Product Design Perception and Brand Categorization

Robert Kreuzbauer, University of Illinois at Urbana-Champaign
Alan J. Malter, University of Arizona

The authors propose a theoretical framework for the perceptual processing of information picked up from product design elements (such as product form) and its influence on consumers' conceptual knowledge and categorization of brands. The proposed theory of consumer knowledge and brand categorization draws from the ecological approach to visual perception, principles of object recognition by components in perceptual psychology, and the emerging perception-based theory of cognition as a perceptual symbol system. The authors describe four bases of brand categorization derived from product design information, provide examples of each, review empirical findings, and discuss implications for consumer research and new product design.

[to cite]:

[url]:
http://www.acrwebsite.org/volumes/12925/volumes/v34/NA-34

[copyright notice]:
This work is copyrighted by The Association for Consumer Research. For permission to copy or use this work in whole or in part, please contact the Copyright Clearance Center at http://www.copyright.com/.
Product Design Perception and Brand Categorization
Robert Kreuzbauer, University of Illinois at Urbana-Champaign, USA
Alan J. Malter, University of Arizona, USA

ABSTRACT
This paper proposes a theoretical framework for the perceptual processing of information picked up from product design elements (such as product form) and its influence on consumers’ conceptual knowledge and categorization of brands. This view of consumer knowledge and brand categorization draws from the ecological approach to visual perception, principles of object recognition by components in perceptual psychology, and the emerging perception-based theory of cognition as a perceptual symbol system. The authors describe four bases of brand categorization derived from product design information, provide examples of each, review empirical findings, and discuss implications for consumer research and new product design.

Despite the increasing importance of aesthetic elements of product design in making products and brands more appealing than others, few marketing or consumer researchers have integrated product design into a more general marketing-theoretical framework (for exceptions, see: Bloch 1995; Veryzer 1993; Wagner 2000). Product design often plays a primary role in creating the identity and value of brands, such as the characteristic styling of Alessi kitchen equipment or the typical shape of a Piaggio Vespa motor scooter, which have become defining elements of the entire brand. Recent research suggests there are at least three central relationships between design and brands (Kreuzbauer and Malter 2005). First, design facilitates product and brand categorization and also influences consumer beliefs about the product and brand (Bitner 1992; Bettman 1979; Berkowitz 1987). Recognition of a new product as belonging to a certain brand category is strongly influenced by brand-typical design attributes. Second, design elements communicate information about the specific functions of a product and how people can physically interact with and use the product or specific brand. Third, designs that are aesthetically appealing lead to positive brand evaluations.

In this way, design elements constitute essential parts of brand concepts, which are stored in long-term consumer memory. Some of these elements are so familiar and accessible (e.g., the shape of the Coke bottle) that when perceived they immediately cue recall of masses of knowledge about the particular brand. Thus design, which we define as the form or shape of a product, to a great extent influences the process of brand concept development as various product signals become transformed into a clear and unmistakable brand construct in consumer memory. One of the primary functions of this conceptual understanding of a brand is that it facilitates a consumer’s identification of a new product as a member of a particular brand category. In this paper, we examine consumer information processes that transform product design information into a brand concept, based on a perceptual theory of how specific elements of product design play a key role in the process of brand categorization (i.e., determining whether product X is member of brand Y).

Most brand research based on an information processing approach focuses on a presumed hierarchical relational structure of brand knowledge (Keller 1998). We believe a proper understanding of how product design becomes embedded in brand knowledge also requires consideration of perceptual processes. In the present context this means how product design information is “picked up” by human sensory systems and integrated into a consumer’s conceptual understanding or knowledge of a brand. More specifically, we propose a general theoretical framework of consumer information processing of product design elements and its effects on brand categorization. We focus on the process by which product design signals are visually perceived and become mentally represented and organized as brand concepts within consumer memory (see figure 1). We further discuss the subsequent influence of product design information on brand categorization.

The proposed framework can be used to study possible consumer response to a range of new design alternatives or extensions of existing brands. Thus, the model can be used to consider consumer response to such design questions as:

1. Within a given product line (such as Volkswagen cars), which design parts can be transferred to a new model (such as the Tuareq) to ensure brand familiarity? (i.e., that the new model would be considered a member of the Volkswagen brand family).
2. In the case of a model extension, which design parts from an old model need to be transferred to a new model to ensure brand familiarity? (e.g., when the Volkswagen Golf 5 is introduced, which parts from the Golf 4 need to be transferred to the Golf 5 to ensure that consumers perceive the new model to also be a Golf?).
3. Or more generally, to support strategies to reposition brands through product design, e.g. when a car brand seeks to be positioned as higher in luxury, which design elements need to be added to the design of the car to create the appearance of luxury?

