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The roles that artefacts play: technical, social and aesthetic functions

Nathan Crilly – *University of Cambridge*

Abstract: *The concept of 'function' is often employed and sometimes defined in such a way that it only relates to how artefacts can be used to satisfy physical goals (e.g. transportation). Using artefacts to satisfy non-physical goals (e.g. social recognition) is typically described without reference to an artefact's function. By drawing on the various disciplines that are concerned with function, this article demonstrates that there are many different kinds of function, some of which will account for non-physical uses. By referring to these different kinds of function we can reduce the conceptual distance between physical and non-physical uses. Furthermore, by applying the concept of function to non-physical uses our understanding of such uses can benefit from prior work on function.*

Keywords: industrial design, interdisciplinarity, philosophy of design, styling, user behaviour

> "From fountain pens to baby buggies, products were designed with *non-functional* aerodynamic shapes in an attempt to create product appeal. … U.S. cars of the same era were decorated with such *non-functional* features as tailfins and chrome teeth."
>
> (Ulrich & Eppinger, 2003: p 190, commenting on the work of U.S. industrial designers of the 1930s.[1] Emphasis added).

Various attempts to categorise what people use things for distinguish between the functional and the non-functional. For example, the function of a motor car might be loosely defined as 'transporting people safely and conveniently', and using a car to satisfy such goals might be described as exploiting the car's function. Cars may also be used for many other purposes, including the expression of people's personal values or the

management of their social identity. Despite this, these other uses are typically described with respect to the car's symbolic value rather than its functionality (i.e. they are considered as 'non-functional' uses). Drawing such a distinction between different kinds of use is clearly thought to be productive as it provides the conceptual basis for considering the features that artefacts[2] possess and the ways in which they are understood and used.[3] However, despite the apparent benefits of distinguishing between the functional and the non-functional in this way, there are many definitions of function that would not support such a distinction.

This article suggests that by thoroughly exploring the concept of function we can consider all uses of artefacts to exploit artefact functions; they just exploit different kinds of function. In this sense, the terms 'use' and 'function' have a similar scope, but *people* use artefacts, whilst *artefacts* perform functions. In returning to our example of the car, we would then simply say that using a car for transportation is to exploit one of the car's functions (a technical function), and using a car to express personal values is to exploit one of its other functions (a social function). This is not just a question of semantics, but a distinction that is useful for two reasons: (i) the underlying connection between seemingly remote uses can be revealed; and (ii) well-developed ideas from one domain can be deployed in a domain in which ideas are less well-developed. With respect to the first point, regarding all artefact use as dependent on artefact functions reduces the conceptual distance between technical and non-technical artefact uses. This discourages adopting an attitude where exploiting an artefact's technical function (e.g. transportation) is privileged over employing it for other purposes (e.g. deriving social benefit from the artefact). With respect to the second point, considering artefact function as a concept that relates to non-technical uses (e.g. social uses) permits our understanding of such uses to benefit from the wealth of work done to understand function. This encourages consideration of, amongst other things, the goals these non-technical uses serve, the ways in which artefacts contribute to the fulfilment of those goals, the processes of selection by which artefacts are reproduced for their ability to make that contribution, and the extent to which that selection and contribution are recognised and acknowledged.

Design research, especially its more technical branches, has much to say about the concept of function, and such work is certainly useful to us here. However, there are other branches of enquiry that also provide compelling perspectives on function and these will be considered as the article proceeds. In particular, a branch of philosophy called *function theory* concerns itself with the definition of function as it relates to both biological systems and man-made artefacts. Despite this focus, function theorists have primarily concerned themselves with technical functions and most have given little attention to how their work applies to the non-technical. A more extensive consideration of non-technical functions is found in functionalist perspectives on sociology and art theory where the social functions of

institutions and the aesthetic functions of artworks are considered. Finally, by looking to archaeology, we find functionalist approaches to artefacts that consider both the technical and the non-technical in functional terms. By examining the different perspectives that these various disciplines adopt,[4] we can understand function to be a concept that both helps us to distinguish between the various ways in which products are used, and also helps us to connect those uses by describing them in a common language.

The article begins by considering the relationship between function and design, and by exploring how the concept of function has typically been defined. In recognising that such definitions are often broad in scope but restricted in their application, we can establish the potential for a more inclusive approach to the concept of function. This motivates a review of the different classifications of function that can be found in the various literatures. By considering how these classifications relate to each other, a function matrix is constructed; this indicates how the different function classes might be combined. An example artefact (the motor car) is then examined from the various perspectives that the function matrix suggests, thereby encouraging a more thorough consideration of that artefact's various roles. The benefits of taking such a function-based view of artefact use are then evaluated before suggestions are made for how the matrix might be further expanded and refined.

1. Functions and design

The concept of function is important for thinking about how designers and users relate to artefacts. This is because designers work to produce descriptions of artefacts that will perform certain functions (Suh, 1990: pp 25-26; Roozenburg & Eekels, 1995: p 53), and because users derive benefits from artefacts that have the capacity to perform those functions, or the capacity to perform other functions (Rosenman & Gero, 1998; Chandrasekaran & Josephson, 2000).[5] Despite this centrality of function to design and use, it is often complained that there is no stable or generally accepted definition of function available (Mahner & Bunge, 2001: p 81; Kroes & Meijers, 2006; Mital, Desai, Subramanian, & Mital, 2008: p 244). Some definitions emphasise that a transformation must take place for a function to be fulfilled (see Table 1, rows 3, 4(ii), 6 and 8), whereas others require that some purpose, goal or requirement must be satisfied (rows 1-4(i), 5, 7 and 9-12).[6] Looking outside the design literature, various definitions of function can also be found in philosophy, where although purposes are still considered (see Table 2, rows 3-6), emphasis is additionally placed on issues of planning (rows 5 and 6), selection[7] (rows 1, 5 and 7) and capacity (rows 2 and 5; also see Table 1, rows 4(i), 6, 11 and 12). In promoting an interpretation of function that includes many different kinds of artefact use, we shall first consider problems with the transformative definitions of function before explaining why those that are

less restrictive are more suited to considering the non-technical. In doing so, the aim is to explore how existing definitions can be applied to a broader range of artefact uses than are typically considered. No existing definition is prioritised and no new one is invented because the different definitions usefully emphasise different aspects of the roles that artefacts play (see Vermaas, 2009) and most of them will already admit the non-technical roles upon which we will focus.

1	"The function of a thing is its reason for existence, its justification and its end, by which all its possible variations may be tested and accepted or rejected" (Teague, 1940/1946: p 59)
2	"The mode of action by which a design fulfills its purpose is its function" (Papanek, 1972: p 5)
3	"…it is useful to apply the term *function* to the general input/output relationship of a system whose purpose is to perform a task" (Pahl & Beitz, 1977/1996: p 31)
4	"Two concepts are particularly useful in systematic design methodology: (1) Function as the duty the product must be capable of fulfilling ... (2) Function as a general connection between input and output ..." (Hubka & Eder, 1980/1982: p 106)
5	"*function*: the relation between a goal of a human user and the behaviour of a system" (Bobrow, 1984: p 2)
6	"The function of a product is the intended and deliberately caused ability to bring about a transformation of a part of the environment of the product" (Roozenburg & Eekels, 1991/1995: p 56)
7	"A function is what an element (system, part, component, module, organ, feature, etc) of a product or human actively or passively does in order to contribute to a certain purpose" (Warell, 1999: §6.2, defn 3)
8	"A function of a product is a statement of a clear, reproducible relationship between the available input and the desired output of a product, independent of any particular form" (Otto & Wood, 2001: p 151)
9	"The word function is … a description of the action or effect required by a design problem, or that supplied by a solution" (Chakrabarti & Bligh, 2001: p 494)
10	"Function (F) variables: describe the teleology of the object, i.e. what it is for" (Gero & Kannengiesser 2004: p 374)
11	"*Functions* … Those physical dispositions of an artefact that contribute to the purposes for which the artefact is designed" (Vermaas & Dorst, 2007: p 147)
12	"*Function* … serving given *purposes*: A set of physical dispositions such that any material object having them can be used in a way that contributes to the purposes" (Galle, 2009: p 332)

Table 1. Collection of definitions of function from the design literature. For other collections see works by Warell (1999), Chandrasekaran (2005), Erden et al. (2008), Mital et al. (2008: Ch 9) and Maier and Fadel (2009).

