

Product Semantics

How design can affect user response and behavior

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ABSTRACT

Semiotics is the study of signs, and semantics is the study of their meaning. In product semantics, these linguistic concepts are used to describe design. Applied to design, the product is the sign, and it concerns how designers encode meaning into their products, and how they communicate with the user. Possible goals can be to describe the product's purpose or use, to express desired attributes or characteristics, or to encourage certain user behavior. The importance of product semantics has been to create products with improved usability and likability to increase their chance of success. This article explores through literature review and product analysis how various design elements can be used to achieve this. The paper's ultimate objective is to gain understanding to better design products with the help of product semantics.

KEYWORDS: Product semantics, product design, user behavior

1 INTRODUCTION

All products or objects designed have a purpose or meaning, both for the designer and user. Some products offer little to no user interaction, others see heavy use, while some still are passive artifacts to be experienced. They all still communicate, or are at least able to, something to the user, whether it be how to install or use the product, or to elicit emotions. Product semantics describes this communication and can be a tool for designers to better understand its utility.

A goal of industrial design is to create successful products, either from a commercial or altruistic perspective. Product semantics' importance stems from its participation in the processes that evoke attraction to products, improving their chances of success [1]. Vihma [2] argues that semantics is one of the four dimensions of design, and that the ability to communicate through form is what sets designers apart from other professionals participating in product development.

The term semantics comes under the umbrella of semiotics. Semiotics is the study of signs and what they mean, how they are combined, and used. Here, a sign is defined as "a unit of expression and content." [3] Semantics refers to the sign's message. The other elements of semiotics are syntax, which concerns the sign's relations to other signs, and pragmatics, studying signs' use in different contexts. The signs in question can be anything from a literal road sign, to a letter or single symbol. An entire product, like a car, can be considered a sign, as can its brand logo.

The term as applied to product design has its roots in cognitive psychology and was first presented by Krippendorff and Butter where they defined it as the "study of the symbolic qualities of man-made forms in the context of their use, and application of this knowledge to industrial design." [p.5][4]

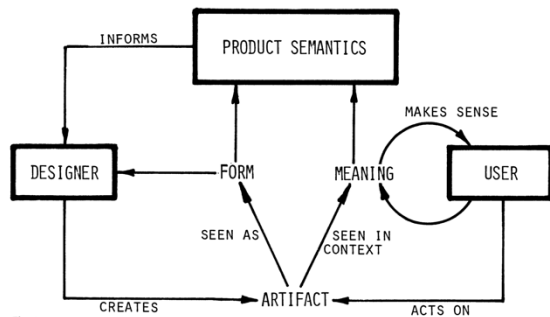


Figure 1: Krippendorff's proposed model of the relationship between designer and user.

Later, Krippendorff wrote that product semantics "is a concern for the sense artifacts make to users" [p.10][5] and that it describes the relationship between the cognition of the designer and the user. Krippendorff suggests that products are always considered in contexts and users make sense of them through an iterative process. Figure 1 illustrates this relationship.

While Krippendorff and Butter coined the term, research applying semiotics to products precedes their publications. For example, starting in the 70s, Gros and Fischer (in [6]) developed the Offenbach theory of product language. In this theory semantics refers to how design explains what a product is, as well as their symbolic associations. They are named the indicating and symbol functions. Separate from the semantic functions are the formal aesthetic functions, which are the "aspects that can be observed irrespective of the meaning of their content" [p.87][6]. These are based on gestalt principles and the dichotomy between order and complexity, and reduction or richness of stimuli.

Monö states that "a useful product is more than being useful." [Contents][7] An object or product can be perceived differently by the observer, context or situation. Some examples of perceptions or meanings given to products the author give are as an implement, or its designed function, as an ornament, where the product is used for decoration, and from an industrial perspective. To satisfy the different perspectives, Monö argues that an object has a semantic necessity. Further, Monö [7]

discusses the semantic functions of products, and defines four:

- To describe its purpose and mode of operation
- To express its properties and characteristics
- To exhort reactions from the user
- To identify the product in terms of origin, kinship, location, nature, or category.

These functions are partially analogous to the ones described in the Offenbach theory. The descriptive function echoes the indicative. The symbolic function (Offenbach) is wider than Monö's in that it includes symbolism by origin and art style, which is covered by the function to identify (Monö). The inclusion of meaning communicated by gestalt in semantics is another distinguishing factor between the theories.

