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Principles of pleasure in design

Hekkert, PPM

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Design aesthetics: principles of pleasure in design

PAUL HEKKERT[1]

Abstract

In this paper I propose that only part of our experience of events, and products in particular, should be coined aesthetic. This part, the aesthetic experience, is restricted to the (dis)pleasure that results from sensory perception. The main part of the paper is devoted to explaining why we experience certain things as gratifying to our senses. Following thinking in evolutionary psychology, it is argued that we aesthetically prefer environmental patterns and features that are beneficial for the development of the senses' functioning and our survival in general. Four general principles of aesthetic pleasure, operating across the senses, can be explained on the basis of such argumentation: (1) maximum effect for minimum means, (2) unity in variety, (3) most advanced, yet acceptable, and (4) optimal match.

Key words: aesthetic principles, pleasure, product experience, product design, evolutionary aesthetics

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[1] Department of Industrial Design, Delft University of Technology, Landbergstraat 15, 2628 CE Delft, The Netherlands; E-mail: p.p.m.hekkert@io.tudelft.nl

Design aesthetics: principles of pleasure in design

A typical Sunday afternoon, quiet all around, few people in the street in front of me, and nobody to disturb my flow of thoughts. I pick up my Sony Ericsson T630 mobile and feel how its shape fits comfortably in the palm of my hand. Together with the weight and temperature of the device, it makes for a pleasurable interaction. I push the little joystick and a number of icons pop up on the screen. I want to look up the telephone number of a friend and understand that the image of a book must refer to the directory. Scrolling towards the icon and a second push confirm my prediction: I am on the right track. But, getting to my friend requires a lot more menus to go through and buttons to push and I finally get annoyed by the sheer complexity of the navigation structure. Just looking it up in my paper directory would have been much faster! Disappointed I put the phone aside.

What I describe here is an account of a typical everyday experience with a product. It is *an* experience since it is demarcated by a beginning and an end to create a whole (Dewey, 1934). During the experience, I performed actions, e.g. lifting, scrolling, pushing, and received reactions from the device, e.g. weight, images, sounds. In Dewey's words, there is a continuous alternation of doing and undergoing that together shape the experience. Since there is a product involved, we can easily call this experience a product experience. The question I would like to raise now is, can we also call this experience an aesthetic experience? Or is this the wrong question and should we rephrase it in, what part of the experience is aesthetic?

In this paper I argue that indeed only part of the full experience (of products) should be considered aesthetic, i.e. pleasurable to the senses. The rest of the experience deals with faculties of the human mind, i.e. cognition and emotion, as we will see, and they should thus be conceptually separated. All three levels of the experience, the aesthetic, understanding, and emotional level, have their own, albeit highly related, underlying processes. These processes are not arbitrary, but lawful. Although this seems rather obvious for the way we understand a product and respond to it emotionally, this also applies to our aesthetic responses to products. This is something we have only recently come to realize and the main part of this paper is devoted to an account of these lawful patterns underlying our aesthetic reactions. Before I discuss these aesthetic principles and their rationale, let us first look more closely at (the history of) the concept of aesthetics.

Aesthetics

'Aesthetics' comes from the Greek word *aesthesis*, referring to sensory perception and understanding or sensuous knowledge. In the eighteenth century, the philosopher Baumgarten picked up the term and changed its meaning into gratification of the senses or sensuous delight (Goldman, 2001). Since works of art are (mostly) produced for this reason, i.e. to gratify our senses, the concept has since been applied to any aspect of the experience of art, such as aesthetic judgment, aesthetic attitude, aesthetic understanding, aesthetic emotion, and aesthetic value. These are all considered part of the aesthetic experience and although we can still experience nature or people aesthetically, the phrase is most often used in relation to the arts, especially visual art.
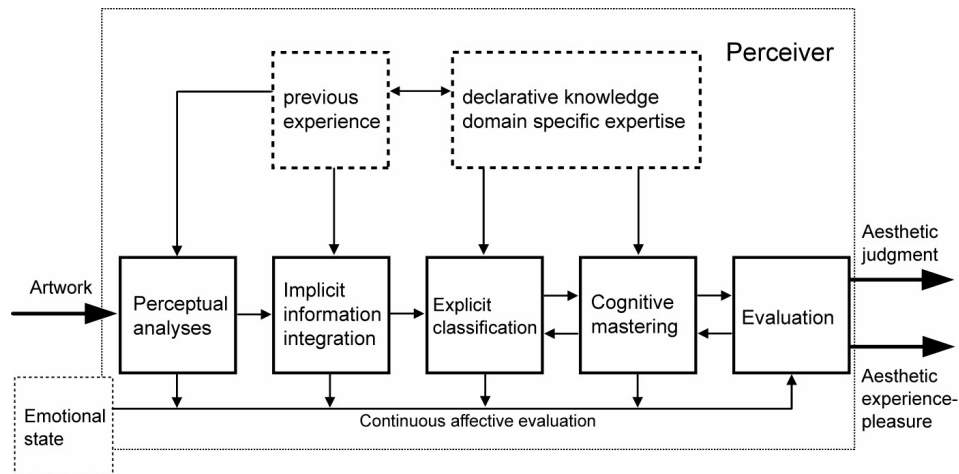
Figure 1:
Schematic model of aesthetic experience
(adapted from Leder, Belke, Oeberst and Augustin, 2004, BJP)