1	"The function of *X* is *Z means* (a) *X* is there because it does *Z*, (b) *Z* is a consequence (or result) of *X's* being there" (Wright, 1973: p 161)
2	"*x* functions as a ϕ in *s* (or: the function of *x* in *s* is to ϕ) relative to an analytical account *A* of *s*'s capacity to ψ just in case *x* is capable of ϕ-ing in *s* and *A* appropriately and adequately accounts for *s*'s capacity to ψ by, in part, appealing to the capacity of *x* to ϕ in *s*" (Cummins, 1975: p 762)
3	"the function of an artifact is the purpose or end for which it was designed, made, or (minimally) put in place or retained by an agent" (Neander, 1991a: p 462)
4	"The function or purpose of an artifact is the end to which it is a means – whether successful or unsuccessful – for whoever made it, aquired it, used it, is expected to purchase it, or is supposed to be given it as a present" (McLaughlin, 2001: p 47)
5	"The capacity to ϕ is ascribed as a function to an artifact *x* by an agent *a*, relative to a use plan *p* for *x* and relative to an account *A*, iff: I. the agent *a* has the belief that *x,* when manipulated in the course of execution of *p*, has the capacity to ϕ, and the agent *a* has the belief that if this execution of *p* leads successfully to its goals, this success is due, in part, to *x*'s capacity to ϕ. C. the agent *a* can justify these two beliefs on the basis of *A*; and E. the agents *d* who developed *p* have intentionally selected *x* for the capacity to ϕ and have intentionally communicated *p* to other agents *u*" (Houkes & Vermaas, 2004: p 53 [ICE stands for *intentions*, *causality* and *evolution*])
6	"An artefact *x* has the technical function ϕ if and only if there is a use plan *p* for *x* such that (1) *p* has been assigned to *x* by an agent or group of agents that has the appropriate type of social position in relation to *x*, and (2) it is both true and socially recognized that there is considerable chance that competent execution of *p* with *x* will lead to the goals of ϕ" (Hansson, 2006: p 22)
7	"A current token of an artifact type has the proper function of producing an effect of a given type just in case producing this effect contributes to the explanation of historically attested, dominant patterns of use to which past tokens of this type of artifact have been put, and which thereby contributed to the reproduction of such artifacts" (Preston, 2009: p 48)

Table 2. Collection of definitions of function from the philosophy literature.

Much work on the concept of function has taken place in engineering design research where it is often claimed that functions involve the performance of some transformative operation. For example, Pahl and Beitz (1996: p 31) famously apply the term function to the general input/output relationship of a system (see Table 1, row 3; also see rows 4(ii), 6 and 8). However, this requirement for inputs and outputs clearly leaves many non-transformative functions unaccounted for, such as retaining, guiding and supporting. If a nail, a railway track or a bridge are not each converting some input to an output then it is difficult to account for the functions that they fulfil (Umeda & Tomiyama, 1997: p 42). Transformative notions of function also fail to account for human-centred aspects of product use, and this has prompted Warell (1999) to propose three distinct classes of function: operative functions (e.g. transforming, controlling), structural functions (e.g. connecting, supporting) and usability functions (e.g. simplifying, exhorting).8 In so doing, Warell brings issues of interpretation and interaction within the remit of function, whilst also preserving the device-centred issues that have traditionally been the concern of engineers.

Confusion over the definition of function and perceived limitations in the scope of its application, have encouraged the development of alternative concepts that relate design acts, artefacts and uses. Of most relevance here is the appropriation and adaptation of Gibson's (1968) ecologically inspired notion of *affordances* (Norman, 1988; McGrenere & Ho, 2000; Galvao & Keiichi, 2005; You & Chen, 2006). In particular, Maier and Fadel challenge the hegemony of function-based notions of design, and question the power of design theories founded on concepts of transformation (for a distillation of their views, see Maier & Fadel, 2009). Following Warell, they suggest a 'relational paradigm' for design (i.e. relating designers, artefacts and users) that is non-transformative. They base this on a concept of affordances, which they define as "what one system (say, an artifact) *provides* to another system (say, a user)" (p 19). Of particular interest here is that, Maier and Fadel do not limit themselves to considering only physical provisions, but extend their concept to include experiences, such as buildings *affording* aesthetics to occupants and passers-by (Maier, Fadel, & Battisto, 2009: p 396). Experience is thereby considered to be a separate category of affordance, dependent not just on the physical relationship between artefacts and users, but also on the beliefs and preferences of those users (Maier et al., 2009: p 402-3; also see Almquist & Lupton, 2010).

In exploring the relationship between function and affordance, Brown and Blessing (2005) state that consideration of function often assumes that the functional behaviour intended by the designer is the actual behaviour of the system, and that this is also the behaviour desired by the user. They suggest that affordances encourage a more environment-centric view where the users' interpretation of the artefact is emphasised, as is the potential for new uses to be assigned. In this perspective, functions are

defined narrowly, and affordances are defined to cover what functions miss. However, as we shall see in the discussion that follows, there are existing notions of function that account for capabilities and uses that are not intended by designers, that acknowledge the potential for new uses to be assigned, and that do not require a physical effect or transformation to take place. Therefore, many of the perceived limitations of transformative concepts of function are already addressed by *other* concepts of function without appealing to non-function-based concepts. Although concepts of affordance can certainly enrich our understanding of design and use, in this article attention is focussed on definitions and classes of function that already cover those aspects of design and use that affordances have recently been credited with addressing.

Examples of non-transformative definitions of function in design can be seen in Table 1, many of which emphasise that the function of a thing is what that thing is for, its *for-ness*,[9] or teleology (Gero & Kannengiesser 2004: p 374; also see Gero, 1990). Compared to the transformative definitions, these treatments are more compatible with the concepts of function considered by those philosophers who emphasise the role of goal-oriented intentional agents who design or use the artefact as some means to an end (Boorse, 1976: p 79; Losonsky, 1990: p 84; McLaughlin, 2001: p 47; Houkes & Vermaas, 2004). This emphasis on agents and their goals leads to recognition that unlike properties (such as length or mass, which are objective and descriptive), functions are both subjective and normative: *subjective* because they are assigned to artefacts by people rather than being intrinsic to the artefacts themselves (Achinstein, 1977: p 357; Searle, 1995: pp 13-14; 2007: p 8); and *normative* because with the introduction of function, we move from the idea of what an artefact is like to the idea of what it should do (Kroes, 2001: p 5; Franssen, 2006; Searle, 2007: p 8).[10] The consequences of this are that different people may assign different functions to a given artefact, and that artefacts may perform more or less well with respect to the functions that they have been assigned.

By recognising that functions are assigned to artefacts with respect to the roles that those artefacts serve, we are discouraged from considering functions as necessarily relating to technical uses. This is because artefacts can be assigned roles that are not physical and they can support the satisfaction of goals that are not practical. In this sense, although philosophers' definitions of function have often been developed to account for 'technical artefacts',[11] these definitions are often sufficiently broad to include artefacts that perform non-technical functions. For example, none of the definitions in Table 2 make explicit reference to physical means or physical effects, and many of those in Table 1 do not either.[12] For our purposes here, the core element of such broad definitions is that *an artefact is assigned a function if it is taken to have the capacity to play some role for an agent using the artefact in some context*.[13] The roles that artefacts play might generally contribute to satisfying a variety of human goals and therefore

any use to which an artefact might be put involves the artefact functioning in some way. This suggests that there might be various different types of function that are assigned to artefacts according to the goals that the person making the assignment is considering.

It is well known that people pursue a variety of goals (Chulef, Read, & Walsh, 2001), and that artefacts are valued for the roles they play in fulfilling those goals (Csikszentmihalyi & Rochberg-Halton, 1981; Dittmar, 1992; Richins, 1994).[14] However, those goals and roles are seldom all considered in functional terms as it is common to distinguish between the functional on the one hand and the non-functional on the other. For example, Park (1986: p 136) distinguishes consumers' *'functional'* needs from their 'symbolic' and 'experiential' needs, and Crozier (1994) distinguishes response to an artefact's *'function'* from response to its 'form' and 'meaning' (for similar distinctions see Prentice, 1987; Fournier, 1991; Johar & Sirgy, 1991; Ligas, 2000; Boivin, 2008: pp 4-6). In each case, the functional relates to the satisfaction of instrumental (often physical) goals whereas the other categories relate to the satisfaction of sensory, psychological and social goals (see reviews by Crilly, Moultrie, & Clarkson, 2004; Rafaeli & Vilnai-Yavetz, 2004). It would thus seem that those researchers most interested in how artefacts are experienced tend to view function as relating to a particular component of that experience – *and often the component they are least interested in* – rather than as an underlying concept by which much of that experience can be understood.

Although many authors interested in the experiences of users and consumers have associated the functional with the technical, there are also those who argue that function should be considered as a general concept that includes the non-technical. For example, Papanek (1972: pp 6-20) argues that that which is often referred to as 'functional' (i.e. the technical or the practical) is really only one part of what he describes as the *function complex,* a set of functions that includes 'association' and 'aesthetics'.[15] Similarly, Roozenburg and Eekels (1995: p 57) consider function to be a general concept, that includes not just the technical, but also the 'ergonomic', the 'aesthetic', the 'semantic' and the 'social'. Whilst such work brings the technical and the non-technical under the same functional heading, the idea is scarcely developed further, and theories of function are seldom used to explore or illuminate this broader set of possible artefact roles. Where theories of function *are* related to non-technical uses, it is often done only in passing and is seldom central to the authors' concerns (but see Preston, 2000).[16] As a result, there is still little discussion of what a complete set of functions might include or what the relationship between those functions might be. In the sections that follow such a discussion will be offered, not by considering the different *definitions* of function that exist (as we have above), but by exploring the different *classes* of function that many of those definitions might admit.

