that tailgate is far from convincing the viewer of its protection. From a semiotic point of view, the shield-shaped tailgate is only an iconic sign which can be interpreted without relation to functionality.

Lotus APX seems to attain the designers’ objectives except the shield motif. It was highly rated as the representation of a powerful and exciting sports car as a result of innovation and high quality.

### 3.5 Comparison of the Stimuli

Table 3 comparatively demonstrates the semantic profiles of the stimuli on the basis of mean values. There are several scales on which representative cars were similarly positioned by the participants. On the scales of “slow-fast” (1) and “weak-strong” (3), Car A and Car C were positioned close to each other as feminine cars. On the “usual-unusual” scale (4), Car A and Car B received almost the same value due to the possibility of being familiar on the market. Since “boring-pleasurable” scale strongly and positively correlates with the “ugly-beautiful” scale (10), the representative cars were positioned likewise but Car D is slightly beautiful than others (see table 3). Car B and Car C were rated with an approximate mean value on the “cheap-expensive” scale (11) although Car B is more expensive than Car C on the market. The reason may be the innovative design of Car C in addition to unprecedented design of Car B in Mercedes product family that both of them may result in unfamiliarity with the cars. So the participants may rate the cars with an

approximate value on this scale which is a representation of quality.

Car C received a mean value approximated to that of Car A on the “insolent-cheerful” scale (12). This scale strongly correlates with the “aggressive-friendly” scale (9) so that Car A and Car C are likely to form a style with their feminine characters as seen on the last scale (15). On the contrary, Car B and Car D tend to form an aggressive type in relation with their masculine character. There is almost strong correlation between scales of “aggressive-friendly” (9) and “masculine-feminine” (15). In the same manner, two groupings appear on the “dangerous-safe” scale (14) as the feminine cars were perceived to be safer than the masculine cars.

It is a fact that age groups have to be considered in order to examine user perception. To see the validity of results, the data was controlled with regard to age groups. Participants who are more than 39 years old were excluded from the data analysis and the comparison of cars was renewed. In this condition, 24 males and 26 females between 24-39 years old had been considered and a second graph of comparison was generated. It was seen that comparison also based on similar mean values and the second graph appeared similar to table 3.

### 4 Conclusion

The statistical analysis revealed meaningful information on user perception by examining how both genders had attributed adjective scales to the characteristics of cars. Associations perceived by participants were interpreted by comparing the results with the intended characteristics that had been announced by designers or manufacturers. Results of the survey verified that impressions can be conveyed to users through particular design elements but sometimes not the way designers or manufacturers intend for as it was seen in the case of Car D. However, the associations with Car B can be interpreted as the result from the communication of traditional values that were

embodied on gestalt design rather than design elements through the intention of a brand image.

The comparison of the stimuli clarified that cars can be grouped according to the differences in genders. It is apparent that Car A and Car C were perceived to be feminine while Car B and Car D were the opposite. This result is parallel to the study [36] that also resulted in two main groups as one is associated with speed, movement and agility and the other associates with solidity, safety and reliability. It is obvious that feminine cars (B and D) appeared to be safer and slower than masculine cars (C and D). It is stated that the cars can be female (evoke stereotypes of females) or feminine (associated with use by females), or on the opposite side, male or masculine as a subtle but important distinction in the prior study [36].

It is difficult to handle product character without relation to brand image however this study aimed at visual perception based on the 'form language' emerging from gestalt design as well as particular design elements. Other aspects of user perception are not relevant to the study although they are important in purchase decisions. It is also sensible to differ consumers from users whose perception is more complex. This study aimed to shed light on the communication through product appearance by assuming that vision is dominant in user perception. A drawback is the lack of three-dimensional perception of cars through representations. To stimulate three-dimensional view, representation took place from three different angles as front, side and rear views in the questionnaire. The results were considerable despite the five-step scales, larger scales can be used in order to rate the characteristics intensely.

It is the fact that consumer response to product design has a major role in current design strategies. It is possible to communicate with users through product appearance in order to form the perception for which designers intend. Govers and Schoormans states: "Companies that design product variants according to a pre-determined personality that matches the personality characteristics shared by the members of their target group can create preference." [2]

Based on the the findings of the current study, further research can be conducted with the larger extent of participants. Extracting the relationship between design

elements and user perception will be useful to designers and companies for design strategies. Besides, product character can maintain product attachment [12] or meaningful product relationships [37] for the benefit of sustainable design.

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# Making Strange with the Falling Body in Interactive Technology Design

## Abstract

In this paper we present the beginnings of a methodology of *making strange*, that can support the design of movement-based interaction with video-based motion-sensing technologies. By *making strange*, we mean ways of unsettling habitual perceptions and conceptions of the moving body to arrive at fresh appreciations and perspectives that are anchored in the sensing, feeling, moving body. This approach is demonstrated through a discussion of a study of falling that was conducted with trained dancers and physical performers. Analysis was performed on the raw data from this study from two perspectives – an *experiential perspective* and an *external or machine perspective* – generating a range of different descriptions and representations of the moving body in the act of falling. The results of the study identified potential methods and tools for inclusion in the developing methodology of *making strange*.

## 1 Introduction

“Calling attention to ourselves in movement in this way [by performing free variations on our own habitual movement patterns to appreciate first-hand what is kinetically there], we have the possibility of discovering what is invariantly there in any felt experience of movement. This is because whatever the habitual movement, it now feels strange, even uncomfortable. Just such oddness jars us into an awareness of what we qualitatively marginalize in our habitual ways of doing

things. By *making the familiar strange*, we familiarize ourselves anew with the familiar.”

(p.143, *The Primacy of Movement*, Sheets-Johnstone, 1999 [our emphasis])

This research is founded upon a commitment to designing movement-based interaction from an experience of movement. Movement-based interaction refers to interactions with computing technologies which are based on the moving body as the source of input. It is an emerging subfield within the field of interaction design (eg. [1], [2]). In this research we are working with the moving body in interactive spaces built on video-based motion-sensing technologies. This commitment signals a methodological shift in perspective for designers, such that one of their fundamental activities is cultivating a *bodily* awareness of the forms, processes and qualities of movement being considered for design. It stems from a phenomenologically-inspired inquiry into the moving body, where we investigate our own experiences of movement, together with the experiences of others. In the manner of von Helmholtz, we become ‘laboratories unto ourselves’ [3].

A starting point for this kind of inquiry into the moving body can be taken from the notion of “making the familiar strange”, as described by the phenomenologist, Sheets-Johnstone, in the quote above [3]. Through varying our normal movement patterns and processes we can unsettle

our habitual perceptions of the world and ourselves. One way of reacquainting ourselves with familiar or habitual movements is to do a familiar movement differently, to perform the movement with a range of kinetic variations, and so reveal the specific felt quality of the original movement. As Sheets-Johnstone [3] describes with the act of walking, “Changing not only our leg swings, for instance, by initiating movement from our ankle joints by a spring action rather than from our hip joints, but changing our arm swing, the curvature of our spine, the cadence of our walk, the amplitude of our step, and so on.” Similarly, performing a movement outside of our everyday realm, such as learning a new physical skill or performing an unfamiliar movement, such as falling, can also bring us into a fresh encounter with our movement possibilities and break us out of habitual ways of thinking about movement.

In the context of design of movement-based interaction, this *unsettling or making strange* through the moving body serves the purpose of breaking out of old patterns of perception to arrive at fresh appreciations and perspectives for design that are anchored in the sensing, feeling and moving body. Creative thinking in design requires an overturning of our habitual perceptions and conceptions of things, or in this case, of the sensing, feeling and moving body. Edward de Bono [4] advocates a similar approach with his set of thinking tools that aim to counteract the natural tendency of the mind to operate within engrained patterns of perception. This is not new and is an established principle in arts and design practices. For example, turning a picture upside-down interrupts our habitual patterns of perception and allows us to see the composition from a new perspective [5]. Alternatively, we could turn our body upside-down to gain a similar, yet different, change in perspective! In a similar vein, Bell et al. [6] employ a method of making strange, or *defamiliarising*, understandings of the home in the design of domestic technologies. They use ethnographic techniques, in order to call into question our usual interpretations of everyday objects.