The observation that the aesthetic experience is held to cover all processes involved in our interaction with a work of art, is perfectly illustrated in a recent model by Leder, Belke, Oeberst, and Augustin (2004, Figure 1). In this 'model of aesthetic experience', an observer of an artwork starts off with a perceptual analysis of the work, compares this to previous encounters, classifies the work into a meaningful category, and subsequently interprets and evaluates the work, resulting in an aesthetic judgment and an aesthetic emotion. Only the first two (or three) stages would be considered aesthetic in the Baumgarten sense of the word. In these, mostly automatic stages perception is at work and the degree to which our perceptual system manages to detect structure and assesses the work's novelty/familiarity determines the affect that is generated. At these stages we talk about sensuous delight (or displeasure), whereas at later stages cognitive and emotional processes enter the experience. There is every reason to consider these stages part of the experience of the work of art, but there is also good reason not to call these stages aesthetic.

Staying close to Baumgarten's definition, I would propose to restrict the term aesthetic to the pleasure attained from sensory perception, as opposed to *anesthetic*. An experience of any kind, e.g., of an artwork, a product, a landscape, or an event, thus comprises an aesthetic part, but the experience as a whole is not aesthetic.

Product experience

Next to the aesthetic part, a typical experience involves understanding and an emotional episode. Although these three constituents of an experience are conceptually different, they are very much intertwined and impossible to distinguish at a phenomenological level. We *experience* the unity of sensuous delight, meaningful interpretation, and emotional involve-

ment, and only in this unity we can speak of *an* experience. So, why (re)installing this division between the three building blocks of an experience? Next to the conceptual clarity it provides, in order to understand our experiences with the things around us, we need to look at underlying processes. And these processes are fundamentally different for the three constituents. Before devoting the rest of this paper to the processes underlying our aesthetic pleasure (or aesthetic experience), let me briefly sketch the processes guiding our understanding of and emotional responses to the world.

Given the above, a tentative definition of product experience would be: the entire set of effects that is elicited by the interaction between a user and a product, including the degree to which all our senses are gratified (aesthetic experience), the meanings we attach to the product (experience of meaning), and the feelings and emotions that are elicited (emotional experience). With respect to the attribution of meaning, many cognitive processes play a role, such as interpretation, retrieval from memory, and associations. These processes allow us to recognize metaphors, assign personality or other expressive characteristics, and assess the personal or symbolic significance of products (e.g., Csikszentmihalyi & Rochberg-Halton, 1981). The attribution of meaning is, however, not an exclusive activity of the mind. In line with current developments in cognitive linguistics (e.g., Gibbs, 2003; Glenberg & Kaschak, 2002; Lakoff & Johnson, 1980), we have recently demonstrated that our bodies and bodily actions also play an important role in understanding the figurative expressions of products (Van Rompay, Hekkert, Saakes, & Russo, 2005).