2. *Classifications of function*

Having considered the technical bias that is often evident in discussions of function, and also the potential for a more inclusive understanding of the concept, we shall now investigate the different classifications of function that are presented in the literature. These classifications are drawn from various academic disciplines that are concerned with function, including philosophy, sociology, art theory and archaeology. Unfortunately, when considering functions these disciplines have often operated in mutual isolation and so the concepts that they have developed are seldom related to each other. As a consequence, the different classes of function that they describe do not readily combine into a single neat system of classification where the classes are mutually exclusive and collectively exhaustive (see Bailey, 1994; Bowker & Leigh Star, 1999). Instead, they constitute a flexible menu from which different function classes can be selected and combined according to the artefact uses that are of most interest.

We begin by considering how artefact functions might be classified according to the different *purposes* those artefacts serve or the *effects* they have or the *means* by which those effects are realised. We then proceed by considering how functions might be classified according to whether or not (or to what degree or by whom) artefacts have been *selected for* or were *intended to be* or are *recognised as* performing their roles. Classifying functions according to purpose, effect or means helps us to consider the different roles that artefacts play. For example, an artefact might perform a technical, social or aesthetic role, or might perform some combination of those roles. Classifying functions according to selection, intention and recognition helps us to consider the different ways in which a particular role might be regarded as an artefact's function. For example, it might be because performing that role is what the artefact is meant to do, what it can do, what it's believed to do or just what it does.[17] Having explored these different types of classification separately, we are then in a position to explore the relationships between them and the opportunities for combining them.

2.1 *Classification according to purpose, effect or means*

Although developing an expanded concept of technical functions is not really our project here, before proceeding, it is worth noting the different kinds of technical functions with which non-technical functions might be contrasted. We saw earlier how Warell (1999) has sought to overcome the limitations of an entirely transformative conception of function by defining three different *classes* of function: operative functions, structural functions and usability functions. Operative and structural functions can be further categorised according to the energy forms involved, and therefore mechanical (including sonic), chemical, thermal, nuclear, electrical, and

electromagnetic functions can be envisaged (for more expansive classifications of operative and structural functions see Kirschman & Fadel, 1998; Hirtz, Stone, McAdams, Szykman, & Wood, 2002).[18] In combination, these different systems of classification yield function classes such as mechanical connection (structural) and thermal regulation (operative). For the usability functions, we can employ the traditional ergonomic distinctions between the sensory, the physical and the cognitive (Hartson, 2003). Each of these in turn can be effectively subdivided according to the different senses employed (vision, hearing, etc.), the different physical capabilities required (dexterity, locomotion, etc.) and the different mental processes involved (memory, attention, etc.).

With some idea of the different functions that are implicitly subsumed within the technical, we can now seek to understand something of the variety of non-technical functions that might also be considered, and something of how those functions relate to the technical. Again, no detailed system of classification is readily available for this purpose, and such a system may not be possible given the multitude of perspectives from which human experience can be viewed. However, we can still benefit from drawing on the classificatory systems of different authors, and we shall in turn attend to: (i) Searle's distinction between *physical and status functions*, (ii) Binford and Schiffer's distinctions between *techno-, socio- and ideo-functions*, and (iii) the *aesthetic and non-aesthetic functions* that have been discussed by various art theorists. Here, as in the later discussions, each classificatory system is illustrated with the examples that their proponents offer because these examples have become canonical within their fields and the ongoing arguments found in the literature often refer to them.

It is common to assign functions to artefacts where those functions depend on the artefacts' physical properties or behaviours; these are 'physical functions'. However, in seeking to demonstrate the continuity between the physical world and the social world, Searle (1995: p 21) defines a special class of functions called 'status functions'.[19] Here, an agent intentionally uses an artefact to represent something else – something independent of the artefact itself. With status functions, Searle claims that people collectively impose functions on artefacts where those functions cannot be achieved solely in virtue of the artefacts' physical properties or behaviours. Instead what is required is "continued human cooperation in specific forms of recognition, acceptance, and acknowledgement of a new *status* to which a *function* is assigned" (Searle, 1995: p 40; also see Mumford, 1998: p 203).[20] Searle presents the simple example of a wall that physically prevents people from crossing a boundary; that is the function of the wall. If this wall then crumbles to the point that it is only a line of stones then it can no longer physically prevent people crossing the boundary. However, if people recognise that particular line of stones as marking the boundary, and if that recognition prevents them crossing the boundary then the line of stones may still achieve the same function even though that function is

now achieved by virtue of the stones' symbolic status rather than their physical capacities (Searle, 1995: pp 39-41; 2007: p 12).[21] In this way, Searle demonstrates how artefacts assigned a status function can achieve effects similar to those assigned a physical function, even though those effects are achieved by very different means.

If artefacts can perform functions by virtue of their culturally accepted meaning, and if these functions permit the performance of roles that might otherwise be performed physically, then collecting the technical and the non-technical under a common 'functional' heading makes sense. Such thinking can be seen in the work of Binford (1962: p 219), who distinguishes between three major functional subclasses of material culture: technomic artefacts which function with respect to the physical environment, socio-technic artefacts which function with respect to the social system, and ideo-technic artefacts which function with respect to the ideological components of a culture. Whilst Binford explicitly uses these terms as labels for different categories of artefact, Schiffer and colleagues adapt them to define three different categories of function: 'techno-functions', 'socio-functions' and 'ideo-functions' (Rathje & Schiffer, 1982: pp 65-67; Schiffer & Skibo, 1987: p 596; Schiffer, 1992: pp 10-12; Skibo & Schiffer, 2008: p 110). By distinguishing between function types rather than artefact types, these different functions can all be assigned to any single artefact according to the context of use. For example, the techno-function of a chair is to support a seated person, but it may additionally have the socio-function of expressing social position and the further ideo-function of perpetuating hierarchy within an organisation. Even artefacts that are ostensibly entirely technical may also perform socio- and ideo-functions. For example, electrical power systems, in their early stages of adoption, did not just provide heat and light, but were also representative of a company's or a community's commitment to modernity; representing that commitment was one of the functions that the power systems performed (Schiffer, 2001: p 218).[22]

Binford and Schiffer's categories of techno-, socio- and ideo-functions have been brought into function theory and further developed by Preston (1998: pp 246-247; 2000: pp 29-30), whose work is discussed later. However, the coherency and completeness of these functional categories has seemingly escaped scrutiny and no alternatives have been suggested. If we look for other categorisations of human experience to which the Binford-Schiffer scheme might be compared, then Tiger's (1992: pp 53-60) four basic categories of pleasure are notable for their terminological similarity: physio- (sensory experiences), socio- (collective or shared experiences), psycho- (individual enjoyment and satisfaction) and ideo- (intellectual and aesthetic experiences).[23] Tiger acknowledges that his categories are loose, and we need not consider them to be complete for the purpose of classifying function, a purpose for which they were not developed. However, they do indicate the incomplete nature of Binford and Schiffer's

classificatory schemes, and suggest that a broader range of non-technical function classes might be considered. In particular, Tiger's ideo- category is different to Binford and Schiffer's ideo- category because Tiger's does not relate to ideology, but instead to intellectual and aesthetic experiences. At the very least therefore, aesthetic functions should be considered as a separate class, especially as the functionalist theories of art provide some convenient foundation for this.

In arguing against institutional, historical and practice-based definitions of art, Stecker suggested that artworks must fulfil (or at least be intended to fulfil) a *function* of art (Stecker, 1994: p 255).[24] In promoting this function-based conception, Zangwill (2001: pp 124-5) claims that "just as hearts have the function of pumping blood, and spades have the function of enabling us to dig, so works of art have the function of embodying or sustaining aesthetic properties, such as beauty, elegance, delicacy, daintiness, and dumpiness" – these are 'aesthetic functions'. Of course, art may also have 'non-aesthetic functions', such as representation (of some object), revelation (of some truth) or provocation (of some action), but such non-aesthetic functions are not essential for making an item an art work *per se* (Stecker, 1994: p 260; also see Zangwill, 2001: p 141; Hansson, 2006).[25] Whilst aesthetic and non-aesthetic functions can seemingly be independent of each other, they can also be inseparable if the outer form that is considered appropriate for a particular artefact kind is not considered appropriate for another (Zangwill, 2001: pp 141-142). Such notions apply not just to domains that have traditionally been considered in aesthetic terms, such as nature, art and architecture, but also to everyday artefacts, such as furniture, vehicles and tools. That is, people appreciate the aesthetic qualities of such artefacts in addition to any utilitarian benefits that are offered, but such qualities should generally be appropriate to the utilitarian purposes to which those artefacts are suited (Parsons & Carlson, 2008: pp 167ff).[26]

In reviewing the three classifications of function described above, some basic relationships between their classes might be suggested. Searle's physical functions will often be seen to map onto Binford and Schiffer's techno-functions, and ideo- and socio-functions depend on the status that is assigned to artefacts. The relationship between socio- and ideo-functions is not so clear, but we might regard ideo-functions as a special class (a subset) of socio-functions, as they both involve the expression of values and depend on collective agreement. The addition of aesthetic (or aesthetico-) functions allows us to include those functions that operate at a personal level but do not require (yet may still permit) the expression of values to others. This means that the seven function classes outlined above can usefully be reduced to *technical, social and aesthetic functions*, but this is clearly incomplete because a range of non-technical functions still remains unaccounted for. For example, we can imagine that artefacts might perform functions that are psychological (including affective), political, economic,

and so on, but a serious discussion of such types of artefact function has not been uncovered here.