In this paper we present the beginnings of a methodology, for designers of movement-based interaction, that embraces this principle of making strange. It is a methodology that seeks to design *for* and *from* the sensing, feeling, moving body. To this end, it is characterized by two fundamental needs. The first is ways of accessing the experiential nature of the moving body, that are rooted in

our own bodily knowing, and/or the lived experience of other moving bodies. The second is the production and use of descriptions and representations of the moving body that enable design work to be done.

Other researchers have developed a variety of different approaches to designing for and from the moving body. There is a growing commitment amongst these researchers to grounding understandings of their design domain in their own experiences as sensing, feeling and moving beings through approaches including: the use of acting out and physical gestures by designers to analyse and convey findings, and to gain a bodily understanding of such gestures and interactions [7], [8], [9]; the use of the moving body as both design material and the means of communicating design ideas [10], [11], [12]; and employing experiential understandings of movement and kinaesthesia as concepts and criteria for design [13], [14].

Representations of the moving body are a crucial part of the design process. Forms of visual representation include sketches, photographic images, video footage and stills, and movement notation, to name a few [15], [16], [17], [18], [19]. Each form of representation focuses on certain aspects of movement, whilst throwing others into relief. As Bodker [20] recognised, representations are situated within the specific practices of design, and thus each design project uses and produces whatever representations are most appropriate. Her notion that representations cross boundaries between design and use activities is fundamental to the production of representations in this research.

The research work presented in this paper is part of a larger project aimed at investigating ways of experiencing, describing and representing the moving body in the design of movement-based interaction. We chose to work with trained dancers and physical performers for their expertise in experiencing, creating and performing with the moving body. The practices of dance, movement and choreography were seen as a rich source of potential methods and tools that could be reapplied in this field of movement-based interaction design. A series of studies was undertaken to trial and identify a range of methods and tools for working with the moving body, which start from the experience of the moving body. The first study in this series, the focus of this paper, is a study of the falling body.



## 2 Study of the Falling Body

This study examined the act of falling as a specific form of movement that is outside of our everyday realm of movement and has a complex changing form through space and time. The action of falling is a common occurrence in our movement patterns as children, but over time recedes from the movement repertoire of most adults. We can take the action of falling for the purposes of 'making strange', moving into unfamiliar territory, stretching our everyday range of movement and experiencing a new, or revitalising an old, movement pattern and pathway. Another motivation for studying the act of falling is that it is not part of the established movement lexicon in digital praxis. This makes it open for investigation, unlike gestural actions such as reaching and pointing, which are well known and researched in human-computer interaction and virtual reality.

The aim of the study was to explore the act of falling from a first-person, experiential perspective and from an external, observational perspective. Together the two accounts produce an understanding and description of the moving body in the act of falling that can act as a foundation for subsequent design work. Interviews and physical demonstrations were conducted with trained dancers and physical performers to examine the process and experience of falling. These sessions were filmed on digital video tape, and also recorded with a digital audio recorder for transcription purposes. The video footage and audio recordings were utilised as records of the session for later iterative analysis. Analysis was performed on the raw data from two perspectives – an experiential perspective and an external or *machine perspective*. The analysis generated a range of different descriptions and representations of the falling body. These included first-person accounts of the process and experience of falling, characteristic components of movement for describing the act of falling from an experiential perspective, movement sequences of the moving body, silhouettes of changing spatial shapes of the moving body, and Effort/Shape descriptions of the qualitative, dynamic character of the movement. The data, results of the analysis and the activities of the study itself were examined to identify potential methods and tools for inclusion in the proposed methodology. These activities are described in more detail below.

### 2.1 Interviews and Physical Demonstrations

Interviews and physical demonstrations were conducted with a set of eight participants. There were six female and two male participants. All participants were trained as dancers or physical performers in a range of dance and movement practices including acrobatics, butoh, contemporary dance, stilt-walking, physical theatre, Feldenkrais and improvisation. Each participant took part in a half-hour session that required them to physically demonstrate acts of falling using the bodily techniques in which they were trained. During this session, they were interviewed about the act of falling, specifically to determine the techniques for falling, the sensation of falling, and how it fits into their practice, both in training and in performance.

Participants undertook their own warm-up prior to the interview/demonstration. Each session began with the participants improvising their own movement and initiating acts of falling to the ground. After a few minutes, the interview began with the researcher asking questions and prompting clarification. Participants would answer verbally and quite often begin to move again to demonstrate aspects of the action/process of falling.

**Accessing In-the-moment Sensations.** They would often repeat the action of falling to access in-the-moment sensations and to pay conscious attention to what they were doing while falling. Here is an example from participant 2's explanation. The text in square brackets, describes the actual physical actions executed by the participant.

"But if you have energy that is going downwards – one way to get down, like another thing that might be interesting is falling into a roll, [falls into a roll] because then you actually kind of distribute the energy differently. Does that make sense? So even – something like – [falls backwards and rolls] that's actually ... because the energy becomes something else, I'm using the momentum, it actually sort of softens it ... that was probably more comfortable then.

Or if I go [falls], it just sort of – if I try to stop it, like if I let myself splat, then I've got to stop the energy. And I guess that's also what I'm doing when I'm going in the other direction, I'm minimising the amount of force, by thinking that way – it's working against gravity, breaking up the amount of energy that's going to the ground, or something. I'm not sure."

For this particular participant, more awareness and insight into his process and sensation of falling were acquired as he continued to experiment with different ways of falling. He began the session by simply moving around and falling, without any conscious thought about how to do it, as evidenced in this quote.

“When I’m doing it I don’t really think at all. I don’t really go okay I’m making my body do this and this and this. I learnt how to do it and the patterning in my body is already geared towards certain things, that I know will make me feel comfortable or safe.”

As the session continued, he was able to give more precise descriptions of his movement process, techniques and felt sensations. This was the case for most of the participants.

**Learning a Technique.** Some participants instructed one of the researchers in learning a given technique. This was done to gain more insight into breaking down the technique and to acquire a bodily understanding by the researcher. Here is an example of participant 8 teaching the first author the technique of a shoulder roll.

“So, the first thing is, if we just start like this [sitting on floor with legs stretched out in front]. So this is what we call a shoulder roll. So you can go either way. So what I’m going to do is – just have a look first. I’m going to put my arm out like this [right arm out to shoulder height], and turn my head that way [head turned to left and down], having a look at my left knee [rolls backward over right shoulder]. Look at my left knee – that’s it. And back that way. [rolls forward over right shoulder]

Go from sitting. And we’ll go like this [rocks back with knees bent], and you can bend your knees. You can use that momentum. You’re going to look at your left knee. [First author rolls back] Look at your left knee. Yep, that’s it. Good. Try it again.

So what we could do next, is go from standing. We’re just going to take one step back like this [lowers to floor with right knee bent], put our hands down [on floor by side of hips], and then go over onto the knees, and push off the floor up to stand.

That’s it. Once we get that kind of smooth, we can start to do it from a walk. And eventually we could take it into running backwards. You can use a shoulder roll to come out of all kinds of fast-moving falls.”

This excerpt illustrates the breakdown of the technique into a sequence of preparatory exercises. With learning to fall, one commonly starts on the ground, and then works back up to initiate the fall from standing. In order to fall safely, we need to first establish familiarity with contacting the ground. After that we learn how to resolve the trajectory of the fall into the ground. Once this is achieved, we can then begin to execute the technique more freely in different situations. As participant 8 demonstrates here, this technique can be done from walking or running backwards.

## 2.2 Analysis from the Experiential Perspective

The raw data was transformed and analysed to gain an understanding of the act of falling as experienced by the people performing the movement. Written transcriptions of the interviews were taken from the audio/video records. The video footage was edited to produce a summary of each participant’s demonstration and explanation of falling. These *video summaries* were useful for returning to a dynamic, visual replay of a particular participant’s way of falling, and function like selected transcripts as described by Jordan and Henderson [21] in the use of video data for interaction analysis. The data then was analysed to produce two forms of experientially-based descriptions of the act of falling – *first-person experiential accounts* and a summary of participant descriptions organised into characteristic components of movement.

**First-person Experiential Accounts.** The written transcriptions were edited into a more compact form, which we will call a first-person experiential account. The first-person experiential accounts were reviewed with participants in a follow-up session to ensure that they were a faithful record and representation of their understanding of falling. Table 1 contains a sample of excerpts from verbatim transcripts.