The main part of this article will attempt to describe some of the principles that facilitate the first three of these functions and subsequently explore their use in real life products.

Product semantics is an expansive field and the "sense" and "meaning" of a product have many facets. This article's focus is on how product semantics relates to how the user understand and experiences products, and not on aspects regarding self-identity and social concepts like status.

2 METHOD

This article is based on a literature review and design analysis. Sources are theoretical research on product semantics found in journal articles as well as books on design principles and guidelines. The article is written in conjunction with a project regarding the design of an automatic hand disinfectant dispenser for use in hospitals.

3 SEMANTIC FUNCTIONS

The semantic functions of products as defined by Monö [7] are based on the Organon model of linguistic communication by Karl Bühler.

Bühler's model represents the sign at the center of a triangle comprised of a thing or stimuli, a sender, and a receiver. For example, a vocalized expression becomes a sign when it is *represented* by a thing, *expressed* by the sender and *appeals* to the receiver [8]. These three are the semantic functions. It must be noted that this is one of many theories on signs that have been applied to design research.

Applied to products, the sign is the product's physical appearance, the thing its functional principle, the sender is the message created by the designer, and the receiver is the mind of the target user with its knowledge and experience. When adapting the model, Monö has changed the appeal function to exhortation and added the function to identify.

3.1 Description

Efficiently describing a product's purpose, functionality, and usage might be the most important functions of a product's design. A product's shape can be a strong sign of the product's purpose. Consider how smartphones all share the same basic rectangular shape. Design can also communicate function, though these are most often simpler or older products, such as a locomotive with its steam boiler and pistons. A complex product like a computer does not show how it functions. They do not need to however, as their usage is often described through an interface.

3.2 Expression

This refers to the qualities or characteristics of the product the designer wants to convey. The expression might be of durability, flexibility, speed or appeal to a certain user group. Many tools, such as shape, color, and material choice can be used to define a product's expression.

3.3 Exhortation

Exhortation deals with user behavior and "is always intended to trigger a reaction in the person to whom it is directed." [98][7] This can be a handle that says: "grab me!"

3.4 Identification

The product's identity includes its origin, affiliation and category. Logos and color schemes are central tools to create a product's identity. Sometimes a designer's trademarks are part of the identity. To limit the scope, this function is not discussed further.

4 APPLICATION

Butter [9] explains how emerging theories on design do not automatically prove to be useful for designers and says that the same was true for the semantic approach. Companies started looking towards product semantics to differentiate their products in a market dominated by similar high-technology products. One of the first companies to actively apply product semantics was Philips in the 1980s [10]. A successful product of this strategy was the "Rolling Radio", where the designers focused on communicating its mobility with speaker grills shaped like moving soundwaves and a passing resemblance to a motorcycle.

In a student project designing truck cab interiors supervised by Butter [9], the work was based on eight steps to apply product semantics. The essentials of this process are to list characteristics of a desired design result and then search for physical manifestations to implement them. Butter emphasizes that it is important to distinguish between functional and expressive attributes, echoing Monö's semantics functions. One of the student groups was charged with designing a low-tech truck interior and defined attributes like "mechanical, powerful, rugged, and dependable." One of the manifestations of low-tech was a fisherman's vest. The vest's multiple easily accessible pockets manifested in wall-mounted storage. While the inspiration of the vest may not be directly perceived by the user, the similarity between their expressed characteristics might. This use of metaphor shows how linguistic concepts can be used in product design. Furthermore, simile, metonymy, pun, and paradox can also be applied in design through a semantic approach [7].

Butter stresses that a product should not pretend to be something it is not, or it might be rejected by the market. Monö [7] echoes this and says that good semantic design should be clear, unambiguous, and honest.

5 AFFORDANCE

Whenever an object is encountered we evaluate how it can be interacted with or what it can be used for. For example, if we come across a tree stump in the woods it is clear to us that it can be used for sitting. This is not universal, and a child might look at the same stump as a suitable table. This interpretation of objects' use-value is described with the theory of affordance.

The theory of affordance was developed independently from product semantics. The term was coined by psychologist James J. Gibson [11] to refer to his theory that objects have intrinsic usability due to their physical properties, regardless of human interpretation.