A FRAMEWORK FOR PRODUCT DESIGN INFORMATION PROCESSING

According to cognitive science and most academic literature on branding, brands can be considered cognitive constructs relating to a certain company’s product offerings (Aaker 1996; Keller 1993; Meffert 1998). Thus, product and brand knowledge stored in long-term memory constitutes a mental concept (Anderson 2000; Barsalou 1992a, 1999). In general, a concept is the knowledge and accompanying processes that allow an individual to mentally represent an entity or event adequately (Barsalou 1999). For instance, a person’s concept of car is their mental representation of this specific entity. Yet the car concept is not a simple picture in the mind of one or more perceived cars, but rather an organized unit of a general car-derived from several prior car experiences-which enables the individual to identify other objects with similar attributes to cars (Barsalou 1999; Mandler 1992). Consequently, concepts determine whether or not a new object or event belongs to a certain category, whereby a category is a set of related entities from any ontological type (e.g., robins, sweaters, weddings, plans) in the human brain (Barsalou 1993, 1999; Lakoff 1987). Thus, a concept is the organized set of attributes, features, rules and relations which represent an entity or event. For example, the concept for car might, in part, include the features 4-wheels, sheet metal, consumes diesel fuel or gasoline. But concepts, and hence rules, for category membership are never fixed and may vary from context to context as a result of situational goals (Barsalou 1983) or developmental experience and physical
action (Mandler 1992; Smith 2005). For example, the car concept constructed on a different occasion might include the features 4-wheels, synthetics, consumes diesel fuel or gasoline or electricity.

As the framework in figure 1 shows, to gain a proper understanding of how product design stimuli affect the development of specific brand concepts and thus influence brand categorization, we must consider aspects of both (1) perception and (2) knowledge representation and organization. Scholars of brand knowledge representation and organization (Keller 1993; Lawson 1998; Sujan 1985; Zaltman 1997) have applied some findings from cognitive psychology but have paid little attention to product perception in general (cf. Veryzer 1993; Veryzer and Hutchinson 1998) and largely neglected the role of design in brand perception (Keller 1998; Mowen and Minor 1998). While general g\(\text{estalt}\) principles (Köhler 1947; Wertheimer 1912, 1924) were articulated in the early 20th century, these and more recent theories of visual perception and object perception from perceptual psychology (Biederman 1987; Hoffman and Richards 1984; Goldstein 1997; Marr 1990; Treisman 1969, 1993) have not been integrated into theories of consumer information processing or brand concept development. In contrast, our research specifically examines the role of perceptual processing of product design information in brand categorization.

How do consumers process perceptual information such as product design elements? Within product design perception, a process of selective attention focuses a consumer’s information processing on information relevant to a particular goal (Barsalou 1992a). As shown in figure 1, the process of perception passes through several stages: retinal image, image-based stage, surface-based stage, object-based stage (Palmer 1999). Whenever stimuli are considered relevant, attention is selectively focused on them and concepts are developed and stored in memory. In parallel to this bottom-up process, an existing concept, in a top-down manner, influences the attention to and perception of particular stimuli. Consequently, both bottom-up processes and top-down processes influence product and brand perception. Thus, product and brand perception are, to a large extent, controlled by previously stored brand knowledge as it shapes the consumer’s interest and thus the attention that provides guidance in perceiving specific product stimuli.

Perceptual Psychology and the Process of Product Design Perception

As suggested by theories in perceptual psychology (Biederman 1987; Marr 1982; Palmer 1999; Treisman 1993) brand design perception follows a four-stage process. The first stage describes a two-dimensional retinal image which is a first impression of a visual product stimulus that is projected to the viewpoint of the observer’s eyes. Retinal image is perceived without the consumer’s attention, and the information is unstructured and uninterpreted (Julesz 1984; Treisman 1993). In the second stage, the two-dimensional retinal product impression is further processed, so that elements such as lines and edges are detected and “sharpened” (image-based stage). Further in the surface-based stage, general surface and spatial information is recovered. True three-dimensional processing first occurs in the final stage, called the object-based stage, since the product perception process does not end with the mere representation of all the visible surfaces. Instead, it is assumed that during perception surface information is related to general stored knowledge about the intrinsic nature of the three-dimensional object (Palmer 1999). An example would be aspects of a product that are occluded from the current viewpoint, such as the back or underside of a camera, TV, car, bottle, etc. Thus, by simply perceiving the curved surfaces of a bottle, the observer is able to make clear predictions regarding the probable appearance and properties of the back of the bottle. Therefore, hidden assumptions about the nature of the visual world are also required to enable the inclusion of information about unseen surfaces or parts of surfaces.