The first-person experiential accounts and the video summaries fed into the next activity of analysing the salient aspects of the act of falling.

**Characteristic Components of Describing the Act of Falling.** Both the original footage and the summary videos were viewed multiple times to identify the salient aspects of the act of falling as experienced by the participants. Phrases uttered by the participants

themselves were selected from the transcripts. These phrases reflected each participant's individual ways of articulating their understanding of their own movement processes. These phrases were then grouped into three characteristic components of movement, as defined below. Each of these characteristic components will be elucidated with examples from the participants.

- **Movement process and technique:** The process of the movement and the technique for performing the movement are inter-related.

**Process** is the dynamic unfolding of a bodily movement in space and time. The process may be split into distinct stages for a given movement, depending on the complexity of the movement.

**Technique** is an established means for directing or informing the movement process.

- **Sensing and awareness – internal and external:** what senses are actively engaged and how; the senses include the visual, aural, tactile, and proprioceptive/kinaesthetic; awareness and relating of internal and external environment.
- **Felt quality:** the particular sensation or feeling as experienced in the whole or part of the body

*Movement Process and Technique.* The movement can be analysed as a process of the body changing relationally in space and time. This movement process can be broken down into a series of distinct stages, which are dependent on the particular movement being analysed. For falling, there are three distinct stages in the process of falling – initiating the fall, descending, and contacting the ground. The technique for informing or directing the movement process is an intrinsic part of the performance of the movement.

There are a range of techniques peculiar to the act of falling for initiating the fall, controlling the descent and contacting the ground safely. These techniques can be broadly categorised as being mechanically based or image based. In mechanically based techniques, the focus and emphasis is on the order, organisation and sequencing of body parts in relation to each other and the environment as the movement unfolds. However the conscious focus on the detailed mechanics of the movement lessens as the technique is mastered. As participant 8 explains, you “give over the rational; technique goes into automatic pilot.”

Here are some examples of this category of technique for the three stages of falling. Participant 8 goes off-centre to initiate the fall, whereas participant 1 drops her weight vertically down to the ground. Participant 4 uses an internal muscular lift to slow down the descent, and participant 1 controls the slide out to the side by extending the other arm away from the direction she is moving in. Participant 2 contacts the ground safely by making the contact with the ground take the greatest amount of time and cover the greatest surface area of the body, whereas participant 3 releases any tension and softens into the floor. In general, all participants worked with softening into the ground as they landed.

In image based techniques, the focus and emphasis is on working strongly with the image to direct and inform the movement process. If you surrender fully to the image, the body follows. There is less attention given to specific body parts moving in a certain order. Participants 6 and 7 use the image of a string being cut from the crown of the head to initiate the fall and the image of the body as a bag of bones to descend and contact the ground. A different example is of participant 5's use of the image of being pushed purely to initiate the falling.

*Sensing and Awareness – Internal and External.* This characteristic component refers to the active sensing and awareness of one's body in relation to itself and to the external environment. We include the senses of the visual, aural, tactile, and proprioceptive/kinaesthetic (taste and smell are not included as they were not mentioned by any of the participants in this study). In regards to falling, it was interesting to tease out the relationship between the visual and kinaesthetic senses, and how they were utilised in the act of falling.

Protecting the head is crucial when falling. Looking at participant 4's first-person experiential account (see Table 1), we can see that she is constantly mapping where her body is in internal relationship to itself. She first ascertains where her head is in relation to the rest of her body, and then maps where her pelvis and feet are in relation to her head. In the act of falling, we draw continuously on our kinaesthetic sensing to know what the body is doing and how it is aligned at any particular moment.

The visual sense is predominantly used to check where one is in the space and in relation to others.

### Participant 3

“There’s certainly a sense of great release in the upper body, as long as I have a basic arrangement of landing here and shooting out. (Be)cause I notice with this side, I think there are complications with falling first [slaps left thigh], so this [left arm pointing out to left and jabbing] – the order of things. There’s also a lot of – I’m feeling fear, about doing it, I mean not great fear, but just enough to be kind of hesitant. You can’t afford to be hesitant if you going to be falling, I guess.”

### Participant 4

On a mechanical level, I guess I kind of take into awareness where my head is in relation to the rest of me. And I find that equilibrium with my head first I think. And then, in the act of falling, there’s a relationship between where my head is and my pelvis, and my head and my feet, so that by finding a way where they can be in some kind of alignment I save myself. So I’m always kind of mapping where I am. As I’m going down, I let the legs and the arms catch some aspect and then, the passage into the floor is dispersed through the body.”

### Participant 6

“It’s an image of extension and then release, tension release. There’s an idea of a, almost like a hook, or a long string from the clouds, at the head. And then it’s been cut. And then the head is being pulled back up again. The cut gives that real weight to the body ... it becomes – an impact ... The most important thing is to have that image, so then you’re imagining, if that’s cut then it’s a crumpling.”

### Participant 7

“I get a lot out of just the sense of weight, so exactly that. So if that’s [touching the crown of the head] being pulled up, I’ve just been strung up then this is an entire weightedness. You really try and get the sense of, like a sack of potatoes, really heavy in the body. This is being kind of hooked up there. And so then that really heavy feeling. Particularly in the fingertips, in the legs and the feet and the thighs and the butt, especially in the pelvis. I tend to work with slightly bent knees. To get a sense of that suspension.”

### Participant 8

“Going off-centre (is the stimulus), which is something. Always finding in different situations of your movement, where you can find an off-centre moment, I suppose. And I guess talking about off-centre, it’s like finding interesting configurations. Like before when I was collapsing, I could collapse by degrees. I’m actually just collapsing by small bits, as opposed to a big drop. And what I’m looking for when I’m doing it, is interesting configurations, that surprise me. What I find interesting, that’s interesting [as he collapses incrementally]. And then, playing with the dynamics, I might, so how can I get from here up to standing, quickly or ...”

The awareness of the external environment is reliant primarily on the visual sense. Participant 6 explains that “Visual sensing keeps me aware of the outside, otherwise can become too internal”. Participant 8 explains, “You need that visual to know where you are in the space, to remember what plane you are on, especially when you’ve thrown yourself off-centre.”

The two senses work together to provide an ongoing awareness of the internal relations and state of one’s body in relation to the external environment.

*Felt Quality.* The felt quality of the movement refers to the sensation or feeling in the body. It is an inextricable part of any movement. It may be informed by the kinaesthetic sense; the sense that governs our self-perception [3].

Looking at an excerpt from participant 2’s account, he separates out the felt quality of the descent from the felt quality of the landing.

“... it feels very free ... it feels like my body, I’m letting go, I’m releasing, I’m letting go of my body ... oh, I’m trying to separate out the experience of actually doing it, the actual falling, ‘cause once you’ve landed it’s slightly different. And the feeling actually in the moment of falling is quite a – yeah you’d probably say it is *exhilarating*, but it’s so quick. It’s over in less than a second that I get more caught up in the actual – the landing. And the *clunkiness* of that [laughter].” [our emphasis]

Participant 3 provides a different account of the felt quality in the act of falling. For her it is a feeling of “suspension and precariousness, teetering over the edge – dissolving into that.”