However, affordance did not originally refer to product design; Donald Norman appropriated and popularized the term for use in design with his work *The Design of Everyday Things* originally published in 1988. While Norman, a cognitive psychologist, worked with Gibson, he proposes an alternative definition. Norman's view differs from Gibson's in that it is the relationship between the object's innate characteristics and the user's capabilities and experiences that determines how the object can be used [12]. Monö shares this view and refers to the contextual *code*: "[a] system of rules for the way in which signals are to be interpreted." [p.117][7] An example of affordance in a product is the keys on a computer keyboard; the action the keyboard affords is pressing the keys.

Since introducing the term to the world of design, Norman argues that the concept of affordance has been misunderstood. Norman argues that it has been used by designers to mean any signal to the user how the object should be used, such as push and pull signs on doors. For this usage, Norman proposes the

term signifiers. If we reuse the keyboard analogy, the keys' affordance is that they can be pressed, but the symbols on the keys signal their function.

You and Chen [13] agree that the term affordance has been misused, and suggest a clearer divide between the theories of affordance and product semantics. They argue that Norman's view of affordance is more closely related to product semantics, and utility of the "true" theory of affordance in product design has suffered because of this ambiguity. Boess and Kanis [10] suggest that clearly identifiable affordance cannot be implemented reliably and point to Gibson's goal not to design for or predict human interaction.

Related to affordance and signifiers, Boess and Kanis have introduced another concept they call usecues. A usecue is any perceived attribute that help the user understand how something is interacted with. A lever is not by itself considered a usecue, but the characteristics that suggest which way or how it is activated are. Usecues and Norman's signifiers are the tools of the semantic function to describe use.

While the symbols on a keyboard and push/pull labels on doors explicitly signify the product's use, other elements such as color and shape also affect how users read a product.

6. PRINCIPLES OF PRODUCT SEMANTICS

This section discusses the aspects deemed central from a product semantics point of view, although the field encompasses more than the ones included. Both physical aspects of the products and elements focusing on user behavior are discussed.

6.1 Gestalt

One general way to describe gestalt is as "an arrangement of parts which appear and functions as a whole that is more than the sum of its parts." [p.33][7] Consider how a dish combines the flavors of its ingredients to create something new.

In design, a product's shape, color and material give meaning to each other that did not exist by itself. The color might change the shape, or the material might change the color. Gestalt is created by features of the design or by the entire design.

There are certain factors to help us perceive these individual elements instead as a whole. Some of the most important are described below. They are based on proximity, similarity, closure, and good continuation. These can be used by designers to aid the user in usability.

The law of *proximity* states that objects placed close to each other or in a group create a gestalt. There is a perceived relationship between them due to their proximity [14]. An example is found on a television remote control, where the buttons are arranged by shared function.

Visually *similar* objects also create gestalts much like proximate ones. Returning to the remote-control example, buttons with similar function often share shape and color. When using color similarity, no more than 3 or 4 colors should be used [14].

The *closure* factor describes the mind's tendency to complete patterns or shapes even if they are incomplete or partially hidden. An example is a circle obscured by a rectangle, where the mind would fill in the missing lines and interpret the circle as whole. The effect is strongest when the patterns are similar and close to each other. Good use of closure will reduce complexity and make the design more interesting [14]. Use of the closure effect is often found in logotypes.

We perceive lines and shapes to retain their direction, even though they are partially obscured or intersected by another object. This is known as the *good continuation* factor. It means that objects along a line or curve are perceived as one and are easier to process [14].

6.2 Shape and form

An object's shape is one of the first elements we perceive. Shapes can be used to describe

the product's function or express characteristics the designer wants to convey. Shapes also elicit different emotional responses and can be used to attract attention or affection from users. Both the gestalt of a product's form and the shapes of isolated features or elements are important to consider.

We perceive shapes to have attributes based on previous experience and context. Some shapes appear heavy or light, sturdy or unstable while others can evoke speed or flexibility. For example, we know from experience that objects with wider bases are harder to topple. In this way shape has an expressive function [7].



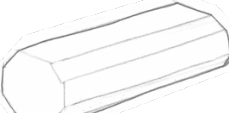
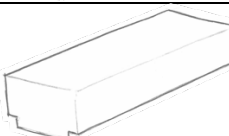

	A simple rod.
	The sloped sides express stability.
	The facets make the shape seem denser.
	The recessed edge makes the shape express lightness
	The difference in height expresses flexibility due to its ability to fit various space requirements.