The process underlying our emotional response to products can most accurately be described by an appraisal model (e.g., Arnold, 1960; Frijda, 1986; Scherer, Schorr, & Johnstone, 2001; Ortony, Clore, & Collins, 1988). According to these appraisal theorists, an emotion is elicited by an evaluation (appraisal) of an event or situation as potentially beneficial or harmful to a person's concerns. For example, on seeing a bracelet a person may experience desire because she expects that possessing it will fulfil her concern of being admired. An important implication of appraisal theory is that each distinct emotion has a distinctive pattern of appraisal, but there are few if any one-to-one relationships between a situation and an emotional response. It is interpretation of the event or situation, rather than the event itself, which causes the emotion. Since our emotional experience of products can also very well be explained by such an appraisal process (see Desmet & Hekkert, 2002), understanding this process holds a key to 'designing for emotion'.

Evolutionary aesthetics

"The sensory aspects of the normal human being should be taken into consideration in all forms of design. Let's take the Coca-Cola bottle, for instance. Even when wet and cold, its twin-sphered body offers a delightful valley for the friendly fold of one's hand, a feel that is cozy and luscious" (Loewy, 1951, page 297). This is a perfect example of sensuous delight or how a product can gratify our senses, in this case our sense of touch. It belongs to the realm of aesthetic experience and I will now examine the underlying processes of aesthetic pleasure. In line with influential thinkers from philosophical aesthetics (e.g., Hume, 1757; Kant, 1952), I will show that some of the general principles of taste or aesthetic pleasure are uniform in human nature. This does not automatically imply universal agreement. Just like the process underlying our emotions is uniform, yet leading to individual differences as a

result of interpretation differences, so can aesthetic responses differ in a lawful manner. It is only in this way that beauty can be said to lie in the 'eyes of the beholder'.

To trace the pattern underlying our aesthetic responses, we have to ask ourselves a simple, but very complicated question: *why* do we like things? As soon as we phrase the question in terms of 'why' we ultimately force ourselves to look into the way human beings have evolved over time. When it comes to our thinking and behaviour, this is exactly what an increasing number of thinkers in psychology have been doing: trying to understand why we act the way we act [or think the way we think, or feel the way we feel] by explaining the advantages of these acts for the evolution of our species. Because aesthetic phenomena seem apparently useless, they offer a great challenge for evolutionary psychologists to explain. Many of them have thus devoted a lot of thinking to unfold the logic of aesthetic pleasure (see e.g. Hildebrand, 1999; Orians & Heerwagen, 1992; Pinker, 2002; Ramachandran & Hirstein, 1999) and our inclination to pursue artistic activities (Dissanayake, 1999; Tooby & Cosmides, 2001). Of all the hypotheses put forward by these thinkers, one has been most widely adopted over the years. It has been coined the 'by-product' hypothesis and it very well explains the origins of aesthetic pleasure through all our senses.

Crucial to this hypothesis – in fact to all evolutionary thinking – is the notion of adaptation. Since the main goal of humans is to survive in order to reproduce, we have faced many adaptive problems whose solution would be, sometimes very distally, beneficial to reproduction, such as finding a mate, avoid predators and obstacles, selecting nutritious food, or understanding the intentions of others. Through a slow process of natural selection, psychological mechanisms have evolved that are perfectly fit to solve these problems. These human design features are called adaptations (see e.g. Barkow, Cosmides & Tooby, 1992 and Pinker, 1997, for an extensive account of adaptationism).

The logic of the by-product hypothesis is as elegant as simple. As demonstrated, adaptations have evolved to serve functions beneficial to our survival. It would have been helpful for the development of these adaptations if things in the world around us that contribute to these functions were reinforced (Tooby & Cosmides, 2001). In other words, it must be beneficial for humans to seek cues or patterns that serve these adaptive functions. We therefore (have come to) derive (aesthetic) pleasure from patterns or features that are advantageous to these functions. In a simplified form, this is the core of the by-product hypothesis. It is thus fair to conclude that "beauty exists in the adaptations of the beholder" (Symons, 1995).

If we want to understand why certain stimuli are pleasing to the senses, we have to look into the functions of these adaptive systems. From these functions we can derive the aesthetic principle that explains why certain features of the world, in being functionally favourable, are aesthetically more pleasing than others. In many cases, the principles will be specific for certain adaptations – the visual system, the olfactory system – or even differ from domain to domain – landscape aesthetics, aesthetics of music. Since, as we will see, our modalities also have certain functional and organizational similarities, we believe there is a limited number of principles that are uniform across the senses. Contrary to what Tooby and Cosmides (2001) believe, there are unifying principles of aesthetic pleasure and they are informative. These principles will be discussed next, but let us first look into the primary functions of our sensory modalities.