**Table 1** First-person experiential accounts of falling

Characteristic component of movement	Participant description
Movement process/ technique Initiating the fall	<p>Finding pathways into the floor P4</p> <p>Momentum of dropping down P1</p> <p>Release from the centre P2</p> <p>Like being pushed. An outside force. P5</p> <p>Going off-centre P8</p> <p>Finding interesting configurations P8</p> <p>Toppling like a rock P1</p> <p>Image of extension and then release – like a string being cut P6/ P7</p>
Movement process/ technique Controlling the fall	<p>Internal muscular lift to slow down P4</p> <p>Working in opposite direction to the fall P2</p> <p>You could even control that more by taking your weight to the opposite side P1</p> <p>Finding a way to support yourself down, with your hand P8</p> <p>Collapsing by degrees P8</p> <p>The cut gives that real weight to the body. Then it's a crumpling P7</p>
Movement process/ technique Contacting the ground	<p>Bodily technique is release on the floor P3</p> <p>Relax and soften P2</p> <p>Making the contact with the ground take the greatest amount of time and cover the greatest surface area P2</p> <p>Different surfaces give different sensibilities P6</p> <p>Absorbing it in the joints P3</p> <p>Distal initiation P3</p> <p>Rolling down the body P8</p> <p>Body is like a bag of bones P7</p>
Sensing and awareness – internal and external	<p>Always mapping where I am P4</p> <p>Aware of your body within a larger space P7</p> <p>Visual preoccupation can interfere with kinaesthetic sensing P4</p> <p>Awareness of others, their rhythms P6</p> <p>Visual sensing keeps me aware of the outside, otherwise can become too internal P6</p> <p>You need that visual to know where you are in the space, to remember what plane you are on, especially when you've thrown yourself off-centre P8</p>
Felt quality	<p>Paradox of light and heavy P3</p> <p>Suspension and precariousness, teetering over the edge - dissolving into that P3</p> <p>Out of surrender P5</p> <p>A sensation of falling, but you're in complete control P1</p> <p>Sense of suspension P6</p> <p>Sense of weight, like a sack of potatoes P6</p> <p>Feels exhilarating, then clunky P2</p>

**Table 2** Characteristic components for describing the act of falling, from an experiential perspective

Table 2 presents the range of participant descriptions of falling, sifted and organised into the three characteristic components of movement. It provides a condensed summary of the aspects of falling, as described by the participants themselves. What this analysis reveals is a diverse range of understandings of the process and experience of falling for these eight participants.

### 2.3 Analysis from the External or Machine Perspective

When considering the action of falling as input to a video-based motion sensor, it can be modelled and analysed from an *external* or *machine* perspective in many ways. We present a rudimentary baseline of representations of the falling body to which more abstract and complex transformations can be applied.

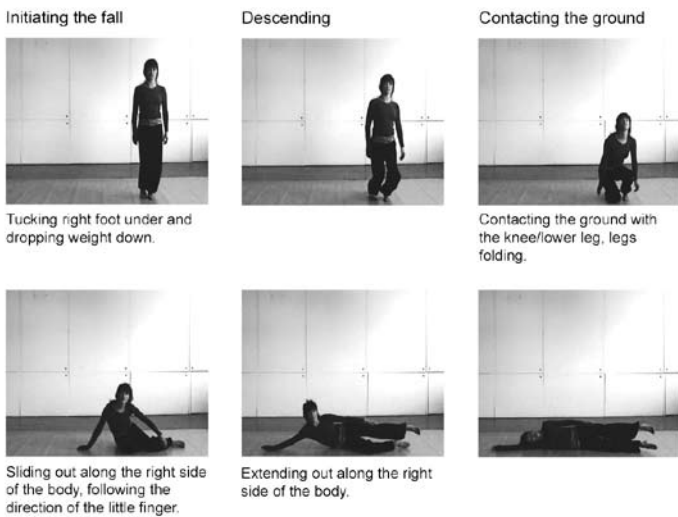
Movement sequences were extracted from the video footage of each participant performing a particular instance of falling. These movement sequences allowed a closer analysis of the moving body in its trajectory through space/time. The movement sequences for participant 1 and participant 4 are shown in Figure 1 and Figure 2, respectively. The time between each image (snapshot) in the sequence is 0.4 seconds.

A series of silhouettes was made from these movement sequences to draw out the spatial shaping of the body for different types of falls (see Figure 3 for a sample of participants). The intensity of the shading increases as the trajectory of the fall progresses.

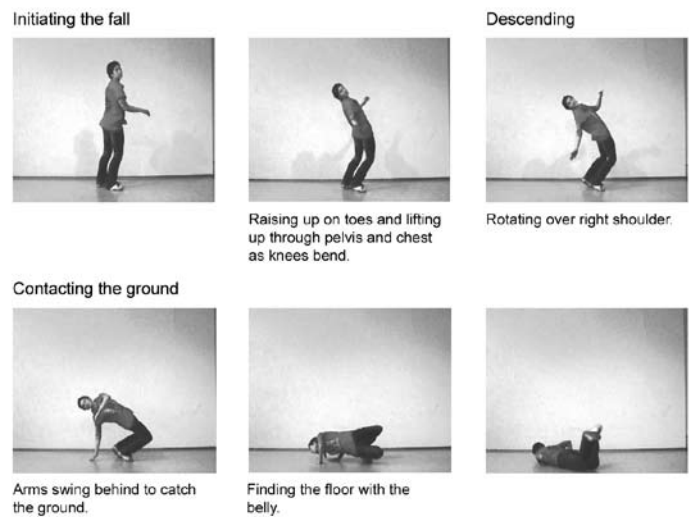
From these two representations a range of different parameters can be derived. These parameters include:

- Trajectory of body
- Changing position and relation of body parts along the trajectory
- Distinct types of falls
- Dynamically changing pattern of spatial shaping

**Fig. 1** Movement sequence for participant 1



**Fig. 2** Movement sequence for participant 4



**Fig. 3** Silhouettes of the falling body

Figure 4 shows the mapping or tracking of body parts over the trajectory of the fall. The changing positions of the head, centre of torso and feet are shown for participant 4. As for the movement sequences and silhouettes, each snapshot in time is spread out spatially in the representation so the body and any overlaid data can be clearly seen at that instant.



**Fig. 4** Mapping of head, centre of torso and feet over time for participant 4

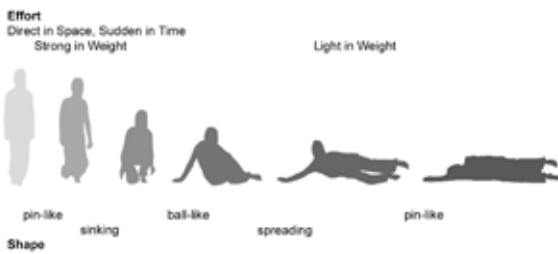
Figure 5 illustrates the dynamically changing pattern of spatial shaping for participant 4, where each snapshot in the sequence is overlaid on the previous. The shade of grey deepens over time to indicate the progression of the movement.



**Fig. 5** Changing spatial shaping for participant 4

The qualitative, dynamic character of the movement can be described using the Effort/Shape component of Laban's system of movement analysis or LMA for short [22], [15], [23]. LMA is a system and language for observing, describing and analysing all forms of movement. It offers a vocabulary for describing the structural and physical characteristics of the moving body, the use of space, and the qualitative and expressive aspects of movement. Movement can be analysed in terms of *Effort* or *Shape*. Effort is the energy expended in performing the movement or the external expression of the inner attitude of the mover [22], [24]. The analysis of Effort is given in four motion factors of Space, Time, Weight and Flow. An example of applying the Effort component to analysing movements used in interaction with a simple motion-sensing game application, Eyeto, is given in earlier work [18].

The spatial shaping of the body can be analysed in terms of what forms the body makes and the relation of the body to itself and its environment. *Shape* analysis provides a set of descriptors for dynamic, fluctuating shape characteristics, classified into categories of Shape Form and Shape Quality (other categories exist but have not been used in this research). Shape Form describes the static shapes that the body takes, for example, wall-like, pin-like or ball-like. Shape Quality describes the way



**Fig. 6** Effort/Shape descriptions for participant 1

the body is changing toward some point in space, for example, opening or closing, indicating the degree of extension or contraction in the body. More specific terms include Rising and Sinking (along the vertical axis of the body), Spreading and Enclosing (along the horizontal axis), and Advancing and Retreating (along the sagittal axis). Shape analysis was developed primarily by Warren Lamb and Elizabeth M. Watson [25]. They describe the shaping process as,

“The actual process of variation, which results in a succession of differently sculpted positions, can be described as a *sculpturing*, or *shaping process*. If we wish to become more aware of the shape of a person’s posture pattern, as he dresses himself, or greets friends at a party, or elbows his way around a store, for example, it helps to imagine that all his joints are emitting vapour trails as though they contained jet engines.”

The qualitative, dynamic character of participant 1’s fall could be expressed as a sudden, smooth drop and slide, or in more evocative and metaphorical terms, like a stone plummeting and ricocheting. In this instance, the Effort is direct in Space, sudden in Time, free in Flow and strong in Weight for the drop to the ground, then light in Weight for the slide along the ground. The Shape is predominantly pin-like in form as the body begins standing erect and finishes on the ground extended along the central axis of the body. The Shape changes to a semi-contracted, ball-like form in the middle section of the trajectory as the legs fold to enable the descent to the ground. The Shape Quality is sinking during the descent, and then spreading during the contact with the ground. See Figure 6 for a visual reference to these qualities.