Figure 2: Shows how changes to a shape can change its expression. Adapted from Monö [7]

Shapes can also be used to describe possible purpose and use [7]. If we consider a shape's likely movement, we know from experience that round objects roll. The dominant and exposed wheels on cars and bicycles can be said to convey that the object moves readily, and perhaps that it is the object's main function. When a shape has come represent use through symbolizing a product category, it's called a prototypical feature [15]. Steering

wheels often have grooves for better grip, describing its ability to be turned.

We have an inherent aesthetic preference towards contoured and rounded objects as opposed to sharp and angled ones [14]. When asked to pick between two similar products, where one is contoured and the other is not, we tend to prefer the contoured one. Round shapes are considered “friendlier” than angular ones. Studies also show that angular and sharp featured objects trigger the amygdala in the brain, which processes fear. At the same time, angular objects activate more thought processing and are therefore more interesting to look at. They also attract more attention than round objects [14]. This is true when the shape is viewed in isolation, but the opposite can be true if angular form is the norm in a given context; the gestalt law of similarity could supersede this.

The human mind is adept at recognizing patterns and certain shapes are interpreted as humanlike, or anthropomorphic [14]. We tend to view objects with such shapes positively and more readily form emotional bonds with them. To maximize the aesthetic appeal, an abstraction should be used instead of a realistic depiction. Anthropomorphic shapes can be used to attract attention and eliciting affective responses from the user [14]. This is compounded by the fact that child-like features in objects elicits happiness. Roundness or cuteness also change our perception of a product’s “age” [16]. Considering the above paragraph, it is likely to assume that angular, masculine features attract more attention whereas contoured, feminine forms expresses friendliness.

A product’s shape and form do not stand alone, but form a gestalt with other elements of the design, such as color.

6.3 Color

Color is an important factor of our environment and is used as a form of expression since childhood. We assign different meaning and associations to colors,

and these can be used in product design to achieve desired goals.

The meanings we assign to colors depend on our culture [17], so use of them must be carefully considered. Colors also elicit feelings and can change our mood [18] and Allegos and Allegos (cited in [16]) suggest that it is the contrast between colors that allow them to evoke an emotional response. Itten [18] argues that the expression of color is both subjective and objective depending on the context. When considering the seasons, blue objectively represents and green spring. Blue is also the color of clear skies but if a person is “feeling blue”, he or she is feeling depressed. This ambiguity also exists in design, where color is used with different symbolism. A fire extinguisher is red to aid visibility but has a different meaning when applied to a sports car. Further, Itten writes that light colors represent levity while darker colors symbolize darkness and negativity.

White	Clean, quiet
Black	Powerful, heavy
Red	Intimate
Green	Natural, unrefined
Blue	Reliable, trust
Purple	Elegant
Yellow	Happiness

Figure 3: Some color associations in the western context [17]

Color also has a dimensional aspect; it will change hue or shade according to the shape or texture it is applied to. In this way color can be used to accentuate or negate the shape of an object. Because they reflect more light, lighter colors best accentuate shape. Swirnoff argues that color has been underutilized in creating and altering shape [19]. Color can thus be viewed as an intrinsic part of the shape it is applied to. Colors also change characteristics by combination with other colors. Complementary colors intensify each other (Fabri in [16]) and may appear darken or lighten depending on combinations [18].

On this emotional level, color is used for expression. Color is also used directly in a

functional manner, for example to describe use by highlighting functions [17]. Consider a telephone where the answer and ignore functions are colored green and red. When color is used to attract attention, which should be done by using saturated colors [14], I argue it takes on an exhortative function.

When choosing which colors to apply for expression, they should correlate with the user's emotional response to the product within the context of category and use [17]. Gutsch uses an example of a purple Dyson washing machine, arguing that it clashes with the customer's ideal of a quietly operating and functional product [17]. Another example of the importance of context of color, is the common use of white on high performance boats [2], while white is less often applied to car equivalents.

The physical application of color can be done through different methods. The use of paint might be an obvious one, but many products' color comes through the materials used.

6.4 Materials

The materials used in a product can be chosen for many reasons. Often, they are selected by some required criteria of strength, weight or cost. Designers also select material on an aesthetical basis, as materials have different characteristics such as textures, colors, tactile feel and reflectance, all elements that can be exploited in design [20]. In the 21st century, designers have expanded their use of materials and are increasingly using materials to convey meaning in their products [21].