Adaptive functions of the senses

Regular textbooks of perception treat all our sensory systems systematically and start each section or chapter with a general discussion of the system's main function. A good example of such a textbook is Bruce Goldstein's 'Sensation and Perception' (2002) and I will use this as the primary source for our overview of the functions of our senses. "One purpose of perception is to inform us about properties of the environment that are important for our survival" (p. 2), Goldstein argues in the beginning of his book. I believe this is the main purpose of all the senses and their functions can be directly or indirectly traced back to this ultimate purpose.

By far the most prominent sensory system in perception research, and maybe the most dominant modality in our experience of the world, is the visual system. The main function of our visual system is to allow us to navigate through the world without bumping into objects or falling from cliffs all the time. Vision therefore allows us to detect obstacles, see passages, estimate distances; to see what actions the world affords. Next, vision also plays a prominent role in the identification of things, to signal us whether something is indeed one thing (partly hidden by something else), a possible resource or refuge, or potentially dangerous. Following the previous argumentation, we can thus predict that *we like to look at things that support navigation and identification*. These 'things' are patterns in the environment that facilitate perceptual organization, so well described by the Gestalt psychologists. These patterns make us see relationships and differences, they make us see that certain things belong together whereas others are unrelated, and they help us to make a most likely and economically efficient interpretation of the world out there. In short, they bring order in the flow of information. We make visual artworks and derive pleasure from exposing ourselves to works of art because these do exactly this. The best – and most down-to-earth - definition of art ever proposed is "to preserve unity while almost allowing for chaos" (Boselie, 1996).

Many events in the world cannot be seen, but it would certainly be helpful to be warned in time of the tiger that is approaching you. Luckily, you heard a rustle of leaves and this signalling is the most important function of our auditory system. More distally, communication also favours survival because it for example allows us to warn others and to cooperate. In sum, *we like to hear events that help us to detect signals and afford communication*. It has been proposed that many of the principles or Gestalt laws underlying visual organization represent our 'best guesses' to order the stream of auditory information (Bregman, 1990). It is easy to see that music is also based on such principles of repetition, closure, and similarity. A melody, for example, is a sequence of tones that look alike and follow each other in rapid pace, with only minor differences in pitch (Cross, 1995).

Maybe the most crucial sense modality for survival is our ability to touch or be touched, foremost to feel pain and assess something as potentially dangerous, and to feel pleasure, motivating us to seek sexual activity. But our sense of touch, including proprioception, also provides us with information about the world, about the shape and weight of things, about its texture and temperature, its verticality and stability, and many other physical properties. Finally, and for some most importantly, our sense of touch makes us aware of having a body and thereby forms a basis for the experience of self (Bermudez, Marcel, & Eilan, 1995). Next to direct reinforcing effects of touch in pain and pleasure, *we like to feel things that afford knowing and (self) learning*. Again, principles of perceptual organization provide a key to these tactual functions. Few works of art address these possible sources of tactual

pleasure, but designers have always explored this potential in for example the designs of baby toys, control panels, and cuddle walls.

The relationship between functioning and pleasantness is maybe most univocal for our chemical senses, the senses that allow us to smell and taste: "… things that are bad for us often taste or smell unpleasant, and things that are good for us generally taste or smell good." (Goldstein, 2002, p. 474). For this reason, these senses are considered the 'gatekeepers' of the body, identifying what is nutritious and should be consumed and detecting what is bad and must be rejected. Next, odours inform us about a person's health, fitness, and fertility and as such play an important role in sexual attractiveness (e.g., Doty, 1981; Thornhill & Gangerstad, 1999). Simply put, *we like to smell/taste things that afford survival and reproduction.* Needless to say that the meals we prepare everyday comply with this function, as well as the scents that are often designed to stimulate sexual arousal. Finally, smell is a rich source for associations and thus serves our ability to memorize past places and events.

"The mind organ … and thoughts are treated as a sense and its object because that is how they appear in experience: we feel that we perceive our thoughts with our mind just as we perceive a visible object with our eye" (Varela, Thompson, & Rosch, 1991, p. 64). For our line of reasoning, adding this 'sixth sense' (smell and taste are normally treated separately) to our list is easily defendable. Our mind has also evolved to execute a range of functions, e.g. to understand and classify the things and events in the world around us, to solve problems, to plan and control our actions (see e.g., Barsalou, 1999), and to anticipate their consequences. The thoughts, categories, ideas, models, and solutions we design to perform these functions obey to the same laws of organization and economy as the input for the other senses. To see what these laws are, we now turn to the first, overarching principle of aesthetic pleasure.