The qualitative, dynamic character of participant 4’s fall is suspended and buoyant within a controlled, circular descent. The corresponding Effort is indirect in Space, sustained in Time, light in Weight and bound in Flow. The Shape begins arc-like in form as the body arcs backwards in spinal extension through a curved trajectory towards the ground. It then becomes more screw-like as contact is made with the ground. The Shape Quality is sinking, retreating and spreading in the descent to the ground. As the hands and front of the body contact the ground, the Shape Quality changes to enclosing, then to rising as the fall is resolved. See Figure 7 for a visual reference to these qualities.



**Fig. 7** Effort/Shape descriptions for participant 4

With any of this kind of movement analysis, the observation of other’s movement is validated or confirmed through an enactment of the same movement by the analyst researcher, whenever possible. It is not enough to have an intellectual understanding of the process and qualities of movement. This understanding must be complemented with a bodily understanding, which is acquired through actual movement enactment and experimentation. Two texts on Laban movement analysis provide a series of exercises to gain a bodily understanding of, and skill in using, the system of movement analysis – Laban’s *The Mastery of Movement* [22] and Newlove’s *Laban for Actors and Actors Dancers: Putting Laban’s Movement Theory into Practice* [24].

Computerised motion recognition systems like EyesWeb exist that process the incoming video stream using algorithms based on Effort/Shape parameters [26]. The EyesWeb expressive gesture processing library offers modules for motion, space and trajectory analysis [27]. These kinds of systems are seeking to recognise the more expressive components of human movement. Our use of LMA and representations emphasising silhouettes and spatial shaping of the body fits well with this kind of system.

### 3 The Beginnings of a Methodology of Making Strange

The activities of the study, the data and results of analysis were examined as sources of methods and tools for potential inclusion in the proposed methodology. The methods and tools were abstracted from this specific domain of falling, and reframed to be applicable, at least as a starting point, to any movement under investigation. The use of these methods and tools would be tailored and adapted according to the specific research or design context.

There are two main areas to the emerging methodology: *Accessing the experiential, moving body and Describing and representing movement*. Each of these areas contains methods and/or tools that may be useful for designers of movement-based interaction, who wish to base their work in the experiential, moving body and to produce suitable representations of the moving body which enable design work to be done. Figure 8 presents an overview of the methodology, which is described in more detail in the following sections.

### 3.1 Accessing the Experiential, Moving Body

The methods presented here are concerned with accessing the experiential, moving body, either directly with one's own body, or through observing and interrogating other bodies. This area of the methodology is directly concerned with practices of making strange through movement inquiry.

**With One's Own Body.** One can begin an inquiry into the potential movement possibilities and felt sensations of one's own body by *performing a familiar movement differently* or by *performing an unfamiliar movement*.

Various techniques can be employed such as performing a movement with kinetic variations of speed, scale and direction to produce different dynamics and qualities of movement. The movement inquiry can be deepened through repetition of movements to consciously access in-the-moment sensations and process. We can experiment with finding pathways into a pattern or form of movement, by varying the source of initiation of movement from different parts of the body. A different kind of technique uses imagery to shape body movements and generate distinct movement qualities, such as 'like a heavy stone' or 'like a floating feather'. We can select physically challenging or unorthodox movements, like falling, for investigation. We can learn to perform a movement by breaking down a specific technique. The techniques presented here provide ways of exploring and improvising with the moving body to cultivate a refined awareness and ability of the sensing, feeling, moving body. They form but a small part of an established repertoire of movement improvisation techniques from dance and movement practices. Some of these techniques are published in the text, *The Moment of Movement: Dance Improvisation* [28]. A bodily exploration and knowing supports the analysis of other moving bodies.

**From/Through Other Bodies.** The experiential, moving body can be accessed through observation, interrogation and analysis of *other* bodies.

Conducting movement inquiries with *skilled* movers provides finely nuanced understandings of particular kinds and forms of movement. One method of accessing their bodily knowledge is through *physical demonstration* in tandem with verbal explanation of their movement processes and felt sensations.

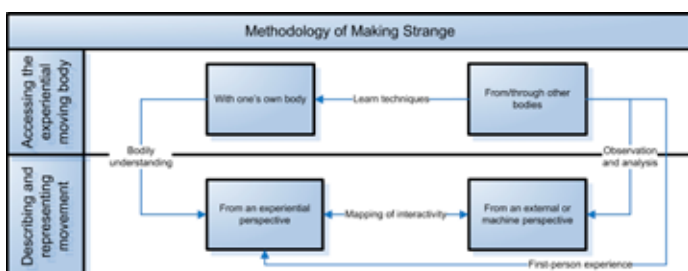
Recording this process on videotape provides raw data for feeding into the tools for describing and representing movement, described below.

### 3.2 Describing and Representing Movement

The tools presented here are for describing and representing movement. They fall into two categories: describing movement from an experiential perspective, and representing movement from an external or machine perspective. The first category of tools provides renderings of understanding and describing movement, based in actual experience of that movement, and couched in the language of the person explaining their own movement. The second category of tools provides a rudimentary baseline of visual representations of the moving body. These representations can be transformed in many ways to bring out different aspects of the moving body in space and time. They can be used as resources for the design of machine interpretations of the moving body, and for computerised motion analysis.

**Describing Movement from an Experiential Perspective.** These descriptions preserve the voice of the person describing their understanding of their process and experience of particular movements.

*First-person experiential accounts* are edited transcripts of a person explaining how they perform a particular



**Fig. 8** Overview of methodology of making strange



movement, how it feels in the body, and how it fits into their practice. These accounts can be rendered into a more condensed form of description using three characteristic components of movement. The three characteristic components are Movement process and technique; Sensing and awareness – internal and external; and Felt quality, as explained in the analysis section of the study.

Representing Movement from an External or Machine Perspective. Visual representations of the moving body enable closer examination of the moving body from an external or machine perspective. The data gained from this kind of inspection can assist with the design of machine interpretations of the interactivity, and bridge the interface between human-centred design approaches and technologically-driven implementations.

The *movement sequence* is presented in a number of formats to provide different kinds of information and emphasis. Movement sequences extracted from video data focus on the key postures and organisation of the body through its trajectory in space/time. They assist in analysing the *mechanics of the body movement* in relation to the environment. The movement sequence can be transformed into a *sequence of silhouettes* of the body. These silhouettes highlight the *changing spatial shapes* made by the body as it moves through a trajectory. From these movement sequences, a range of other data can be derived such as changing position of the body and its parts, the trajectory of the moving body, use of space, timing and rhythm.

Laban's [22] Effort/Shape description provides a system of analysis and a vocabulary for the *qualitative, dynamic character* of movement. The energy or *Effort* expended in a movement can be expressed in dimensions of Space, Time, Weight and Flow. The dynamically changing spatial shaping of a movement can be analysed with *Shape* categories describing the static form and the relation of the body to itself and the environment. The qualitative, dynamic character of movement can also be described less formally using *evocative and metaphoric language* that conveys the essence of the movement [9].

#### 4 Conclusion

We have presented here the beginnings of a methodology of *making strange*. This methodology marks a significant

shift in design perspective that calls on designers to re-examine their assumptions about the moving body through practices of *making strange*; that is by unsettling or disrupting habitual perceptions and taken-for-granted conceptions of the moving body through a movement inquiry of our own bodies and the bodies of others.

The methodology of *making strange* offers methods and tools for experiencing, describing and representing the moving body that can assist designers in making movement and interaction choices that are grounded in the sensing, feeling and moving body. In its current state it contains two primary areas: accessing the experiential, moving body and describing and representing movement from the experiential and machine perspectives. The methodology is by no means complete, but it offers a starting point that can be both expanded and refined through further research and investigation. The second study in the series of this research project investigates choreographic and movement improvisation techniques for ways of creating, devising and documenting movement that may be of use to designers of movement-based interaction. This is an aspect of designing movement-based interaction which we identified as missing from the current state of the methodology after a careful analysis of the findings of the study of falling that is reported here.