In the absence of an exhaustive classification of the goals that artefacts serve, or the ways in which they serve those goals, we might regard technical, social and aesthetic functions to be an indicative rather than definitive set. However, because these functions relate to three different branches of design research, they do demonstrate the broad applicability of the concept of function. In doing so, they effectively illustrate the variety of roles that might be considered in functional terms even if those are not the terms in which such roles are typically considered. Distinguishing between the technical, the social and the aesthetic in this way results from classifying functions according to the different purposes to which artefacts are put, the different effects they have or the different means by which those effects are realised. As we shall see below, functions can be distinguished not just according to purpose, means or effect, but also according to issues of selection, intention and recognition. This is particularly important for the consideration of non-technical functions because the performance of those functions is often something that artefacts are not selected for having done, intended to do or recognised as doing.

2.2 Classification according to selection, intention and recognition

However we might classify an artefact's purpose, means or effect, there is always the question as to whether we are concerned with what an artefact's *function is*, or simply what that artefact *functions as*. This is the difference, for example, between claiming that the (technical) function of a car is to provide transportation, and claiming that, in a particular instance, a car (again, technically) functions as a barricade. Issues like this can be approached from a number of different perspectives, and we shall here attend to: (i) issues of selection and capacity – distinguishing between *proper and system functions*, (ii) the question of whose intentions are definitive – distinguishing between *design, use and service functions*, and (iii) the extent to which an artefact's functions are intended and recognised – distinguishing between *manifest and latent functions*. Whilst some of these distinctions are often made with respect to technical functions, as we shall see later, they can just as well be made with respect to non-technical functions such as those discussed in the previous section.

Philosophical function theorists have long concerned themselves with the task of distinguishing between the function that an artefact *should serve*, either by intention or selection, and the functions that it simply *is capable of serving*, whether by accident or otherwise (for classic arguments see Wright, 1973: p 161; Cummins, 1975: p 762). The term 'proper function' was defined by Millikan (1984) to cover the former category, and the term

'system function' was defined by Preston (1998) to cover the latter. According to this terminology,[27] proper functions are those which explain the artefact's existence on the basis of its selection history, whereas system functions are those determined simply by the capacity of the artefact to perform a role within some context. To use a popular example, the proper function of a hammer is to drive in nails because hammers get reproduced for their capacity to do so. If a hammer was used as a paperweight, that would be to exploit one of its system functions – a system function that it shares with many other physical objects, but for which neither it nor they (apart from paperweights) are reproduced.[28] Making one further distinction, we might use the term 'ongoing system function' to describe those cases in which a thing is permanently available and frequently used for a system function, but is never reproduced for that purpose – for example, chairs being used as a step ladder (Preston, 1998: p 241; Preston, 2000: p 32). If the original function becomes subservient to the ongoing system function, then the artefact may now be selected and reproduced for that new function and that new function may then become proper (Preston, 1998: p 241; Scheele, 2006: p 70).

The idea of a selection history defining an artefact's proper function stems from notions of biological evolution, where the natural selection and reproduction of traits encourages a normative view of the resulting trait's performance. Of interest to us here is that such notions of selection can be extended to artefacts, either because a similar selection takes place in the environment in which artefacts are designed, or in the environment in which they are used (Preston, 1998: p 218; Scheele, 2006: p 69).[29] Unlike biological organisms, this selection can lead to the survival and reproduction of artefacts because of their *supposed* performance (rather than their *actual* performance) if designers are mistaken about which features fulfil which functions (Griffiths, 1993: p 421).[30] Preston (1998: pp 245-246) extends this argument to selections made by the user also, employing the term 'phantom functions' to describe those instances in which artefacts (such as those in ritual, beauty and health contexts) are routinely used and reproduced for purposes which they cannot fulfil. However, whilst phantom functions may at first appear to be a distinct class of function, all artefacts perform more or less well, and phantom functions are just the limiting case in a continuum of more or less successful operation (Preston, 2009: pp 46-47).

Considering whether functions are selected for by designers or by users prompts consideration of the intentional acts that these different agents perform. In this sense, Achinstein (1977) uses the terms 'design functions', 'use functions' and 'service functions' to distinguish between what an artefact is designed to do, what it is used for, and what it actually does in serving a benefit to something.[31] To illustrate, he gives a fictional account of a throne that is designed to seat the king (the design function), but is used by the guards to block a doorway (the use function), and yet is so

beautiful that it attracts crowds of spectators who make financial contributions to the upkeep of the palace (the service function). The difference between these functions is determined by which agent's intentionality is considered definitive: design functions are intended by designers; use functions are intended by users; and service functions need not be intended by either party (they might just be recognised by the agent making the ascription, e.g. an onlooker).[32] Whilst these categories have some intuitive appeal, there are four complications that are worth acknowledging before we proceed. First, acts of design and use may each be seen as inventive, creative and transformative (Preston, 2003: pp 606-608; Vermaas & Houkes, 2006); this blurs the boundary between design functions and use functions. Second, designers may attempt to communicate their intended function to users, and users may infer the designers' intended function from the artefact (Dipert, 1993: p 5; Houkes, 2006);[33] this connects design functions and use functions. Third, as users recognise the benefits that an unintended artefact function bestows on them, they may then intend that artefact to fulfil that function; this means that service functions can be converted to use functions. Fourth, as products progress from one generation to the next, functions that were originally only intended by users may later be accepted and promoted by designers (Faulkner & Runde, 2009); this means that use functions can be converted to design functions.[34]

Whilst functions can be considered with respect to the intentions of different agents, they can also be considered with respect to the strength of those intentions and the degree to which they are recognised and acknowledged. In promoting this approach, the social theorist, Merton distinguishes between what he terms 'manifest functions' and 'latent functions'.[35] Manifest functions are defined as those objective consequences that are intended and recognised by participants in the system, whereas latent functions are neither intended nor recognised by those participants (Merton, 1957: p 51; also see Searle, 1995: p 22; Mahner & Bunge, 2001: p 90).[36] By way of example, both Merton (1957: p 69) and Coser (1977: pp 271-272) refer to Veblen's (1899) notion of conspicuous consumption, in which rare and expensive goods are acquired not in the pursuit of quality and performance, but to demonstrate their owners' financial wealth and social status (also see Almquist & Lupton, 2010). It is important to note that these latent functions need not be secondary to the (manifest) functions that the artefact is ostensibly for. On the contrary, although neither recognised nor acknowledged by all the actors in the system, latent functions may well be the very reason that the artefact continues to be developed, produced and used. In this sense, Stinchcombe (1968: pp 84-85) suggests that where users offer a variety of reasons or purposes for their own behaviour, or for what an artefact is for, the presence of latent functions should be suspected.

In reviewing the three classifications of function described above, some similarity or overlap between their classes can be identified. For example,

in most cases the proper function assigned to an artefact will also be a design function, and an artefact's use function will often be a system function. Considering a proper function to additionally be a design function, or a use function to additionally be a system function will seldom add much information to the description of those functions. Consequently, some preference would normally be exhibited for distinguishing functions according to *either* selection, intention or recognition, with that choice depending on the focus of the analysis. That is, our choice would be based on whether we are interested in why an artefact is reproduced (perhaps then using proper and system functions), on who assigns the functions (perhaps then using design, use and service functions), or on how that assignment is recognised and acknowledged (perhaps then using manifest and latent functions). As we shall see below, such distinctions might be made with respect to any of the function classes considered in the previous section, whether those are technical, social or aesthetic.

3. Combining function classes

In the preceding sections, a number of function classifications were presented, each of which contains a number of function classes. In considering how these classes might be combined, some general observations can be made. First, certain combinations are *redundant*, in that they involve classes that are highly similar or even coincident in scope. For example, distinguishing a technical function as additionally being a physical function does not refine the sense of that function any further. Second, we can note that this redundancy is *directional* if one class encompasses another. For example, all ideological functions are status functions but not all status functions are ideological functions. Third, certain combinations are *conflicting*, in that they combine classes that are contradictory. For example, claiming that a technical function is also a status function is not really possible because of how those classes are defined. Fourth, certain combinations are possible but *ambiguous*, in that they are not logically incompatible, but neither do they seem to be especially descriptive of any functions that can be imagined. For example, it might be possible to consider a status function to also be a non-aesthetic function, but that seems to be more confusing than it is illuminating. Finally, certain combinations are *productive*, in that they involve classes that have been defined in ways that are meaningfully independent of each other. For example, determining whether a social function is also a proper function really would be useful in further distinguishing the type of function that was being considered.