Principle 1: maximum effect for minimum means

Possibly generalizable over all the senses is the assumption that our systems want to function as economically as possible. If we can smell, see, hear, or decide something faster or with less effort, we will prefer it over the more demanding alternative. This is summarized in the principle of maximum effect for minimum means. We like to invest a minimal amount of means, such as effort, resources, brain capacity, to attain the highest possible effect, in terms of survival, reproduction, learning or explaining. So, a theory or formula is considered beautiful when it only has a few assumptions or parameters that can describe or predict a vast range of phenomena (Boselie & Leeuwenberg, 1985). Likewise, a visual pattern is pleasing to the eye when relatively simple design features reveal a wealth of information, such as in caricatures or impressionistic paintings.

In a different area, Margulies (1977) demonstrated that the same principle can be applied to chess problems. A move leading to a checkmate without the capturing of a piece was considered as aesthetically more pleasing than one in which a piece had to be taken. Applying this principle to the area of design, we can for example look at the Domus winery of the Swiss architects Herzog & de Meuron (Figure 2). In order to design a building that would perfectly fit into the California landscape of rocky hills, they build a cage-like construction and filled it with rocks from the surroundings. This simple solution results in a range of

Figure 2:
Domus winery by Herzog and de Meuron.

effects; the fit is easily established, the construction is cheap and very solid, the thick walls bring about a cool and constant inside temperature, and above all, the sunbeams that peep through the walls cause a poetic pattern of dancing lights. The net result is one of high aesthetic quality.

Two special cases of this principle are now discussed in detail, conjunctive ambiguity and metaphor. When a pattern is ambiguous, it allows for more than one interpretation. Think for example of the famous duck-rabbit drawing that can be seen as a duck or a rabbit. These two interpretations of the drawing are incompatible; you either see the duck or the rabbit. This is a typical case of disjunctive ambiguity, a type of ambiguity that is regarded as detrimental to beauty. In some case however, the two (or more) interpretations are only perceptually incompatible. In those cases, the additional interpretation or meaning adds something to the pattern that is physically compatible with the first interpretation. A good example, again from the field of architecture, is the famous Institut du Monde Arabe in Paris from the French architect Jean Nouvel (Figure 3), also described elsewhere (Cupchik, 2003). Approaching this building from a distance, one sees a façade that refers to the typical weave patterns from Islamic culture, as can for example be observed in Persian tapestry. When getting close to the building, one discovers that many of the holes that make out the weave pattern are actually shutters that could be opened or closed, depending on the amount of
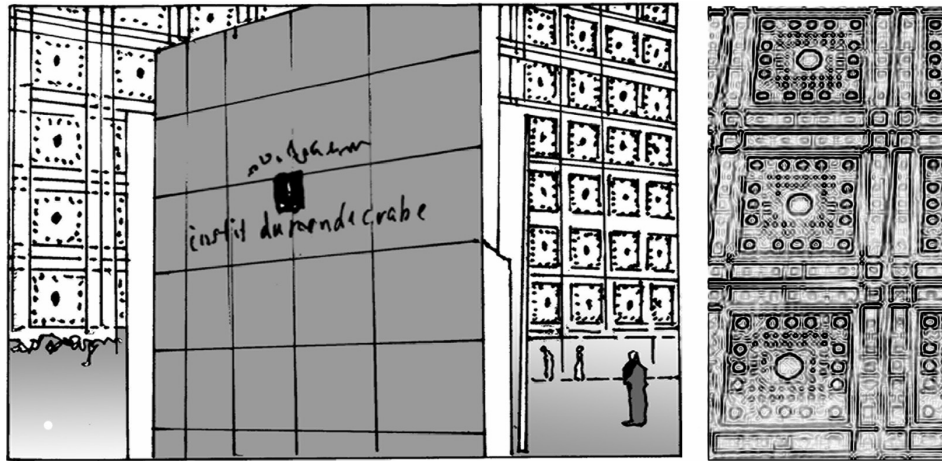
Figure 3 :
Institut du Monde Arabe by Jean Nouvel.

sunlight that is allowed to enter the building. This (functional) interpretation at a local level is compatible with the one at the global level and thereby adds to the overall aesthetic impression of the design. Conjunctive ambiguity is therefore said to enhance the beauty of a pattern (e.g. Arnheim, 1974) and Boselie and Leeuwenberg (1985) provided empirical evidence for this principle in their classic study of polygons.