The assumption behind our research is that design of movement-based interaction begins with the experiential, moving body. In future movement-based interactive spaces, we will need different kinds of movements with meanings that are as yet, unthought. We suggest that the methodology of *making strange*, introduced here, can act as a way of orienting and supporting designers of movement-based interaction within emerging motion-sensing technologies.

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# Pure Shape – to realise intended meaning in practice



Fig. 1 The Imsdal label (2002)

## Abstract

This article presents a case study of a design project of a still water bottle within a brand context. It shows that product development within a brand context brings questions that have great implications for the form of the product designed. These questions need to a great extent to be solved by the designers in close dialog with the managers in order to engage the consumer in the meaning creation through the product.

## Keywords

case study, still water, design, brand values, context, product, communication, meaning making, consumer

## 1 Introduction

Traditionally, brand building has fallen within the domain of marketing [1], with emphasis on building a consistent brand identity that differentiates the brand in the market [2]. The field of branding and a number of theories expand on the importance of how to develop an emotional brand through every point of touch with the consumers [3], appealing to all senses to create a bond with the consumers [4] and involving consumers in the brand development [5]. As a result, managers' emphasis is to generate meaning through the product.

However, how to ascribe meaning to artefacts through design have gained wide attention [6,7]. In the design discourse the concept of a user is employed instead of

that of a consumer and one may take a critical viewpoint towards branding [8,9]. But development in branding is how to bring meaning to consumers, which is an important part of the design practice [10]. However, there is a dearth of examples of how to create a brand meaning through the product, therefore there is a need to explore brand building in the context of product design.

This case study is based on a Norwegian brand of still water called Imsdal (see fig 1.) and a design office called the Scandinavian Design Group (SDG). The reason for choosing still water is that, as one of the people interviewed stated, it is "one of the few products that almost exclusively sells on feelings". The case was chosen as a representative case: *Here, the objective is to capture the circumstances and condition of an everyday or commonplace situation* [11]. The condition to be captured is how a design company specialising in brand building and graphic design is working to develop a brand identity through the still water container<sup>1</sup>. The question when conducting the study was: how does the designer manage to realise the meaning of a brand and which constraints are encountered in building a brand identity through the product? Obviously, in all design projects there will be various constraints as standards to be met in different stages in the life cycle and production techniques. This paper will focus on constraints met explicitly because of the organization emphasize on branding.

<sup>1</sup> In Imsdal the product is the still water and the bottle is the package. Still, since the bottle is three-dimensional and has commonalities with other products to be designed, it was regarded as a relevant study for the question raised.

The prime sources were material outcomes from a design process in terms of bottles, together with ten semi-structured interviews, comprising three brand managers, one strategist, one project leader and two graphic designers from the design company, one strategist from the market survey company and two industrial designers. Other sources were internal emails, budgets, blogs, websites and news articles.

## 2 Establishing a Brand

Imsdal is the market leader for still water in Norway. The brand is distributed by the Norwegian brewery Ringnes AS, which is owned by Carlsberg Group. The brand was launched in 1994, with the vision that one day people would walk up the main street of Oslo with a bottle of Imsdal. At the time it appeared an ambitious goal because of the availability in Norway of pure, free tap water. In order to achieve the goal they needed to know who would buy still water in Norway and why. The questions were answered with young urban girls with the need of identity and convenience of buying bottled water. As a result, Imsdal created a character of a charismatic, smart young female, referencing a need for purified water in a polluted city. Now the identity was established and later communicated through advertising films [12].



**Fig. 2** Imsdal 0,5l bottle.  
Left: 2002, Right: 2006

In 2002, two bottles of Imsdal containing white spirit were found on the market. Ringnes' answer was to recall all bottles and reintroduce them in a disposable bottle with a plastic seal [13]. This was the starting point for using not only the label but also the bottle as a communicator. The disposable bottle had to conform to requirements for recycling besides entailing a special fee. Despite the extra cost, Ringnes saw this as creating a unique potential for communicating through the bottle and through use of both colour and shape in the process of communication. The feeling of drinking out of a disposable bottle is purer, and it does not have the scratches that a standardised bottle suffers in the cleaning process.

## 3 Market survey and project brief

Ringnes started the re-design process with providing Scandinavian Design Group (SDG) a project brief based on the market survey's conclusions. SDG first carried out a workshop with the designers and the managers to discuss the values and translate them into pictures. In 2002, the core values were *Pure*, *Norwegian* and *Natural*. In 2006 the market's attitude towards bottled water had changed. The concept of *Contemporary* was added to signify the importance of following changing market preferences. The design company also adopted the term *Body Beautiful* to position the brand [14], describing a person who is health conscious but not dieting. However, despite changes in the value statement, during the interviews everyone who had been involved referred to "the purest of the pure" when describing the bottles.

One difference observed in the processes of 2002 and 2006 is how the goal to build an identity and the goal to create a *distinctive* product may have amplification of the appearance of the product. In 2002 the core goal was to make a bottle as distinctive as possible, inspired by the distinctiveness of Coca-Cola bottle from 1915 [4]. This meant that the product should not have references to other products. In the 2006 design process of Imsdal, the core focus was in making the bottle as *pure* as possible, even though it shared the common design references with brands in fine water segment. During the design process, the designers and managers started to focus on the importance of being proud of the core values. This was embedded in the bottle with high shoulders to communicate a stately posture.

The 2006 re-design process was a re-design of all packaging (see fig. 3). In previous years Ringnes had focused on product development and stretching the brand into new categories, such as flavoured water or water with other additives (such as fibre). Consumers had already accepted these as part of the Imsdal family, so there were no arguments for changing names to create brand architecture, as in the understanding of a brand architecture as: *an organizing structure of the brand portfolio that specifies the brand role and the relationships among brands and different product-market brand*. [15]. Instead Ringnes chose to distinguish different categories through the bottles. An example is the 0.5L bottle that SDG called the mother brand. It has a stately posture and it has all of the design elements. On the other hand, the restaurant



**Fig. 3** The 2006 Imsdal portfolio, launched 2007

bottle is regarded as a sub-brand. It has the same shape as the mother brand, the logo, the ice mountain, the coloured bottle and the flag, but it has a silver cap, silver label, thicker plastic and an embossed texture. The bottle is still part of the Imsdal family, but it has added exclusivity to the values (see fig 3.).

Even having chosen to design their own bottle, Imsdal faced several obstacles that impacted what the bottles communicated. An obvious visual trace of this is found by comparing the 0.5L and the 1.5L bottles, which share exactly the same explicit design cues, but with different proportions. Another example is that the vision of the design company was to have high shoulders to show a stately posture (see the shoulders at the asymmetrical bottle fig. 4), but this was not possible due to technical constraints. The final solution had lower shoulders than desired to show what SDG called a proud and stately posture.

#### 4 Market, brand values and extensions

The re-design process of 2006 was run by the brand manager for Imsdal and the brand manager for water; reporting to the board at Ringnes, which in turn reported to Carlsberg. Two other important stakeholders were Kroner AG (delivering production tools), and Opinion AS (conducting market surveys). Here I will leave out the impact Kroner had on the product, and focus on Opinion recommendation since it goes straight into important question brand building through the product may rise.

Imsdal has performed a number of design tests together with Opinion AS. Former tests showed that five design elements are found to carry meaning for the consumers. These were: the Imsdal logo, the Norwegian flag, the ice mountain, the blue colour of the bottle and the label's form. In the 2002 bottle three of these were connected to the label and not the bottle. In the re-design in 2006 the mountain in the base was displaced in favour of a standardised so-called elephant base due to concern to budget. Since the mountain was one of Imsdal design elements the mountain was introduced into the label.

In the re design process in 2006 Opinion was included at the start of the process by conducting market survey and

in the middle of the process when it came to selection of a design solution. The market survey that started the process of the re-design in 2006 showed that the consumer's attitude towards Imsdal had changed. When Imsdal launched its specialised bottle in 2002 it was regarded as innovative and fresh among its target group. But the market situation for still water changed, and in 2006 market surveys revealed that Imsdal was seen as old-fashioned and dull. Imsdal was according to the market survey not prepared to meet the market's demands on functional bottles and style. One strong competitor, Bon Aqua a Coca Cola Company brand, launched a bottle that met the demands.

Another important shift in the market was that while formerly the majority of bottled water consumers were young girls, now both females and males across different age groups consumed bottle water. This had to be reflected in a design that appealed to both sexes. The designers interpreted this as softer curves appealing to females, with harder lines associated with males. The 2002 bottle were regarded as a more female bottle than the 2006.