There is also a growing consensus in research on visual perception that representing the functions of an object involves dividing the object’s shape into parts (Baylis and Driver 1995a, 1995b; Bennett and Hoffman 1987; Biederman 1987; Biederman and Cooper 1991; Hoffman and Richards 1984; Hoffman and Singh 1997; Marr 1977, 1982; Marr and Nishihara 1978; Palmer 1975, 1977; Tversky and Hemenway 1984), leading perceptual psychologists to seek ways to recover the part structure of an object. Once a set of parts has been identified, higher-level parts can then be constructed by grouping together the more general parts. Biederman (1987) introduced a recognition-by-components (RBC) theory of object perception and recognition whereby objects can be specified as a spatial arrangement of so-called “primitive” or primary volumetric components, which he called geometric icons, or geons. The idea behind geons is analogous to speech perception, in which all kinds of words can be coded using a relatively small set of primitive elements, or phonemes (Marslen-Wilson 1980). In visual percep-
tions, the primitive elements (geons) are a modest number of simple geometric components such as cylinders, blocks, wedges, and cones (Marslen-Wilson 1980). A major assumption of RBC theory is that the mental representation of an expected object (including products) is a volumetric structural description composed of geons. Depending on the size and type of geon, as well as the relationships between several geons (see figure 2), any kind of object can be represented by the human conceptual system. For example, a geon can be a generalized cylinder (or cone), which is a volume constructed by sweeping a two-dimensional shape around an axis (Biederman 1987; Binford 1971; Marr 1982). To determine how a geon-object structure is constructed, one needs a set of rules for designing geons and the necessary relations among them for constructing a huge number of object representations. For a detailed description of “geon-rules” and other examples of simple object representations, see Biederman (1987) and Palmer (1999).

Organization of Product Design Knowledge and Brand Concept Development

Of past research on brand knowledge organization (Keller 1993; Sujan 1985) perhaps the best-known framework is Keller’s (1998), which distinguishes between two main dimensions: brand recognition and types of brand associations. Although both dimensions may potentially include aspects of design, neither Keller’s model nor other traditional theories of brand knowledge structure (Grunert 1996; Meyers-Levy and Tybout 1989; Mitchell and Dacin 1993; Sujan 1985) perhaps the best-known framework is Keller’s concept of brand Knowledge Organization (1998) theory of perceptual symbol systems (PSS). In this view, knowledge represented in the human brain is based on an organized set (frames) of perceptual symbols, which Barsalou defines as records of the neural activation that arises during perception. Perceptual symbols are neural representations in sensory-motor systems that function either consciously or subconsciously and are also schematic (Barsalou 1999). Through selective attention, a consumer perceives information and stores in long-term memory a record of the neural state at the time of perception. For example, if selective attention focuses on product design elements, the neurons representing these parts are selected and a record of their activation is stored (Kreuzbauer and Malter 2005). Note that perceptual symbols are componential and not holistic (Barsalou 1999). Thus, an object such as a laptop computer is not stored as a whole image but is composed of several perceptual symbols that represent design parts (overall shape, monitor, keyboard, touch pad, etc.). Perceptual symbols are further organized within mental frames or schemata, which explain the underlying stability and yet flexible organizational structure of knowledge (for a more detailed description of frames, see Barsalou 1992a, 1992b).

An important function of a perceptual symbol system is its capacity for constructing mental simulations as a basic cognitive process. Related perceptual symbols become organized within a frame, which then functions as a simulator, allowing the cognitive system to construct specific mental simulations of an entity or event in its absence (Barsalou 1999; for applications to social cognition, see Niedenthal et al. 2005; see also Markman, Maddox, and Baldwin 2005; Zwaan 1999). Thus, a person’s mental frame for computer can be used to mentally simulate several types of computers based on exemplars that have been previously experienced. Since perceptual symbols are componential, a person is also able to combine different frames and produce novel mixed simulations that have not been experienced previously. For example, a consumer can combine perceptual symbols of the computer frame with perceptual symbols that represent Alessi style brand designs in order to construct a coherent mental simulation of a hypothetical Alessi style computer. Such a computer does not yet exist and hence has never before been experienced, but it can easily be simulated mentally. Similarly, it is also possible to develop mental simulations of novel conceptual combinations that derive from different concepts. For example, consumers can construct a simulation with the concepts computer and luxury to develop a mental simulation of a “luxury computer,” or they can combine a specific brand (e.g., B&O) with the computer concept to simulate a hypothetical B&O computer.