Metaphor has for long been seen as a stylistic device to say something that is difficult to express in words. For this reason, we often use metaphors to express our emotional feelings, as in "frozen with fear". Recently, it has been acknowledged that the application of metaphors is much more widespread and that we use metaphors as an economical and efficient way of expression that is not restricted to language (e.g., Forceville, Hekkert, & Tan, 2006; Ramachandran & Hirstein, 1999). Via a simple reference to something else (the source), we can map a wealth of meaning and a novel perspective onto the target. A subtle example is the very popular coffeemaker by Philips, the Senseo Crema (Figure 4), that consists of a curved shaped reservoir 'holding' a little plateau on which the cups must be placed. In an embodied way, the bended shape refers to a servant, courteously serving you the coffee (see Forceville et al., 2005, for an extensive discussion of this example). As a result, this minimal design feature has a big effect on our experience of the coffee maker.

Up to now, all examples demonstrating the principle of maximum effect for minimum means have been drawn from the fields of vision and mind. It is probably not too difficult to come up with examples for other sensory domains. Instead of extending the list of examples, I will now turn to three other and highly related principles of aesthetic pleasure. These principles are closely allied to this first overarching principle. In their discussion I will occasionally present examples for other sensory domains. In general however, I think the claim is defendable that all four principles are modality independent and can explain what is pleasing in the areas of vision, sound, touch, smell/taste, and mind.

Figure 4:
Senseo Crema coffee maker (Philips).

Principle 2: unity in variety

Going back to the functions of the senses, we see that most of them are active in gathering information about the world and identifying what is bad or harmful or what is good or contributes to our survival. The world out there is however loaded with information and we can simply not pick up any source that happens to be within reach. It is therefore beneficial to perceive connections and make relationships; to see what belongs together and what not. In sum, in order to perform these tasks, our sensory systems must detect order in chaos or unity in variety.

Unity in variety is an age-old principle that was already acknowledged by the Greeks, but only recently we have come to understand the evolutionary and neurophysiological rationale behind it (Ramachandran, 2004; Ramachandran & Hirstein, 1999). In order to explain this logic, let us look at one of the underlying mechanisms that allows us to bring order or perceive unity. We tend to see things that are close together or look, sound, or feel the same as belonging together. This perceptual tendency of grouping, of discovering relations, is reinforcing because it allows us to detect objects or meaningful wholes, such as the tiger that is partly hidden behind the tree. Next to this evolutionary advantage, there is a clear neurophysiological advantage for making connections. Given the limitations of our brain's capacity, extracting relationships is an economically sound way to minimize allocation of attentional resources.

Like grouping, some of these unifying mechanisms are known as the Gestalt laws of perceptual organization, such as symmetry, good continuation, and closure. As discussed before, these laws also govern the organisation of auditory information. Detecting such structural relations is thus rewarding, leading some to argue that the aesthetic experience of music is (nothing more than) the perception of organization and regularities, such as rhythm, motifs, and harmony, in tonal sequences (Scruton, 1983). Complex pieces of music often re-

quire repeated hearing to derive all details of the musical structures and bring them into full integration (Jackendorff, 1987).

Other mechanisms that have been proposed, like peak shift, isolation, contrast, and solving puzzles (see Ramachandran & Hirstein, 1999), can be explained on the basis of the same logic. Contrast, for example, helps us to detect dissimilarities between features or objects that are close, but do not belong together. This principle is often applied in meals to make us appreciate the variety between the courses, while at the same time the tastes within each course have to correspond, hence unity in variety. Solving puzzles, finally, is an interesting special case. Because we like to see connections, we also consider it aesthetically pleasing to invest effort in finding them. This not only explains why we like crosswords and other puzzles, it may also explain why we are attracted to people and designs that do not give everything away at once, such as complex buildings and products that make use of translucent materials to partly conceal the internal components from human eyes, like the famous Apple I-mac.