The design test run in two stages. First Opinion performed a qualitative test in terms of focus groups and in dept interviews, later they performed a web based quantitative test with 505 consumers. In the qualitative test they tested seven design solutions and four label solutions. The result of the test was a recommendation of which design solution to go forward with, and which to leave out. As an example they were recommended to drop a solution that was asymmetrical because the consumers in the test could not make sense of it (see fig. 4). Another concept with a grip handle turned out to be a love or hate object for consumers, and since this feedback mismatched with the intended message, the bottle was dropped despite protests from the design office (see fig. 4). These recommendations were pivotal in informing the Board, and the final bottles were close to the recommendations.

#### 6 Concluding remarks

There are several lessons learned which designers should consider when it comes to building a brand identity through the product. First of all the question of which values that are relevant for the brand. In this case the designers and the managers worked together to establish a common understanding of the values. Based on market



**Fig. 4** Samples from the design test. Left: asymmetrical

survey and research done by the design company they chose to change the value statement to appear relevant for their target group. This follows recent marketing theory that argues for the fact that brands manage to become an icon when they change their value statement in accordance with consumers changing preferences. [16] This is also an example of how marketers and designers often use similar methods as building a persona of the consumer. The market survey provides information of how to build the personas and vice versa.

In interviews with the marketing company it came up that in their experience designers were seldom interested in consumer tests. Additionally, the use of consumer tests and especially focus groups is widely debated in marketing theory. [17] Focus groups are criticised as a base for decision making on new products. This is because of their limited possibility to build trust and thereby get deeper into thoughts and feeling. Other critiques are how group dynamic affect the answers and the constructed setting with two dimensional pictures without anything from the actual context that they appear. [17] When asked about the limitation of focus groups the moderator argued that focus groups was important, not because of their ability to provide exact information of which design solution to choose, but because they gave company and perhaps designers an opportunity to keep in dialog with their consumer.

When it comes to design tests designers should be aware of the limitations of providing consumers tests. For example the presentation, context it is tested in, the graphic and logo are all elements which change the consumer's perception of the bottle. By being aware of how the tests are provided and understand how consumers react in this setting, the designer could come a step closer to design solution to be tested that gives valuable input in the further design test. However, how designers integrate consumers into their process will perhaps become one of the most important questions when it comes to realising the meaning of a brand through products.

The designer also needs to ask which competition there are in the market and which position the brand already has in the market place. For example, in the Imsdal case the answer to the project brief was not to change to meet competitors design style that the consumers appreciated,

but to design a bottle that is closer to their own value as "pure". Even though, water brand in the fine water market have translated this value in a similar way. The position as market leader gives them good product placement. And what so ever, fine water brand are found in another price segment than Imsdal and are not their competitors.

Another question when it comes to building a brand identity is how established the brand is and what design elements brings meaning to the consumer. One may assume that in the fast-moving consumer market changes are important in order to remain relevant to consumers; on the other hand patience with the consumer is a key in conveying meaning through products. To communicate a brand through the product can create strong bonds if it allows consumers to create their own stories e.g. the Coca-Cola bottle [4] or Phillip Starck's Lemon Salif [18]. If the company manages to establish explicit design cues that are meaningful for the consumer, its designs could perhaps last longer than three years at market. The question of balancing novelty with what is established in the company is important in design [19] and it is equally important when it comes to changes of branded products.

Designers and managers share a common goal in the product development process. This goal is in design terms to design products towards a user and in marketing terms to satisfy a consumer. By combining the methods of design with the methods of marketing, companies will come a step closer in generate the brands meaning through products.

### **Acknowledgements**

The author acknowledges Ringnes and Scandinavian Design Group for their willingness in sharing this information. I also wish to thank Martina Keitch, Jan Michl, Viktor Hjort af Ornäs and Ben Smith for helpful comments on the paper.

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# The Crawler

## Abstract

The demonstrator illustrates how behaviour can be sculpted through experience by autonomous training. The underlying theory, known as Reinforcement Learning, is a view on situations involving behaviour. At the same time it is a principle that explains behaviour. Last but not least it is a computational principle: you can use it to create behaviour. The essence of the approach is that an artefact is created that can obtain rewards.

This crawler has wheels to freely move forward and backward. In order to move itself, the crawler can only use its arm, which has two joints under motor control. The Crawler has sensors to measure the position of the joints of the arm and also one distance sensor which “sees” the distance from a wall or another reference object. Inside The Crawler is an NXT control brick, an embedded processor programmed in Java to execute the reinforcement learning algorithm (Q-learning). It is rewarded if it moves forward. It explores its possibilities and learns how it should move to accumulate the maximal rewards. The demo shows The Crawler starting from seemingly random movements, but after a few minutes really finding a kind of rhythm how to move the arm and efficiently move forward. Usually this type of algorithms is demonstrated through screen demos and applets, but here the potential of embodied learning is made visible in a truly embodied model. From a semantic point of view, it is very interesting to observe and interpret the behaviour.

A human observer recognises the primitive but charming initial attempts, the gradual progress and the surprising final achievements.



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# Johnny Q

## Abstract

The demonstrator illustrates how behaviour can be sculpted through experience by user-initiated training. The underlying theory, known as Reinforcement Learning, is a view on situations involving behaviour. At the same time it is a principle that explains behaviour. Last but not least it is a computational principle: you can use it to create behaviour. The essence of the approach is that an artefact is created that can obtain rewards.

Johnny Q has wheels and left-right motor drives to move forward, backward, rotate left and right. Johnny Q measures the brightness of the floor and “sees” the distance from a wall or reference object. Inside is an NXT control brick, an embedded processor programmed in Java to execute the reinforcement learning algorithm (Q-learning). The reward is being hit on the shoulder; a simple button serves to count touches. Johnny Q learns by being trained. Depending on what the human user does or does not reward, Johnny Q learns behaviours, such as turning away from a dark spot, or running backwards near an obstacle. But it can also learn the opposite behaviour, bumping against the wall. It explores its possibilities and learns how to accumulate maximal rewards. The observer engages in a training session, teaching tricks and little games, much like training a dog. Usually this algorithm is demonstrated through screen demos but here the potential of embodied learning is visible in a truly embodied model. From a semantic point of view, it

is interesting to sculpt the behaviour which (of course) requires some patience. Johnny Q will gradually forget although desired behaviour can be maintained through continued training



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## Questions and answers

Which is the design application area where such expression is most appropriate?

*Whenever the user wants to influence an object's behaviour. For example comfort appliances like home lighting systems, cleaning robots, temperature controllers and so on which should adapt to the user's wishes. The user stays very much in control but yet there is no need to enter difficult coding schemes.*

Why is this valuable for future interaction designers?

*Adaptive user interfaces are an important development, not just for computers. On the contrary, this demonstrator shows that adaptation through learning can be combined with tangible interaction in a very natural way. Embodied behaviour is easily realized in a wide variety of products by reusing the same algorithm as Johnny Q.*

What is the broader reach for the design practice?

*The implication is that one can design active artefacts that adapt themselves to circumstances; but yet the human user stays in control in a natural way. The behaviour is natural because emotions such as empathy and pride (but also frustration) are elicited from the user and can be ascribed to Johnny Q.*

Why does Johnny forget?

*Acquiring new behaviour and forgetting existing behaviour are two sides of the same coin. Johnny's memory is not like a list of facts; it learns to perform the best action in a certain situation. There is a parameter alpha which governs the balance between fast learning and strong memory. If desired, the designer can choose alpha such that it decreases over time. In other words, after a while Johnny does not forget anymore. Curiosity is another parameter, epsilon, which determines the balance between exploration and exploitation. It is up to the designer to design the evolution of epsilon.*

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# From *Sensations* to *Activating consequences* and from *Activating consequences* to *Relational stakes*: Theater as a support for the design of experience. Saturn and SoundSpace sound mixers case projects.

## Abstract

This paper aims to present a contribution to the design of form and movement through a theater-based approach to design. The method, based on Alain Knapp's improvisation techniques, prepares and leads designers to focus gradually on the sensations and the activating consequences of a context, and then from these activating consequences to the relational stakes which give rise to the improvisation and construction of human relations. The method is presented and illustrated within the design project of two sound mixers : Saturn and Soundspace.