Material has great influence in how the product is perceived beyond aesthetics, due to the associations and perceptions of the material. Materials often carry associations before they create gestalts with the whole of the product; wood has an innate warmth and evokes craftsmanship whereas metal is colder, precise, high tech and durable [22].

7 USER BEHAVIOR

How users end up using a product has been shown to be hard to anticipate [10; 23]. The user might find different valid uses for the product or there is a problem understanding the correct use, causing frustration. For the latter, the designer's encoded meaning in the product has not been properly decoded by the user.

7.1 Altering user behavior

To help the user make decisions, or certain desirable decisions, designers can nudge users in the "right" direction. We tend to take the path of least resistance when making decisions, and because of this the most likely choice should yield a satisfactory result [14].

Lidwell et al. [14] list five techniques to achieve this. The first is setting *defaults* that "do the least harm and most good". If the default choice is one the user is happy with, it will cause less frustration and effort. Setting the desired behavior as the default can nudge the user in that direction. *Feedback* should be given for both action and inaction to confirm that a choice has been made and remind the user to make one. *Incentives* can be used to guide users in a certain direction, but should not be conflicting. If the design presents the user with many choices, they should be *structured* to allow for easier searching and filtering. Lastly, if a user's action of performance leads to a goal, it should be clearly visible.

7.2 Forming habits

A part of encouraging desired user behavior can be forming habits. This is especially true if one is designing a product or service that requires users to return to it, like an interactive service. In the book *Hooked*, author Nir Eyal provides guidelines for this and introduces the hook model [24].

This model describes how users form habits, or become "hooked", has four elements and is based on rewarding actions the user makes. The first is the trigger which is an external or

internal event that actuates a certain behavior. Following the trigger an action is made in anticipation of reward. It is important that the reward, the third step, is variable; if the reward is constant the user feels no incentive to keep re-entering the hook. The fourth and last step requires an investment or effort from the user. This can be something that makes the hook easier or more pleasurable the next time around.

8 PRODUCT ANALYSIS

This section explores how real world products incorporate the principles discussed above to better understand them. The examples draw on both public and private products. This distinction is important because public and private products may have different requirements of product semantics as the user has less time to get to know the product.

Three products have been selected. The first is a soap dispenser and was chosen for its relevance to the related project. The second is a reimagining of the fire extinguisher and was selected for its need for efficient semantics in emergencies. The last product is a multi-function printer. Printers are inherently mechanical, but also have electronic aspects. Printers with a multitude of functions are especially interesting to analyze.

These analyses are based on personal interpretation of the discussed principles as found in the design, and we cannot know if they are accurate according to the designers' intentions.

8.1 Quartz soap dispenser

The Quartz soap dispenser is meant for use in public areas like shopping malls and airports. It was designed for Kohler by Henry Yang and River Cheng and won a Red Dot Award in 2016. Being a public product, it can be argued that it should signify its use well as it is likely the user is approaching it for the first time.

It is natural to conclude that the product's affordance is to dispense soap into the user's hands. In this case, Gibson's view is difficult to

defend; it seems likely that a user not acquainted with dispensers would not know its purpose, thus it could be argued that the product affords nothing. According to Norman's view, the affordance (or relationship) is established due in part to the user's previous experiences with dispensers and the context in which it is used, e.g. a bathroom. I argue that the product's purpose is described largely due to context and gestalt created with other product related to its use.



Figure 4: Kohler's Quartz soap dispenser

Its main shape is angular and thus thought-provoking and attention-seeking. The shape is also pointing the user's attention towards the nozzle, improving usability. The exposed nozzle tells the user where to put their hands, describing how to use the product. This is an example of a signifier or usecue. The dispenser has six LED lights that indicate when dispensing starts, slows down and finishes, giving the user feedback on their actions and the product's response. The lights also show when the dispenser is empty, indicating to the user it cannot be used, and to staff that it needs to be refilled.

The color used is either silver or bronze chrome, matching other bathroom fixtures. The chrome symbolizes cleanliness and elegance, the latter especially with the muted bronze color. The Quartz has technological innovations such as solving dripping problems and smartphone app capabilities. This technological aspect is reflected in the use of

metal in the outer shell. Furthermore, the color silver holds associations of technology.

8.2 Act fire extinguisher

The Act is a reimagining of the fire extinguisher and won designer Sigrun Vik the Unge Talenter award in 2010. It was designed to be more visible when needed and less likely to be stowed away and hidden [25]. In contrast to the product discussed above, the Act is meant for use in private homes. Even so it is not a product type that sees regular usage and is not something users learn to know through use. Because of this it needs to communicate well in an emergency.