Principle 3: most advanced, yet acceptable

One of the most tested theories in aesthetics is the preference-for-prototypes theory (Whitfield & Slatter, 1979; see Whitfield, 2000, for an overview). According to this theory we prefer the most typical examples of a category, the ones that are often also very familiar and we have been exposed to repeatedly. Such a preference for familiar things is adaptive since it will lead to safe choices instead of risking the unknown. As Bornstein (1989, p. 282) rhetorically puts it: "Who was likely to survive longer, reproduce, and pass on genetic material (and inherited traits) to subsequent generations, the cave dweller who had a healthy fear of the strange and unfamiliar beasts lurking outside, or the more risk-taking (albeit short-lived) fellow who, on spying an unfamiliar animal in the distance, decided that he wanted a closer look?"

At the same time, people have always been attracted by new, unfamiliar, and original things, partly to overcome boredom and saturation effects (Martindale, 1990). It has been argued that such a preference for novel instances is also an adaptive trait, especially for children, in that novelty facilitates learning. Since these two traits seem incompatible, we have recently performed a series of studies to look into the joint effects of typicality and novelty on aesthetic preference (Hekkert, Snelders, & van Wieringen, 2003). These studies provided empirical evidence for the principle coined MAYA, Most Advanced, Yet Acceptable, by the famous American designer Raymond Loewy (1951). As these studies, of e.g. telephones, teakettles, and cars, show, typicality and novelty ratings are highly negatively correlated, but this correlation is not perfect. As a result, it is to some extent possible to increase the novelty of a design while preserving its typicality. We tend to prefer products with an optimal combination of both aspects.

So far, the MAYA principle has only been tested in the visual domain. Given that people, for instance, also like music that is familiar (Gaver & Mandler, 1989) as well as typical musical performances (Repp, 1997), while a constant striving for novelty can also be witnessed in music, the MAYA principle most likely also applies to the auditory domain. A good example of the operation of MAYA in music is the popularity of remixes of old songs, such as the contemporary beat attached to Presley's "A little less conversation" (Junkie XL,

2002). Similar positive relationships between familiarity and pleasantness have been, consistently and cross-culturally, demonstrated for odours (e.g. Distel, Ayabe-Kanamura, Martínez-Gómez, Schicker, Kobayakawa, Saito, & Hudson, 1999) and cognitive categories such as nonsense and meaningful words (Bornstein, 1989) and brands (Nedungadi & Hutchinson, 1985). Following the same line of reasoning as for the auditory domain, it seems safe to predict that the MAYA principle holds for all sensory domains.

Principle 4: optimal match

Products are always multi-modal, they address various senses simultaneously. When driving a car, we see the dashboard, hear the engine and the clicking sound of the indicators, feel the steering wheel and road-holding, and smell the leather of the upholstery. The final principle is concerned with the relationship between these various sensory impressions. Since, as I have argued, ease of identification has survival value, we tend to prefer products that convey similar messages to all our senses. Consistency of impressions will lead to elevated identification accuracy (Zellner, Bartoli, & Eckard, 1991). Schifferstein and Verlegh (1996), for instance, showed that the levels of the smell and taste components in foods must match for an optimal pleasantness. Next to intensity levels, the product aspects that stimulate the various senses could be congruent on the theme or association conveyed and the level of (individual) affect they produce. Note that we see here how the aesthetic experience links to the experience of meaning. Whereas attaching a particular theme or association to a sensory aspect is a non-aesthetic attribution process, assessing whether these labels are congruent is regarded an aesthetic event; it is pleasing to the mind to see that the themes match, it is displeasing when it finds out the labels are incongruent.

Most likely, congruency not only holds for the internal consistency of the various sensory impressions, each also has to be appropriate for the particular product. This type of appropriateness can be found in the famous dictum 'form follows function' that could now easily be transformed to the other senses in 'sound/touch/smell follows function'. It is important to stress in this respect that this function is not restricted to a utilitarian one. The function of a product can very well be experiential, like to enjoy, to enrich, to inspire, to strengthen one's identity, etcetera, and many believe such experiences are nowadays more decisive in people's buying behaviour than the primary or utilitarian function as such. Making all the sensory messages congruent with the intended, overall experience is therefore an important task for designers. Nevertheless, in some cases the designer may wish to accomplish an experience of surprise, for example to increase interest or prolong the attention value of a product. In those cases, establishing incongruity between sensory messages, for example between the visual and tactual domain, could be an effective strategy (Ludden, Schifferstein, & Hekkert, 2006).