By constructing a 'function matrix' that represents all possible class combinations (see Figure 1), we see that all the unproductive combinations arise from efforts to pair different classes from within the same set (either

both from within the *purpose-effect-means* set or both from within the *intention-selection-recognition* set). In contrast, productive combinations always arise by combining one class from one set and one class from another. Distinguishing between unproductive and productive combinations is partly a matter of judgement for the within-set combinations because the function classes have often been defined according to similar criteria but using different terminology.[37] However, for the seven-by-seven grid formed by the between-sets class intersections, the productiveness of the combinations is clear. This is because these two sets of classes result from systems of classification that are independent of each other and thus the classes from one set are truly orthogonal to those in the other. Even where we find productive combinations of within-set classes (e.g. proper-design functions or use-service functions), those classes will very often be coincident in practice even if their combination is not redundant by definition. Because of this, we will here concentrate on the between-sets combinations bounded by the bold seven-by-seven square in Figure 1; these are combinations which add the most information to our description of a given function.

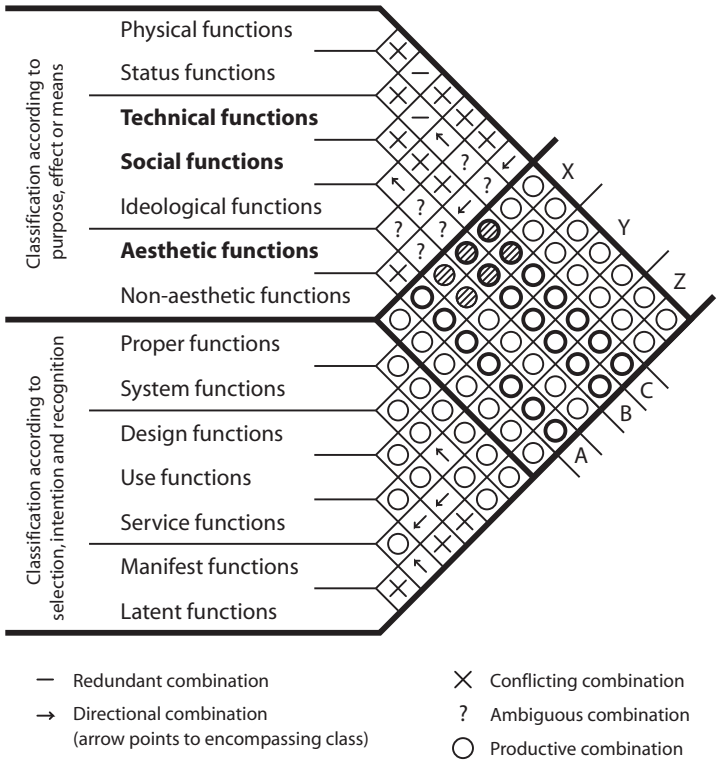

Figure 1. Function matrix representing how the different function classes combine. Each cell of the matrix represents one possible combination of two classes. The status of that combination is indicated with the associated symbol. Interpretation of the matrix can be simplified in three ways: (i) by focussing on only the 7×7 grid of productive combinations, as discussed in the main text; (ii) by focussing on only the bold 'rows' labelled A, B and C, as discussed at the end of section 2.1; (iii) by focussing on only one of the 'column' groups

labelled X, Y or Z, as discussed at the end of section 2.2. The combinations represented by the shaded circles have been discussed by Preston (1998: pp 246-247; 2000: pp 29-30).[38]

The productive combinations of between-sets classes include examples such as: *technical-use functions* (for artefacts that perform physical functions that are exploited by users but were not necessarily intended by designers); *social-service functions* (for artefacts that express some social value even though that need not have been intended by the artefact's designers or users); and *aesthetic-proper functions* (for artefacts that embody or sustain aesthetic principles and have been selected and reproduced for their capacity to perform that role). Forty-nine such combinations can be read from the matrix, but some simplification is possible if we restrict the purpose-effect-means set of classes to just the technical, social and aesthetic functions (as discussed at the end of section 2.1). Further simplification is possible if we recognise that the selection-intention-recognition set includes three ways to divide up functions that are different conceptually but often related in practice. Depending on our analytic objectives we would normally choose to distinguish between functions that are proper or system, between functions that are design, use or service, or between functions that are manifest or latent; using all three of these classificatory systems will seldom be necessary (as discussed at the end of section 2.2).

With a simplified interpretation of the matrix in place, we can either use it to define a particular artefact's function, to identify the range of functions that an artefact serves, or to describe the way in which an artefact's functions change over time. To illustrate this we shall now return to the example of the motor car introduced at the beginning of this article, and explore the various and changing roles that that artefact plays for different agents in different contexts.

3.1 Application to an example: the motor car

The motor car is an often cited example of an artefact that – *on an expanded understanding of function* – performs different kinds of function, and perform those functions in different ways (see Sparshott, 1963: p 200; Fennell, 1978: p 39; Rosenman & Gero, 1998: p 180; Mahner & Bunge, 2001: p 91; Skibo & Schiffer, 2008: p 118).The technical-proper function of cars might be – as is suggested in the introduction – 'transporting people safely and conveniently'. This technical function is one which depends on a number of subsidiary technical functions such as adequate acceleration, deceleration and cornering. A car's ability to perform these functions depends on its physical capacities (because they are physical functions or technical functions) and also on its ability to support the actions of the driver (through various ergonomic functions). In general, cars get reproduced because they perform this transportation function, and that is why this is their proper function. In certain contexts, cars are also used for

other physical purposes; they can function as barricades (for police roadblocks), as battering rams (for criminal acts), and as dwellings (for those in poverty). These functions all depend on cars exhibiting the capacity to perform specific roles in specific systems, but they are not the reason for which cars have been reproduced, and so they are system functions rather than proper functions. They are also, in general, uses to which the cars *can be put* (use functions) rather than uses for which they have *been designed* (design functions). This is the case even if designers are aware that such uses occur, but if such awareness leads to design acts that support these uses then a transition from use functions to design functions would occur. If that transition alters the reason for which cars get reproduced, then a transition from system function to proper function would occur also.

Whether proper or system, design or use, the functions described above are also technical because they depend on the *physical properties* of the car bestowing some *physical benefit* upon some user. Cars also perform non-technical functions, including social and aesthetic functions, and these functions cannot be entirely explained by reference to the physical properties of the car. A car's social functions might include the expression of things such as the user's personal identity, group membership and cultural values. Rather than depending on physical properties, these social functions depend on the collective understanding and agreement of the agents that make up the relevant community; they are social-status functions. A car's aesthetic function is to embody and sustain the sensory qualities appropriate to its type whilst also satisfying various constraints. These aesthetic functions are dependent on the formal properties of the car, and the capabilities and preferences of the audience. Transportation has already been defined as a proper function of the car, but an artefact need not have only one proper function, and proper functions also need not only be technical. Therefore, if the social and aesthetic functions contribute to the reason why cars get reproduced (as they surely do for some categories of car) then these are social- and aesthetic-proper functions (even if they are latent). Similarly, design functions also need not only be technical, and the car's social and aesthetic functions can also be social- and aesthetic-design functions.

The different functions outlined above need not be entirely independent of each other. For example, the social (or status) functions that a given car is able to fulfil might depend on the broader population's understanding of the car's technical (or physical) performance. The outward expression of ecological sensitivity might thus depend on public perceptions of a car's fuel economy, whilst the expression of authority might depend on perceptions of a car's power output. In such instances, the social functions are dependent on perceived or actual technical capacities. To take another example, if we consider the way in which a police car might be required to move quickly to the scene of some incident, this single requirement is

jointly fulfilled by both the technical and the social functions of the car. Physically, the car must attain and maintain the necessary speeds by virtue of various technical capacities, and culturally it is understood that the display of flashing lights indicates that the vehicle is serving some emergency and should be given priority. In this instance functions that are of different kinds – one technical and one social – serve the same overall goal of permitting rapid transit, but either of them in isolation may be insufficient to fulfil that goal. Considering these two examples in turn, we can see that a physical capacity of an artefact may contribute to the fulfilment of both its technical and social functions, and also that a physical goal may be jointly satisfied by an artefact's technical and social functions.

So far, our consideration of the car's functions has focussed on the uses to which its owners, drivers or passengers might put it. During its lifecycle, a car has many other stakeholders – whether those are individuals or institutions – and it performs different functions for each of them. For example, where manufacturers are concerned, particular models of car may function as artefacts that generate revenue (through sales), support the brand (through reviving a product line) or instil pride in employees (through representing the pinnacle of technology). For governments, cars may again function as revenue generators (through taxation), as a means of employment (through production) and as an outward symbol of industrial capability (through export). These financial, societal and political functions may either be manifest or latent depending on whether or not the agents using the cars (the manufacturers and governments) intend and recognise the effects that those uses have. They are also dependent on uses that are indirect, such as through incentives and legislation, and it is generally 'cars' in the collective that are being used rather than any particular instance or token of 'car'. However, because cars may nevertheless be used to achieve these particular effects for these agents, such effects are functions that cars can serve.

