

Creating a Reflective Understanding of the Use of Formal Aesthetics in Product Semantic Frameworks.

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Abstract

This paper critically reflects on selected frameworks of product semantics, which have been applied in form giving and industrial design. Furthermore, a comparative analysis has been made between product semantics and formal aesthetics as different, but related fields of study. Focal areas in this literature review will be to find out: (1) which theories and frameworks of product semantics are specifically relevant for creating meaning and value in design? (2) How formal aesthetics and gestalt principles connect and influence the different product semantic frameworks. Results have indicated that in the semantic frameworks discussed in this article, formal aesthetic and gestalt theories have been established at the cognitive level. They indirectly incorporate formal aesthetic principles, such as geometry, dimension, texture, material, color, graphics and detailing. These principles were addressed from an analytical and descriptive perspective to create a more in-depth cognitive understanding of products and product forms. Although, none of the frameworks proposed the development of a formal design tool for using formal aesthetic characteristics in the generation of prospective form-dominant products, Karjalainen and Snelder's semantic transformation framework, could be further developed to incorporate gestalt and formal aesthetics, through the key drivers.

Keywords: *Product semantics, Frameworks for Product Experience*

1 Introduction

Product semantics is a central theme in the field of Industrial Design, which foremost has been studied and practiced from a theoretical and analytical perspective. Literature in this field has been structured upon early linguistic and cultural concepts and paradigms to provide an understanding of the functions and values carried by the product [1]. It is based upon a tradition of communication studies, which extends and transfers the structure of language into all cultural phenomena such as advertising, film and objects [2]. According to You and Chen [2] semantic value is made explicit and enriched through interactions between the user and the product, and is considered a key factor to successful user-oriented design of products and services. Product semantic was conceptualized in Ulm, Germany and ultimately became significantly important in the mid-1980s. By definition product semantics is the study of symbolic qualities of man-made forms in the context of their use and application of knowledge to industrial design [3]. Furthermore, it has been extended to many fields since 1990s, e.g., user interface design, human factors engineering [4]. Presently, product semantics

has become even more important in the design field, as it enhances the understanding of analogies, metaphors, and allegories [5], which may be instrumental in creating breakthrough meanings in the design of new products and services. This may result in developing greater confidence among designers, who are then capable of creating more self-evident, user-friendly interfaces [4]. In most studies concerning product semantics, the design problem or intent is usually being developed from the designer's perspective. Although the user is being regarded an important actor, real individual desires and personalities are not being specifically considered [1]. In other words, mainstream literature on product semantics refrain from acknowledging subjective choices of the individual user. Most the studies show how designers, through their experiences, impose certain views to the user on for example "what meaningful aesthetic" is, rather than collaboratively aim to develop "good designs"

The aim of this article is to discuss and provide an overview of existing frameworks and models for creating meaningful understandings of products from a designer as well as customer / user perspective. This discussion has risen from the observation that design thinking and discourse have been too much influenced by technological and economic constraints, ergonomic possibilities, users' acceptance, and other issues more than by internal intellectual reflection on design as a visual language [6]. This intellectual reflection based upon visual interactions with the product is important to enhance creativity in the functional and aesthetic development (meaning making) of future products. Hereby, the understanding of how formal aesthetics and gestalt principles influences product semantics may provide a more nuanced meaning making of products. The described aim and argumentation has led to the formulation of the following research questions: (1) what is product semantics and how are the concepts applied in the form giving of industrial designed products? (2) What are the main theories and frameworks of product semantics (and related concepts, such as semiotics, affordances, experience etc.) which are relevant to product design? (3) How are the models/frameworks of product semantics related to visual formal aesthetics (4) What are the most relevant frameworks for semantics analysis and form giving and how they can be used to facilitate the prospective development of meaningful products through the involvement of formal aesthetics?