Conclusion

In this article I have made a start with exploring cross-modality principles of aesthetic pleasure. The rationale behind these principles is an evolutionary one. If certain patterns in the environment contribute to the functioning of our senses, it is reinforcing to expose our-

selves to these patterns. Hence, we have come to derive aesthetic pleasure from seeing, hearing, touching, smelling/tasting, and thinking certain patterns that are beneficial to our primary sense's functioning. Four principles have been proposed that each can be traced back to this underlying logic. The fact that this logic is based on evolutionary theory does not automatically imply that all principles lead to universal aesthetic agreement. Depending on the nature of the principle, people can to varying degrees agree on the aesthetic appeal of a pattern.

The first principle of maximum effect for minimal means could be considered as the overarching principle. In general, a theory, chess move, building, or any other solution or design is considered beautiful or pleasing when a great effect is attained with only a minimum of means. As long as people agree on the magnitude of the effect and similarly estimate the amount of means applied, they will agree on the aesthetic attractivity of the result. Darwin's (1859) theory of natural selection is univocally appreciated for the wealth and diversity of natural phenomena it can explain on the basis of just a few simple assumptions.

The second principle of unity in variety, and its related ordering principles of grouping, contrast, closure, and isolation, most likely ends up in aesthetic universals. The only requirement here is sensitivity. Our senses have to be sensitive enough to perceive the, sometimes hidden, structure. For that reason, some pieces of modern music can only be appreciated by a trained ear that is receptive to the principles of unity that are below the surface. When we look at the MAYA principle, it is easy to see that people will only prefer the same product or musical piece when they agree on the degree of originality and typicality. Since these ratings very much depend on personal experiences with and exposure to these and like products, the MAYA principle will often lead to individual differences. In the case of the fourth principle, optimal match, agreement will arise when we agree on the quality all components have to be congruent with. For example, the components of a product can be congruent with respect to their intensity, but incongruent when it comes to their semantic meaning. The type of product, its function, and the context in which it is used will probably (co-)determine this quality.

In sum, these principles can predict and explain people's aesthetic responses. When these principles are 'correctly' applied, it is most likely, but not necessary, that people will agree on an object's aesthetic value. Sometimes, differences will arise at the group level, when a group shares the same underlying characteristics – we often refer to such a group as a culture, sometimes even at the individual level. These differences can, however, still be viewed as "the product of a common underlying evolved psychology, operating under different circumstances" (Tooby & Cosmides, 1992, p. 45). Put differently, the principles reflect universal psychological mechanisms and cultural or individual manifestations are variations of these 'themes' brought forward by the degree to which people share the underlying characteristics. These characteristics, in terms of sensitivity (principle 2), perceived typicality and originality (principle 3), or the quality focused on (principle 4), will be, more or less, shared if people have similar backgrounds or previous experiences. It is in this sense that aesthetic responses, like cognitive processes, are situated, i.e., arising from the interaction between people and their environments (Smith & Semin, 2004), and subsequently obtain their social or cultural mode of expression. As Tooby and Cosmides (1992) convincingly argue, "The social and the cultural are not alternatives to the biological. They are aspects of evolved human biology and, hence, they are the kind of things to which evolutionary analysis can be properly applied." (p. 86)

Of course, it is easy to come up with real life examples of objects deemed aesthetic that do not obey to one of the principles described here and many cultural manifestations may even seem to reflect the exact opposite of what a certain principle would require. Extreme ornamentations we can encounter all over the world in churches, buildings, jewellery, etcetera, may for example be regarded as opposing a maximum effect for minimal means principle. As omnipresent as such manifestations are, they do not undermine the validity and universality of the mechanisms proposed. When they are violated or obscured, the designer did so because certain properties were (temporarily) highly valued in a particular group or culture, but for other than aesthetic reasons. These properties, such as ornaments, may represent status, wealth, or religious gratitude and thus contribute to a desired experience of meaning. In other cases, violations may have been implemented to evoke a particular emotion, as I showed in the case of 'surprise'. To conclude, however, unless one has very good (often non-aesthetic) reasons to do so, the best recommendation I can give is to obey these universal principles.

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