The Act has the affordance of a traditional fire extinguisher, including the handle and pull tab. The pull tab is circular, signifying that it can be pulled with one finger. The handle's edges are chamfered, allowing for easier gripping. The same is true for the notch to pull out the hose.



Figure 5: Act fire extinguisher

The product's shape is vastly different from the industrial look of a traditional fire extinguisher. It has rounded corners and contoured front and back panels, giving the product a friendly and inviting aesthetic. The main color used is white, doing away with the fire engine red that can elicit feelings of apprehension. The white also makes it discreet and thus easier to place in the home. In addition, the white color accentuates the contoured shape. Red is still used sparsely to highlight the functional parts, such as the pull tab, nozzle and hose. Red is also used to increase visibility when the product is needed, mimicking the use of red in traditional fire extinguishers. A central feature of Act is wireless connection to fire alarms. When an

alarm activates, the handle lights up red to aid visibility.

8.3 Xerox printer/copier

The Xerox WorkCentre 7545 is a multi-function printer that can also be used as scanner and copier. The printer has a modular design that can be complemented by add-ons. It is meant for environments such as offices and workplaces where it might be used by many unique users [26]. Multi-function printers are highly complex products, and this is no exception. There are paper trays, different output trays, and scanning functions. It also has an extensive digital user interface, but that will not be discussed here.



Figure 6: Xerox WorkCentre 7545

On first sight the printer can seem overwhelming and the design pragmatic, perhaps due to lower perceived attractiveness of visually complex objects [15]. Design elements extend from the main shape, drawing attention to their functions. The exposed paper tray is a common symbol of printers and helps describe the product's purpose. The printer's modularity expresses flexibility and repairability.

The focal point of the printer is a section colored dark blue. This encompasses the display and control panel as well as the main output tray. This separates it from the other output trays, but the reason why is not clear by looking at the design. The top left extension affords use as a table to place things while using the product.

The printer has 5 paper trays for input. Four of them can be pulled out and have grips that afford this. A gestalt is created by their similarity and proximity and could be considered a use cue. The fifth tray is for specialty paper and is separate both in function and gestalt, and had it not been for the numbering it would be harder to discern its function. The wheels indicate that the printer is meant to be moved, but the lack of explicit points to grip counteract this, and suggest that moving is an infrequent function.



Figure 7: Physical control interface

Figure 7 shows the buttons of the physical interface. The numerical buttons form a gestalt by their proximity and similarity. It is unclear whether the two buttons above have anything in common with them. The buttons on the lower left are grouped by their proximity and their positioning seem to form a circle. They are however not the same color, which counteracts the gestalt.

9 DISCUSSION

The goal of this article was to explore product semantics through literature review and analysis of existing products, to ultimately gain knowledge to better design a new product. As shown, the toolbox for designers to communicate meaning to users is extensive. It can be used to describe a product's purpose or use, express characteristics or elicit responses.

The building blocks to achieve this is the principles discussed above. The principles may be applied by themselves, but are enhanced by

creating gestalts of multiple elements. For example, using shape to indicate where to grip might more clearly be communicated by adding color as well. By themselves, shape and form seem to be the most powerful and versatile vectors because they are the basis of the design. Color and material are more limited when used in isolation.

The principles are described as if used in isolation and they are not necessarily valid in every context. While a wall painted bright yellow would indeed attract attention, would not a white object on that wall do as well due to the contrast? Similarly, if design elements create a gestalt but differ in use, the point is lost.

9.1 Description

The first semantic function Monö defines is to describe the "facts" of the product [7]. A product's purpose seems to be best understood through its similarity with other products sharing that purpose. This means that in some cases the perceived purpose of a product with a given shape is ingrained in the collective consciousness. For example, the most common symbol for a telephone is still a handset with ear and mouthpieces though they are not sold anymore. I argue that in shape and form, designers have less flexibility in designing to communicate purpose, instead having to abide technological progress and ergonomics. Although, new product types might call on design language from older ones sharing the same function to help communicate purpose. Early mobile phones for example were shaped similarly to the archetype, placing the microphone and speaker at an angle. The Xerox printer is also reminiscent of the printing press' pragmatic design, although that connection might be more tenuous. Context can also be important in establishing purpose. If the soap dispenser discussed above was placed anywhere else but next to a faucet its purpose would be ambiguous.