Simulating conceptual combinations blending various shape and brand concepts produces specific brand categorization effects. We propose four major ways in which product design influences brand categorization through perception: (1) the perception of product affordances; (2) brand-product categorization; (3) brand-sign categorization; and (4) brand-style categorization. The following sections describe and integrate these four bases of brand categorization into the general framework of processing product design information.

FOUR BASES OF BRAND CATEGORIZATION

(1) Product Affordances. The functional properties of some products are so closely aligned with visually observable characteristics (product size or shape) that the actions the product affords to the observer, such as how the observer can interact with the object or what they can do with it, can be directly perceived or “picked up” by the observer’s visual system (Gibson 1979; see also Brunswik 1943, 1952; Vicente 2003). Examples of such product affordances are the handle of a mixer that affords “grasping” by the observer’s hand, or a chair that affords “sitting on” by the observer’s body, given its shape and possible movements. During visual perception of product design elements, affordances may be ascertained through surface-based as well as object-based stages. For example, a smooth texture and surface or an appropriate geon-organization of a handle can afford “grasping” (see figure 3a). These affordances then
become embedded within a particular brand concept. Although these types of products may project certain unambiguous affordances, the essential functional properties of some products, e.g., mobile phones or computers may be more abstract and not directly perceivable. These require additional information from another source (product manual, advertising, direct experience of product use) to identify and comprehend the product’s innate meaning or functionality. For instance, a consumer can directly perceive that a mobile phone handset affords grasping and carrying but would need additional input in order to understand its function as a communication tool, portable music player or camera.

(2) Brand-Product Categorization. Brand-product categorization represents the ‘generic’ product-brand relationship. Any brand concept consists of both brand-level design information and also information about the generic product category. For example, the Mercedes brand concept contains both brand design knowledge about Mercedes car models and generic knowledge about the general concept of car. Brand-product categorization is chiefly determined by geon-structures in the object-stage process. The link between geon-structures and knowledge organization has been experimentally examined by Kreuzbauer and Malter (2005) who found that motorcycle sub-categories (street and off-road motorcycles) can be represented through flexible geon-structures composed of combinations of perceptual symbols in product frames. They further show how alternative organizations of geon-structures enable the consumer to classify a product into either the off-road motorcycle or street motorcycle category. Drawings of motorcycle designs containing different geons typical of either off-road or street motorcycles produced hybrid product impressions. A motorcycle model containing more geons-structures of product-design elements typical of a specific product sub-category (off-road or street motorcycles) was more likely to be perceived as a member of that sub-category.

(3) Brand-Sign Categorization. In addition to purely generic product information, branded products also convey information that is characteristic of a particular brand, such as the lights and grill design typical of a BMW car front. As suggested by semiotics and cognitive semiotics (Kreuzbauer 2002; Mick 1986; Nöth 1990; Peirce 1931–1958) brand-sign categorization can be more specifically divided into brand-symbolic categorization processes and brand-iconic categorization processes. The former occurs when abstract product design elements do not refer to any major external knowledge units except those within the brand concept. For example, the Volkswagen logo does not communicate any inherent meaning by itself but simply represents the Volkswagen corporation. In contrast, brand-iconic categorization derives from design elements that originally refer to non-brand specific concepts, for instance the typical front perspective of a BMW car (“BMW-face”) that resembles a predator. Such design characteristics may facilitate analogical transfer of meaning from attributes of the predator-concept such as aggressiveness, dominance, and speed to the entire BMW brand concept and hence to all members of the BMW brand category.

During perception and processing of product design, surface-based processing can lead to brand-sign categorization. Once a product’s surface has been perceived by the consumer it becomes embedded within the brand concept, which then facilitates brand-sign categorization processes. Surfaces often determine brand-iconic categorization, since they frequently relate to additional non-brand specific knowledge units. For example the surface of a hypothetical “Philips Alessi” mixer (soft and long radii, non parallel; see figure 3a) suggests an organic body because it shares characteristics with the surfaces of human bodies. Thus, “organic” becomes part of the “Philips Alessi” brand concept. In contrast, there are product surfaces that are so particular to certain brands that reference to other concepts becomes non-specific, such as the distinctive characteristic line (surface edge) of the body of a BMW automobile (see figure 3b). Brand-sign categorization is also determined by geon-structures. For example a geon-structure of a Volvo station wagon has a particular form and becomes embedded within the Volvo brand concept. In order to be visually perceived as a member of the Volvo brand, another automobile would need to consist of a similar geon-structure.