In the paragraphs above, cars have been described as playing various roles, including the provision of transportation, shelter, status and income. All of these roles result from some agent using the car to achieve some intended effect that is beneficial to them. The existence and use of cars also has many other unintended effects, such as the frustration of pedestrians, the congestion of roads and the pollution of the environment. However, these are not functions according to most definitions,[39] because although they are plausible (perhaps even transformative) effects that cars have the capacity to exert on people and systems, they are not effects that are selected for, planned or intended, and they do not satisfy any particular purpose (see tables 1 and 2). Of course, it is plausible that some agents (e.g. transport scientists or environmental lobbyists) do benefit from these effects in some ways (e.g. through payment or credibility). Nevertheless, these agents typically do not 'use' cars for these purposes because they cannot control them in ways that contribute to any related goals. So, not all of the effects

that cars have are functions, because not all of those effects are related to a purpose for which some agent is using the car.

What we see from the above discussion of the car is that attributing functions to a given artefact is a potentially complex act because that artefact can perform many different kinds of function and can perform those functions in many different ways. Function ascription requires consideration of not just the artefact, but also the agent and the context within which the agent and the artefact interact. Therefore, to account for something of the range of functions that an artefact might serve, we need to consider the various capacities which that artefact exhibits, the various systems within which it is embedded, the various roles that the artefact plays, and the various stakeholders who use the artefact to perform those roles. By considering such matters, the relationship between different functions can be examined, whether or not those functions realise the same type of effect, and whether or not those effects are achieved by the same means. Considering functions in this way brings us back to the quotation that opened this article and its seemingly common-sense claim that certain product features are non-functional. Such a claim depends, of course, on the definition of function that is adopted, but as we have seen, there are many definitions and classes of function that would permit even decorative or signalling features to be considered in functional terms if those features have the capacity to play some role for an agent who is using the artefact in some context.[40]

4. Discussion

The concept of function is often employed solely to describe the physical, the practical or the technical aspects of what things are for and what they do. However, we have seen that both in the design and philosophy literature there are many definitions of function that will (at least implicitly) admit the non-technical. By considering function concepts from other disciplines we have also seen that there are classes of function that explicitly account for the non-technical. It is therefore possible to consider a collection of function classes that can be employed for describing a broad range of artefact uses. Such function classes might be distinguished according to purpose, means or effect, or according to issues of selection, intention and recognition. The result is that the concept of function can be applied not just to technical uses, but also to non-technical uses such as the social or the aesthetic. At the beginning of this article, two distinct benefits of such a move were suggested. Firstly, it was claimed that we could reduce the conceptual distance between technical and non-technical uses, and secondly, it was claimed that our understanding of non-technical uses could benefit from prior work on function. Having now considered the concept of function in detail and having reviewed a variety of function classes, both of these claims can be examined more closely.

One consequence of considering technical artefact roles to be 'functional' and social and aesthetic roles to be 'non-functional' is that a sharp distinction is drawn between things that are really quite similar. Artefacts play roles for people, and people are motivated to use artefacts because of the roles those artefacts play. As such, functions are assigned to artefacts because they are taken to have the capacity to perform those roles. Artefacts can perform a variety of roles, and agents are motivated by a variety of goals. These roles and goals can be technical or non-technical, and therefore a broad range of artefact uses and features can be considered in functional terms. One consequence of this is that different aspects of user behaviour or user experience can be seen as connected to each other whereas they might otherwise only be seen as distinct. This challenges the common view in which technical artefact use is regarded as rational and instrumental whilst non-technical artefact use is regarded as something else altogether. Whether it is the technical or non-technical that is of interest, a function-based conception of use encourages consideration of the purpose for which artefacts are used, the effects that artefact use has and the means by which those effects are achieved.

Considering all artefact uses in functional terms can not only connect the technical with the non-technical, it can also contribute to our understanding of the non-technical. We obtain the language to explore how, for example, a single artefact may perform different kinds of function, how one kind of function may be dependent on another, how different kinds of function may achieve similar effects, and how functions can change between contexts or users. Distinguishing between function types rather than artefact types emphasises that there is a continuum running from artefacts that perform their roles physically, to those that perform their roles through social agreement or individual interpretation. Artefacts may move along that continuum over time (e.g. Searle's wall, see section 2.1) or may occupy more than one position on that continuum at any one time (e.g. the police car in section 3.1). Functional accounts of artefacts also emphasise the processes of selection by which artefacts are reproduced, the intentions of the different agents who engage with those artefacts, and the degree to which those agents recognise and acknowledge the roles that those artefacts play. Employing such perspectives to understand not just the technical but also the non-technical permits us to view all artefact use within the frameworks offered by functionalist accounts of technology, biology, society, culture and art.

The function classes reviewed, related and combined here have been constructed from the most relevant and best-developed function classifications found in the literature. Still other classifications of function may exist or may yet be created, and therefore the collection of function classes could be expanded. This might result in further development of the function matrix, either by refining the list of classes to be combined, or by constructing additional axes, or additional matrices. This would be

beneficial because, as discussed earlier, there are various kinds of purpose, means and effect that the existing matrix does not account for. However, it is hoped that the matrix prompts consideration of the different roles that artefacts play, and the potential for function concepts to account for those roles. In so doing, it is further hoped that the similarities and differences between those roles might be recognised, and that their interdependence and relative importance might be better understood.

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Notes

[1] Ulrich and Eppinger are here referring to the 'streamlining' movement which reached its peak in America in the 1930s and 1940s. This practice first influenced the form of vehicles (e.g. ships, aircraft, automobiles and locomotives), but later influenced the form of many immobile objects (e.g. office stationary, kitchen appliances and furniture) (Bush, 1975; Hanks & Hoy, 2005). For suggestions that such practices were a manifestation of broad social ideals that also shaped the interpretation and presentation of human forms see (Berney, 2001; Cogdell, 2004).

[2] In this article, the term 'artefact' is used in preference to 'product', 'service' or 'system', both because it is more general, and because it is in line with much of the non-design literature that is referred to. Artefacts need not be material, but may include non-material products such as software, organisations and processes (Galle, 2008: p 273). Hilpinen's (2004) definition is adopted here: "An artifact may be defined as an object that has been intentionally made or produced for a certain purpose". This admits a number of artefact types that are excluded by Dipert's (1993: pp 29-30) more restrictive definition: "An artifact is an intentionally modified tool whose modified properties were intended to be recognised by an agent at a later time as having been intentionally altered for that, or some other, use". By this definition, Dipert asserts that all artefacts perform a communicative role because they are intended to be interpreted as having been modified in some way (Dipert, 1993: p 102). For examples of artefacts (in Hilpinen's sense) that Dipert's definition would exclude see (Sperber, 2007: pp 128-9).

[3] The close relationship between the concepts of 'artefact', 'purpose' and 'use' can be seen in much of the work that is concerned with these concepts. Losonsky (1990: p 84) claims that artefacts have three features: (i) internal structure, (ii) purpose to which they are put, and (iii) manner in which they are used. Similarly, in examining artificial things, Simon (1996: p 5) states that the fulfilment of a purpose or the adaptation to a goal involves a relation between: (i) the purpose or goal, (ii) the character of the artefact, and (iii) the environment in which the artefact performs. Mitcham (1994: p 231) also defines three different but overlapping ways to consider the use of a technology: (i) it's technical function, (ii) the purpose or end to which the technical function is put, (iii) the act of using a thing to perform its technical function to realise some purpose.

[4] Amongst these disciplines, a clear difference can be observed between the design researchers' orientation to function, and the orientation of the philosophers, sociologists, art theorists and archaeologists. Whilst design researchers primarily consider the function of *future* artefacts (often emphasising design intention and the means by which an effect will be realised), scholars from those other disciplines primarily consider the function of *existing* artefacts (often emphasising use intention and the effect that is desired). The different treatment of function that is found in each discipline can thus be understood as resulting from both a different focus of study and a different anticipation of what such definitions might be used for.

[5] Artefacts are not just *used* according to their function, they are often *categorised* according to those functions, and some such categories are even *named* according to those functions (e.g. you use a hammer to *hammer* in nails) (Hilpinen, 1993: p 161; also see Price, 2001: p 11). However, the categorisation and naming of artefacts is a complex topic. Sometimes the name of an item is extended on the basis of its formal similarity to a prototypical item – a similarity of form rather than function (e.g. a glue *gun,* a palette *knife*), and sometimes the name of an item is extended on the basis of its functional similarity to a prototypical item – a similarity of function rather than form (e.g. a magnetic *key* card, a gas propellant *corkscrew*) (Malt and Sloman, 2007: pp 95-96). In this second sense, functions 'stick' to artefacts even when they are not in use, and the function of an artefact can be seen as a 'frozen goal', for which the artefact can be used as a tool. Therefore one can infer artefact functions from goal attributions because attributing goals to the use of unfamiliar artefacts could assist the social learning of artefact functions (Csibra & Gergely, 2007: pp 64-5).

[6] These many and varied definitions are reported to lead to a good deal of theoretical confusion, and to make the concept of function more difficult to approach and build on (Umeda & Tomiyama, 1997: p 42; Rosenman & Gero, 1998: p 165; but also see Vermaas, 2009). Whilst not ideal, this lack of conceptual precision perhaps only became critical when researchers became interested in the prospect of computers taking on functional reasoning tasks (Johnson, 1991; Chandrasekaran & Josephson, 2000). Consequently, there has been much recent interest – especially in artificial intelligence and engineering design – to clarify the concept of function and establish some shared terminology (Chandrasekaran, 2005;

Vermaas & Dorst, 2007; Galle, 2009). Whilst valuable, such work tends to focus almost exclusively on technical functions, and therefore we must look elsewhere if we are to use function as an inclusive concept that will account for how people use artefacts for non-technical ends.