## Keywords

Interaction design, theater improvisation, sound mixers.

## 1 Introduction

Existing sound mixers are products designed for experts. They require means and skills which are not easily accessible to a wider public. Digitalisation and compression of music files with increasing quality are making music more accessible to amateurs through growing media (Internet, PC, GSM, CD's, MP3). However, despite the great design possibilities offered by these new digital technologies, current sound mixers are not taking advantage of this freedom of shaping, nor are they using human interactive skills as an integral part of their design.

The concepts used here refer to the Ishii's [1] theoretical findings on space and time multiplexed input and output

devices. The improvisation techniques are founded on the emotions and the sensations, and help to build interpersonal relationships that give rise to relational stakes and shared emotions. Particular attention is paid to the relational stakes that emerge from the activating consequences due to the different contexts that have been created.

### 1.1 Approach

Unlike features relayed by technical mechanical devices, which impose, through their internal logic, a shape and a mode of interaction [2], the functional elements of today's products are electronic components that offer great potential in shaping and possible interactions. Nevertheless, the resulting shaping is driven by the electronic internal logic and often converges towards a common technology packed into an well-designed box with many buttons and screens. The projects Saturn and Soundspace are sound mixing desks designed for a wider public. These products are the result of an approach centered on the interaction with music through the product itself, rather than an interaction between the user and the product. So each interaction is imagined and materialized through a system which allows the user to manipulate their sound environment or their sound effects by means of gestures which are meaningful for them, in a context where they can interact with other individuals.



**Figure 1** Improvisation exercise with definite context, product and relational stakes.

These new interactions, based on intuitive exploration and simplicity of use, offer new experiences to the user. We have placed the user as the central element in the design phase. All the concepts presented in the pre-project have been materialized by sketch models. The models were tested on the basis of patterns of use in order to observe, understand and improve the interactions between user and music through the product. The most significant ideas were developed further in the final project.

The improvisation exercises start with context-driven emotions, and then gradually evolve into sensation-driven actions, and finally into relational stakes based on interpersonal actions.

The design concept generation phase was carried out with improvisation exercises, defined in a sensorial context. The figure below presents the improvisation phase between two people in the context of a beach on a sunny day.

## 2 Saturn

Saturn is an innovative sound mixer designed for juniors. The product has simple functions which help you create music at parties or with friends, even without prior experience in the domain. With its storage capacity of 200 Go, Saturn allows you to both listen to and manage all your mp3 files.

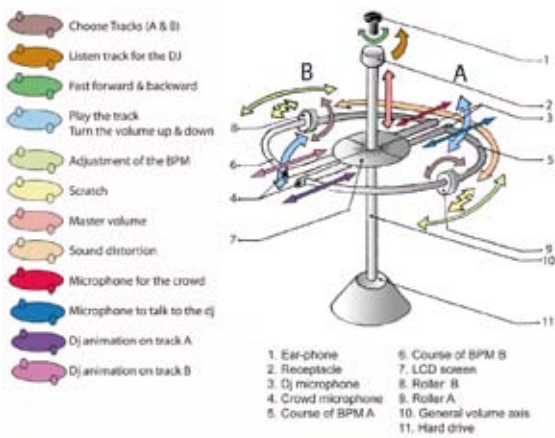
The design of Saturn is naturally inspired by the rings around the planet Saturn, but the lines also come from the attraction Girofoli which, through its rotating rings, combines a sports device and an attraction, providing thrills and sensations which can be compared to some Nasa tests.



**Figure 2** Saturn sound mixer model 1.

The work on textures and colors aims to emphasize the different moving modules. It gives the product a playful identity. This style combines practicality with an attractive look.

Saturn connects two soundtracks. This simplification allows continuous transition from one track to another with no break in the music, which is one of the most important functions of a sound mixing desk. The two half-circles symbolizing the tracks move in well-defined and distinct positions in relation to one another. This easy visualization of the volumes of tracks A and B facilitates



**Figure 3** Saturn sound mixer functional scheme

adjusted whatever the states of the two independent tracks. The volume of these tracks (A and B) is adjustable by means of the rotating movement of the half circles (half circle position high = maximum volume / half circle position low = minimum volume). The scratch wheels allowing the user to change music scan the curved cylindrical axes (like an abacus) in order to slow down or accelerate the rhythm. When activated in scratch mode the wheels distort the sound of each track. A large round screen included in the curvature of the two arcs acts as the interface, allowing the user to visualize the state of the music, the time code and the equalizer.

**3 Soundspace**

Soundspace is a sound mixer that uses a four-speaker sound system to adapt the sound to the space of the entire room.

On the table there are four microphones, which correspond to the four speakers – front right and left, rear right and left. There are also two soundsticks which can play a track of music. There is a small speaker at the end of the stick that sends the sound to the microphones. The user then just has to move the stick to the direction of the microphone he wants to play the music in. This way it becomes possible to create stunning surround sound

**Figure 4** mixing the sound

sound mixing and reduces transition errors. Conventional sound mixers often offer poor display features for active tracks, and this can often lead to accidental interruption of music. Owing to its principle and shape, Saturn clearly indicates sound states and the activities of each track. In addition, the information of the interface (digital screen) confirms these actions and states.

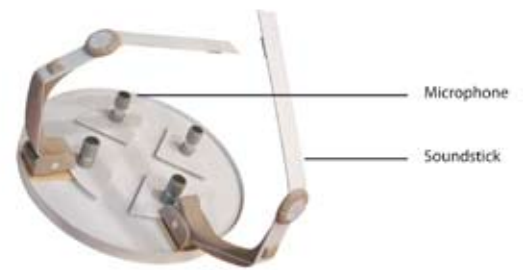
In order to bring value to the product and to make it more attractive, Saturn acts on a vertical axis which symbolizes the general sound volume, and which can be





**Figure 5 and 6**

Soundspace sound mixer model 1, and cad model illustrating the sound twist



effects. A typical stereo diffusion is also possible, if a stick is placed between the two front microphones.

To turn the volume up, raise the microphones to bring them closer to the sticks. To create special sound effects, such as increasing bass and treble, the sticks must be twisted (see below).

#### 4 Conclusion

Saturn and Soundspace, through their principle and their shapes, aim at informing and supporting clearly the interaction between the user and the music. The user can activate the sound mixer with two-handed movements through a direct coupling of features and actions that can be performed at the same time. This is not the case with existing sound mixers, where interactions are focused on small, inaccessible and uncomfortable areas. The hands-on quality of these devices makes the music tangible and allows the user to interact directly with the music. It gives the users the opportunity to enhance their ability to operate and to interact on more than one function at the same time. By allowing the user to interact with their environment and with other people, these devices support and promote self expression and creativity, which are vital elements in enhanced interpersonal relations.

The next step will be the development of actual interfaces, in order to test them with different populations such as musicians, children, and DJ's. From these results we will be able to gain vital insights into what is meaningful for the users themselves as concerns their needs and expectations in different contexts of use.

their enthusiasm and their participation in the project, especially to Yannick Bresson and Renaud Gard, for their sharp actor skills.

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This research provides two key findings : from the young designers' point of view, the approach was centred on experience through theatre practice in order to develop a creative perspective on the concept. From the point of view of practical design, the approach has been defined in two steps : putting the features on centre stage, then improvising the object.

This method can be used as a basis to create breakthrough innovation projects for high technology interactive products, for which the actual user experience is central to the success of a product.

#### Acknowledgments

We would like to thank Jérôme Wacquier for theater practice, and the master course students of the Utc for





## Acknowledgements

The editors would like to thank Philips Design for sponsoring DeSForM 2007.

Special thanks go to the members of the programme committee; Prof. Robert Young, Prof. Steven Kyffin, Prof. Loe Feijs, Prof. Mattias Rauterberg, Prof. Bill Gaver, Dr Anne Guenand, Prof. Bernhard Buerdek, Dr Caroline Hummels and Jodi Forlizzi.

We would also like to extend our thanks to The School of Design at Northumbria University for hosting this years conference, and also the support given from; TU/e, IFIP, DRS and Interaction.

Finally, thank you to the organising committee, student volunteers and all our colleagues who helped make the DeSForM conference happen.







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ISBN-13: 978-0-9549587-1-8