Brand-sign categorization also frequently occurs during the object-based processing stage. Here the sub-process of brand-iconic categorization is chiefly determined by principles of perceptual grouping such as closure, continuity, proximity, common fate, and similarity of orientation or size (for a detailed description see Palmer 1999; Palmer, Brooks, and Nelson 2003). This is of particular strategic relevance for the extension of existing brands, for example, when a new BMW 5-series model is introduced in the market and partially resembles the old BMW 4-series model. In this case, the new model needs to incorporate enough essential elements from the previous model (see figure 4a) so that the new model will be at least minimally recognizable as a member of the parent BMW brand concept. Similarity here is produced by rules of perceptual grouping such as closure, similarity of orientation and size of salient surface attributes, for example the inner headlights and the overall shape of the headlight assembly. Thus, brand familiarity of product design (shape) elements is important in the case of product line extensions. As shown in figure 4b, the overall shape of the handset and orientation of the keys in two Nokia mobile phone models is likely to produce the desired effect of brand-sign categorization.

(4) Brand-Style Categorization. Brand-style categorization describes a special case rather than a distinct process of brand categorization. More specifically, certain style-concepts are determined by various combinations of surface- and object-based perception processes. For example, the “luxury” style concept may include design attributes such as chrome, shiny, ornaments, etc. Attaching these attributes to branded products, such as a Volkswagen automobile, produces a conceptual combination of “luxury Volkswagen.” Similar examples exist for object-based processes, such as sturdy protective components from the concept of sports equipment that when added to a Nokia mobile phone produce a conceptual combination of “sporty and durable Nokia mobile phone.”

FUTURE RESEARCH DIRECTIONS

Although it is not surprising that design affects brand categorization, the proposed framework is a first step toward better understanding how the perception of product design elements influences consumer development of brand concepts and use of brand categorization processes. Future testing of the framework is needed to better understand the relationships and boundary conditions between specific product design characteristics and brand categorization. First, future experiments can test the possible interactions of different combinations of design elements attached to different brand concepts. For example, country-of-origin effects may constrain the acceptance of certain conceptual combinations, as in the case of shiny chrome metal (part of the luxury concept) producing a mental representation of “luxury car” when linked to the concept of car brands from certain origins (Audi from Germany) but not others (Chery from China). Similarly, further research can examine the effects of conceptual combinations of different style and brand concepts.

Second, although brand familiarity can be produced by several product design attributes in combination with existing brand knowledge, some design attributes may be more suitable than others.
FIGURE 3A
Philips Alessi surface (soft and long radii; non-parallel)

FIGURE 3B
BMW surface (abrupt step)

FIGURE 4A
Perceptual grouping of BMW car front

FIGURE 4B
Perceptual grouping of Nokia phones
Additional research is needed to better understand which design components can most effectively induce perceived similarity, including effects of salience perception within the described perception processes. Third, it is important to study the interaction between design innovativeness and brand categorization processes. When new product models are introduced there may be a trade-off between increasing the probability of brand familiarity through familiar product design attributes and creating arousal through the introduction of very novel design attributes that risk being unrecognizable or unacceptable as members of the brand category. Kreuzbauer, Schoormans, and Snelders (2006) show that both brand familiarity and novelty can be produced when products share similar line and surface structure. However, since line perception is an earlier process during object perception than surface perception, shared line structure ensures stronger brand familiarity than a shared surface structure.

Finally, future research is needed to better understand the process and degree of analogical transfer, including how brand categorization processes affect dependent variables such as consumer perceptions of quality and aesthetic appearance.

**IMPLICATIONS FOR NEW PRODUCT DESIGN**

The proposed linkage between product design and brand categorization has several important implications for product designers seeking to effectively communicate intended product and brand meanings to targeted consumers. Both designers as well as brand and product managers need to incorporate product design (form and shape) elements within brand strategies more purposefully. For example, managers need to decide which surface or object components can and must be used to support a given brand strategy. This is of particular strategic importance for brand and line extension strategies or for composite branding strategies, such as producing similarity effects between a parent brand and brand extensions, between old and new models, or between two brands. Currently, brand managers must often rely on the designer’s feeling about how best to elicit an intended brand-categorization effect. Our proposed framework provides a more principled and theoretically-grounded structure that can be used to consider alternative product design concepts and their effects. This approach may prove useful in evaluating which of many possible design elements can best support a particular brand strategy.

**REFERENCES**


Baylis, Gordon C. and Jon Driver (1995a), “One-Sided Edge Assignment in Vision. 1. Figure-Ground Segmentation and Attention to Objects,” *Current Directions in Psychological Science*, 4, 140-146.


Nöth, Winfried (1990), Handbook of Semiotics, Bloomington, IN: Indiana University Press.