Some products also describe how they function. For example, the fire extinguisher's hose tells us something is to be expelled from the nozzle. However, this tells only of part of

the product's functioning. For example, how the microchip inside functions is not evident. The fact that the description of highly technical products is challenging was central to the popularity of product semantics in the 1980s [10].

The product's way of functioning can also help the user understand how it's used or operated. Take for instance the printer's trays. The fifth input tray and scanning tray are similar to the output trays, but they are separated by their ability, or inability, to accept paper. How to use a product's functions can also be more explicitly communicated. This includes knurling on dials to indicate turning and grips on levers. These things explain the elements' use, but not necessarily what they lead to. The Xerox printer has several compartments to remove stuck paper that open by lever, but why is not immediately clear to the uninitiated. Older faucets often had one valve each for hot and cold water. The valves were identical and their use clear but whether they served hot or cold water was indicated by a sign (e.g. text or color). It seems that proper use is best described by shapes that are perceived easily able, and unambiguously, to be manipulated by us. In the fire extinguisher, the hose is nestled along the side with notches at the bottom to indicate that it can be pulled out, and where it is easiest to do so.

9.2 Expression

The function to express characteristics may be where the designer has the most latitude. Designers may want to communicate traits that fit the product or appeals to a certain user group. A sports car expresses its speed and high performance through sleek lines and low profile [1].

Designers can use shape, material and color to aid in the expression of their products. The fire extinguisher's rounded form makes it seem friendly, while the slightly larger base gives it stability. The white color lends a neutrality to the appearance. The printer seems to express pragmatic functionality and seriousness. The shapes expose its functionality and the deep blue color is a safe, conservative choice. Blue is

also associated with conservative businesses like banks [27].

When communicating expressions, designers should be aware both of users' evolutionary psychology and learned experiences. Our heightened alertness when encountering sharp angular shapes is an example of the former. Much, however, is based on what we expect and associate through experience, both personal and collective. The "racing stripes" found on some cars today have come to denote speed because of their use on professional racecars. The stripes' original purpose was to identify cars during the race [28]. How we perceive the qualities materials can also be thought to come from experience. Using metal in a product makes it seem more durable than with plastics because we know from experience that metals often last longer.

9.3 Exhortation

As described above, an exhortation seeks a reaction from the user, or urges to user to take some action. An exhortation can be direct, like the light-up handle of the fire extinguisher that says: "there's a fire, here I am!" or indirectly like the angled shape of soap dispenser attracting attention. I argue that a product's expression can also be exhortative. A car that expresses its capacity for speed and nimble handling can be seen as urging the user to drive it in such a manner.

The functions are not exclusive and it might be difficult to differentiate between them. Design elements might also serve multiple functions. I believe this ambiguity highlights the functions' root in semiotics, as products can be very complex as signs are concerned. I believe this also points to some shortcomings of applying semiotics to design, as it is appropriated from other disciplines. The meanings as encoded in the products, being subjective and based on context and interpretation, can seem ambiguous and maybe even arbitrary. Maybe this is the reason the literature rarely suggests definite "guidelines" on how to apply certain meanings, especially to fulfil the expressive functions. The expressive function is after all

where the designer's knowledge and skill is best displayed.

10 CONCLUSION

Product semantics concerns the meaning designers put into their products. The reasons for doing so is varied, from explaining how the product is used to projecting characteristics. Explaining product use has been described with the concepts of signifiers and usecues, as well as affordances. Because of its roots in semiotics, semantic functions of design have been suggested based on the semantic functions of signs.

These functions are description, expression, exhortation, and identification. Use of design elements like shape, gestalt, color, and material facilitate these functions. Elements

can serve multiple function at the same time. How to apply product semantics depends on the goal. To efficiently explain the purpose of a product, the shape and form as it relates to other products with the same purpose seem to be the most important. When describing how a product is used, design for actions that are easy and comfortable should be used. To illustrate, the proper use of a turning dial is more explicit when knurling is added, because the grooves provide grip and supports rotating more than, say, pulling. The expressive function is about what the designer wants the product to tell about its "personality". It can be attributes such as durability, performance, or playfulness. When designing expressions designers should be mindful of evolutionary psychology as well as cultural and experienced associations. To transfer language into design, a process of looking for metaphors has been suggested.

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