[7] When considering which of an artefact's many effects are its function, adopting a selection-oriented perspective means that the artefact's function is related to the effect that it has been selected and reproduced for performing. Depending on the selection mechanism being considered (natural selection or market-based selection), an artefact need not be capable of actually performing a particular function, it just needs to be selected and reproduced for performing that function (see the discussion of proper and system functions in Section 2.2).

[8] Similarly, but with a focus on device-centric technical functions, Keuneke (1991) describes four different types of function: 'ToMake', 'ToMaintain', 'ToPrevent' and 'ToControl'.

[9] The term *for-ness* is here borrowed from Kroes and Meijers (2006: p 1) who say "artefacts have a purpose or function: they are objects to be used for *doing* things and are characterized by a certain 'for-ness'" (also see Franssen, 2009: pp 22, 26).

[10] Preston (2000: pp 27, 42) notes that not all conceptions of function are normative. For example, see (Cummins, 1975: p 762) – Table 2, row 2. Vermaas (2009: p 117) claims that it is not that functions and goals are subjective, or that structure and behaviour are objective; instead, it is the perspective (either agentive or structural) that determines whether a description is subjective and partial, or objective and complete (respectively).

[11] Although 'technical artefacts' have recently received much attention from function theorists (Kroes & Meijers, 2006; Krohs & Kroes, 2009), what it is that determines whether an artefact is technical remains unclear. For example, Kroes claims: (i) that "A physical object is the carrier of a function and it is by virtue of its function that that object is a *technological* object" (Kroes, 1998: p 18); (ii) that "It is by virtue of its practical function that an object is a technical object" (Kroes, 2001: p 1); and (iii) that "technical artefacts are objects with a technical function and with a physical structure consciously designed, produced and used by humans to realise its function "(Kroes, 2002: p 294). Whilst the terms *artefact* and *function* are well defined in this context, the prefix *technical* is relatively ill-defined but generally seems to refer to the practical, the physical or the functional. A later comment by Kroes and Meijers (2006: p 1) is more specific: "Technical artefacts such as typewriters, hammers, copying machines or computers are different from social artefacts such as laws or money in that the realization of their function crucially depends on their physical structure." Whilst this provides a better definition of technical (i.e. dependent on physical structure), it seems to assume a direct mapping between a type of artefact and a type of function. However, artefact type does not determine artefact use, and therefore even technical artefacts (however they might be defined) can be employed for non-technical ends and can perform

non-technical functions. In this sense, Hansson (2006) suggests that we shouldn't consider a distinction between functional and non-functional properties, but between practical and non-practical functions.

[12] Two recent definitions of function in the design literature that do specify physical means are those by Vermaas & Dorst (2007) and Galle (2009) (see Table 1, rows 11 and 12). In both cases this appears to originate in Vermaas and Dorst's (2007: p 146) restricted reading of Cummins (1975) and Searle (1995). For a more inclusive reading of Cummins see Preston (2000), and for a more inclusive reading of Searle see section 2.1 of this present article.

[13] It is sometimes suggested that there is no single correct definition of function, and that function is usefully defined in different (mutually incompatable) ways by different parties (Vermaas, 2009). However, Vermaas claims that these different concepts of function still relate to the role that an artefact plays in its environment for an agent when the agent uses the device (p 118). Environment centred descriptions ('function as effect') capture this role with respect to the influence that the artefact must have upon its environment when used; device centred descriptions ('function as means') capture this role with respect to the behaviour that the artefact must exhibit when used (also see Chandrasekaran & Josephson, 2000; Erden et al., 2008). It is these device centred descriptions that are often (but not always) transformative in nature.

[14] Exploring such values, Richins (1994) defines six categories of reasons a possession is valued: 'utilitarian'; 'enjoyment'; 'interpersonal'; 'identity'; 'financial'; and 'appearance' (a seventh 'other/unclassified' category is also listed).

[15] Urging against the distinction between form and function, Mayall (1979: p 46) presents a similar argument (and a similar diagram) to Papanek's; he represents the interconnectedness of a number of product characteristics: 'performance', 'safety', 'ease of control', 'comfort', 'attractive appearance', 'roominess', 'moderate purchase price' and 'low running costs'. Within other considerations of design there are occasional acknowledgements that factors such as the social or the aesthetic might also be thought of in functional terms, but these ideas are rarely developed. For example, in what is otherwise an entirely technical article on function sharing, Ulrich and Eppinger (1990) consider the sheet metal body on an automobile to perform not only electrical (grounding), structural and aerodynamic functions, but also an aesthetic function (compare this with the quotation with which this present article opens). An alternative use of the term function in considering the non-technical is the Offenbach 'product language' approach, where 'formal aesthetic', 'indication' and 'symbolic' functions are identified (along with more 'practical' functions). Although these functions are all considered to be relational (existing in the relations between an artefact and a user), they are not linked to any formal theory of function (Gros, 1984; Steffen, 1997; also see Monö, 1997).

[16] For example, in seeking a concise definition of function, Wright (1973: p 161) says that "the function of X is *Z*" means X is there because it does *Z*, and *Z* is a consequence (or result) of *X*'s being there (see Table 2, row 1). In response, Boorse (1976: p 74) notes that the hood (or bonnet) ornaments on cars are often described as non-functional, but that this is difficult to explain according to Wright's analysis. Hood ornaments are intended to create an image of opulence and they are successful in that, and they are also there because they do that. Non-functional in this sense is therefore taken to mean that the hood ornament fails to contribute to the goal of transportation.

[17] Preston (2000: p 30) refers to these as 'ontological' classifications rather than the 'content-based' classifications such as those proposed by Schiffer.

[18] In describing interactions between people and artefacts, Schiffer (1999: pp 13-15) considers a similar energy breakdown.

[19] For Searle, status functions are a special class of 'agentive functions' (Searle, 1995: pp 20-21). Agentive functions are those that are assigned relative to the interests of a conscious agent who puts those functional items to some use (e.g. using a hammer). Nonagentive functions are those that are assigned to naturally occurring objects and phenomena from which some agent derives a benefit (e.g. a beating heart). Searle (1995: pp 20-22) applies non-agentive functions to artefacts also, saying for example that whilst the agentive function of money is to act as a medium of economic exchange it also serves the non-agentive function of maintaining systems of power. Searle thus compares his agentive/non-agentive distinction to the manifest/latent distinction discussed in section 2.2 of this present article. For a commentary on Searle's concepts of function see (Kroes, 2003).

[20] Searle suggests that linguistic marks such as letters and words are the most famous examples of artefacts that are assigned status functions. Similarly, Mumford (1998) lists flags, protests, rules and road signs as examples of things that function by convention.

[21] Rosenman and Gero (1998: pp 169-170) describe function as the result of behaviour, and say that a function may be physical, such as 'providing sufficient space', or a non-physical, such as 'providing an ambience'. Similarly, Kitamura and Mizoguchi (2009: p 214) distinguish between function ascriptions that relate to an artefact exerting a physical effect on its environment, and those that only relate to an artefact setting up the necessary conditions for interpretation by some conscious agent. An example of the former is an electric fan, the function of which is to move air around in a room, whilst an example of the latter is a clock, the function of which is to inform people of the time.

[22] It is possible, of course, to be motivated by a social function that is dependent on a technical function even if that technical function is not of interest to us. In a different but related sense McLaughlin (2001) distinguishes between intermediate and ultimate functions. For example, electric fences deliver small electric shocks to

livestock in order to keep them away from the fence and therefore contained in the field. We are at best disinterested in the intermediate function of delivering shocks – and may actually be opposed to it – whilst being interested and motivated by the ultimate function of containment. The former is the means by which the latter is achieved (McLaughlin, 2001: pp 55-56).

[23] For the application of such categories to design see (Jordan, 2000).

[24] Stecker (1994: p 261) develops a more formal definition: "let *C* be the set of central art forms at time *t*; let *F* be the set of functions standard or correctly recognized for an item belonging to *C*, then

> *w* is a work of art at *t* if and only if (a) *w* belongs to form *C*, and the maker of *w* intended it to fulfil a function in *F*, or (b) *w* is an artefact that achieves excellence in fulfilling a function in *F*".

[25] Stecker elaborates this with an example: "a sculpture might function as someone's doorstop without *being a doorstop* becoming a function of art. … Being a doorstop is not a standard or correctly recognized function of *sculpture per se* any more than being a paper weight is such a function of hammers" (Stecker, 1994: p 260).

[26] For a thorough review of other non-definitional aesthetic and semantic functions in design see (Warell, 2001: pp 67-75).

[27] Both these terms have unfortunate intuitive readings, but they are retained here because of their widespread adoption in function theory. The use of the term 'proper' does not imply any judgement of correctness; it simply comes from the latin *propium*, meaning *one's own* (Millikan, 1999: p 192). The use of the term 'system' does not refer to the function *of a* system, but to a component's function *in a* system. More precisely, system functions are an artefact's or organism's present capacity to perform a specific role within the context of a specific system (Preston, 2000: p 25). Other theorists use alternative terms with similar meanings, such as Neander's (1991b) 'causal role functions', Millikan's (1999: p 193) 'Cummins function' (after Cummins, 1975), and Houkes and Vermaas' (2004) 'accidental functions'.

[28] In a concept similar to system functions, McLaughlin (2001: p 51) considers an item's *functional propensities* to be all the functions that an item ever had or might have for any stakeholder. He gives the example of coat hangers, some of which may have the potential function of propelling arrows if playing children can use them as archers' bows.

[29] In seeking to extend selection-based accounts of function from the biological to the artefactual realm, Griffiths (1993) discusses the presence of what he calls 'vestigial traits'. Here, a trait that once performed one function continues to be reproduced even though it no longer performs that function and may instead perform another. Giving the example of Maori 'fish-hook' pendants he says: "They

are vestiges, not merely because they cannot perform their original function but because they have not been selected in virtue of their original function for so long that they would have been eliminated if they had not acquired a second, decorative function" (Griffiths, 1993: p 420). Griffiths is here considering design as a process that generates a set of alternatives which are then selected from. For arguments surrounding such ideas in the design literature see (Steadman, 1979; Langrish, 2004; Whyte, 2007). For a discussion of the relationship between biological and artefactual functions see (Godfrey-Smith, 1993; Davies, 2001: pp 7-8; Lewens, 2004). Despite the conceptual benefits of defining proper functions in terms of selection, it is often noted that this poses a problem for attributing a proper function to the first instance of an artefact (e.g. a prototype) if that artefact is not thought to have been selected from any predecessor (see Preston, 2006.)

[30] Griffiths (1993) proposes some biological artefacts that complicate this view. Suppose pigeon breeders select for long tails in the mistaken belief that it supports rapid flight: the artefact function of the long tail is fast flight, but the biological function is "to fool people into thinking it is useful" (Griffiths, 1993: p 421) – here the interpreter is human and the bird is the artefact. Also see (Sperber, 2007).

[31] Similar distinctions can be found elsewhere. Kitamura and Mizoguchi (2009: p 208) distinguish between essential functions (relating to design intent) and accidental functions (for uses unintended by designers). Sparshott (1963) distinguishes between basic functions, inessential functions and parasitic functions. Taking the multiple functions of the car as his example, he claims that:

> "[S]ome … functions are parasitic: cars do not exist to provide taxation, but are taxed because they already exist, and revenue could equally well be raised from other sources. The basic function of the car is to get people from place to place, and it is this need, with the social refinements thereof, that brought the car into being, made it a popular institution and saved it from extinction. Between the basic function and the parasitic one comes the inessential: cars are singularly well adapted to the erotic adventures of the young but it did not come into being for that purpose, and this aspect of their utility would probably not suffice by itself to save them from extinction." (Sparshott, 1963: p 200)

[32] Service functions describe the benefit that an artefact offers without that artefact necessarily being put to that particular purpose, or being used as a means to that particular end. As such, the assignment of service functions need not entail commitments to a particular set of values. An artefact may be assigned the service function of bestowing a certain condition upon a user, even if the agent making the assignment does not consider that condition to be beneficial (Achinstein, 1977: p 355). McLaughlin (2001) also notes that function bearers confer some good, but that that good need not be approved of generally, and the perpetrator need not ultimately be happy with the conferred good: "Your value judgement that *Y* is frivolous does not prove that I pursued no perceived good in aquiring the *X* that does *Y*. The pursuit of happiness has something irrevocably first person about it"

(McLaughlin, 2001: p 58). In this sense, functions should confer some good (including pleasure), but that good need not outweigh some bad (Sorabji, 1964); overall therefore, Wright (1973: p 146) claims that functions can rightly be silly, useless or harmful.

[33] Houkes (2006) says designers communicate use plans in which artefacts are embedded (the artefacts may be embedded in the plans – but the communication may also be embedded in the artefact). Designers do not just inform users about possible artefact uses, they privilege one use by communicating it (Houkes, 2006: p 111). From the users' perspective, Dipert says "We consciously speculate, or make habitual and unconscious inferences, about their [objects'] functions, purposes and historical origins in individual minds or in cultures. And finally we use them in a way that is inspired and directed by these speculations and inferences." (Dipert, 1993: p 5; also see Dennett, 1987: p 17; 1990; Crilly, Good, Matravers, & Clarkson, 2008: pp 440-442). Boorse (1976: p 82) claims that such appeals to designers' intentions for the purpose of determining function are justified because designers represent a reliable authority on how a given artefact works.

[34] Faulkner and Runde (2009) offer an extended discussion of the record player as its role changed from a playback device to a musical instrument (in the form of the DJ turntable). This change is described as a radical change in function (or 'technical identity') with almost (and initially entirely) no change to the artefact's structure despite being marketed as a new artefact kind (also see Redström, 2008: pp 419-20).

[35] Merton is here applying the concept of function to human society, an approach that is based on an analogy between the social and the biological. However, this analogy breaks down because (i) in human society, social structure is to a large extent only visible in social function (whereas biological morphology can often be observed independently of physiology), and (ii) in human society, social structures can be reconfigured into new forms (whereas few organisms change their structural type in the course of life) (Radcliffe-Brown, 1935: pp 394, 396-397).

[36] In criticising Merton's work, Isajiw (1968: pp 78-82) points out that by conflating intention and recognition, Merton's classification of function is confused. Isajiw separates these concepts, and additionally distinguishes between conscious and unconscious intention. This results in three classes of function: 'manifested' (consciously intended), 'unmanifested' (unconsciously intended) and 'latent' (unintended), each of which may either be recognised or unrecognised (ultimately resulting in six classes of function).

[37] Even determining the relationship between function classes that originate from the same author is not always clear because some classes may not be mutually exclusive, but still might not be combined in the literature. For example, the matrix indicates that design, use and service functions can be productively combined. Achinstein (1977) is not explicit on this point but such an interpretation of his categories is possible (see Tolhurst, 1984: p 265) because he offers examples that are simultaneously design, use *and* service functions. To take another example, the matrix also indicates that proper

functions and system functions may in some cases coincide, but in other cases they may not. For example, a healthy heart's pumping blood is both a proper and a system function; a malformed heart has the proper function of pumping blood but might not possess this system function; a heart's making a noise for diagnostic purposes is a system function but not a proper function. A variety of other interpretations are possible here, as is discussed by Preston (2006: p 18; also see Walsh & Ariew, 1996). Attempts to decide on the combinatorial status of within-set classes from different fields is even more difficult because they are seldom defined (or discussed) in the same terms. As such, the within-set combinations represented by the matrix simply indicate one possible view.

[38] Preston adopts Schiffer's categories and applies them to the study of function in material culture. In doing so, she overlays the concepts of proper function and system function, and thereby applies these terms to socio- and ideo-functions rather than just techno-functions (as had previously been the case). Extending Schiffer's functional analysis of the chair, Preston can then say that because thrones are reproduced in order to represent authority that is one of their proper functions, a proper ideo-function. In contrast, if an ordinary chair is reproduced only to serve its basic techno-function but becomes the hereditary throne of rulers then representing authority would be a system function, a system ideo-function. For a summary of Binford, Schiffer and Preston's work on the techno-socio-ideo distinction see (Conkey, 2006: p 365).

[39] Rosenman and Gero (1998) *would* consider these effects as functions because they define functions as the results of behaviours. "While cars are designed for the purpose of transporting people…, they also effect unintended (and disadvantageous) functions such as occupying space, producing effluent gases, producing noise, etc." (Rosenman & Gero, 1998: p 180).

[40] One possible consequence of this is that work done to understand non-physical functions in the artefactual realm might illuminate non-physical functions in the biological realm. For example, many species of bird exhibit traits, such as bright and exaggerated plumage, that are not directly physically advantageous, but that *function as signals* to which other birds respond – principally for males attracting a mate (Otte, 1974). Similarly, but more interesting for us here is the example of the bowerbird, many species of which create elaborate structures and decorated courts that exhibit aesthetic qualities. These non-human artefacts (Dipert's and Hilpinen's definitions are stretched here) perform functions that are not entirely physical. By demonstrating the ability to construct and maintain a high quality display (resisting theft and vandalism from competing birds, whilst committing acts of theft and vandalism themselves) the male bowerbirds' decorated artefacts are thought to perform the social function of indicating their age and prowess relative to nearby males (Borgia, 1986; 1995). Incidentally, where bowerbirds live close to human settlement, the court of the bowerbird may be decorated with human artefacts (e.g. pens, bottle tops), and so human artefacts with physical proper functions are redeployed for their capacity to perform non-physical (social) system functions in non-human artefacts. Perhaps by considering such examples, design might not just look to and profit from work in other disciplines when

considering function (Vermaas & Dorst, 2007: pp 144, 147; also see Houkes, Vermaas, Dorst, & Vries, 2002: p 303; Galle, 2009: p 324), but could also make contributions back to those other disciplines by focusing attention on a wider variety of function classes.

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