2 Product semantics in form giving, industrial design and product design.

Product semantics is a study performed in a rather "sterile" and designer-based environment [1]. It is also a study of symbolic qualities of man-made forms in the context of their use, and how this use is being applied to create knowledge in terms of meaning making in industrial design. Hereby, an important challenge is how to express, qualify, quantify and assess user needs, which are based upon subjective dimensions. As earlier mentioned, the term Product Semantics (PS) was commonly used by industrial designers since the 1980s to gain a better understanding how products can communicate additional meanings beyond styling to consumers and users. PS also attempts to convey the functionality of a product through syntactic and pragmatic approaches in form giving. Hereby, the designer uses the shape, material, texture and color to develop meaning in products, which are understandable, engaging and in some cases provoking [2]. Ideally, product semantics is to self-evidently let the user know how a product functions and how it should be used without instructions, alongside its identity, character, and affordance.

3 The main theories of product semantics and related concepts, which are relevant to product design.

Semiotics is the study of non-linguistic meaning and signs in specific cultures and societies, whereas semantics studies meaning in language. Gros [7] subdivided the specific object of

product language into formal aesthetic functions – i.e. those aspects that can be observed irrespective of content and meaning as well as the semantic functions. Within the context of referents, between signifier and signified, Krippendorff [8] p. 273, criticises semiotics on its lack of concepts for relating and interacting with the user. His criticism is built upon the concept of classical semiotics, which comprises of the following sub-disciplines; syntactic, pragmatics and semantics as introduced by Morris. Hereby, syntactic is firstly seen as a study of relations between sign and their uses, whereby humans do not exist or are not allowed to enter. Secondly; semantics is defined as the relationship between signs and objects they refer to or signify a reality independent of the sign user. Thirdly pragmatics as the relationship between signs and their users seems to suggest the existence of the concept of user, the way the sign users are acknowledged is without conceptual participation and without creativity [8].

In a theoretical groundwork proposed by Krippendorff [9], affordances were one of the semantic dimensions describing operational meaning of objects. The term affordance was appropriately denoted as a possible behaviour that confirmed what users are expected to do with the object or how the object influences them. An artefact and its affordance refer to cognitive models or constructions, that user identified as a particular kind of thing, not to what they objectively were [2]. In addition, Krippendorff [10] claimed that product semantics aims at designing things whose affordances cover at least a range of meanings users have in mind. However, he also states the concern that user cognitive models are too much focused on high level cognitive processing rather than being engaged with perceptual motor level interactions, involving perceivable features in product. This claim is supported by You and Chen [2], stating that within the context of semantics, user does not perceive pure geometrical or physical properties in things, but meanings. In semantics, meaning is cognitively constructed in the user mind, based on the information perceived by the senses, whereas affordance-driven meaning making is based upon objective conditions of users and products at present. Besides that affordances concern the intrinsic behavioural relation between the users and the objects and are not meant to convey information for communication purposes.

4 Frameworks for Semantic Analysis

In this section selected theories and frameworks for semantic analysis and form giving will be discussed and compared on how they can be used to facilitate the prospective development of meaningful products through the involvement of formal aesthetics. Although there is no clear indication how semantic frameworks and theories can be applied in design research and practice, as for example, Shannon's and Crilly's frameworks are highly theoretical, whereas Warell's PPE and Desmet and Hekkert's Product Experience Framework are analytical in nature, the authors assume that these frameworks have the potential to incorporate formal aesthetics and so are transformable to be more "creative". The frameworks and theories which will be discussed are: (i) Shannon's "Basic Framework for Communication", (ii) Crilly's framework, exploring "Design as a Process of Communication", (iii) Karjalainen and Snelders Semantic transformation framework to strategically create core brand values, (iv) Warell's Perceptual Product Experience (PPE) framework, (v) Desmet and Hekkert's "Framework of Product Experience".

4.1 A basic framework for Communication

Reference to Crilly et al [11], the term aesthetic is commonly used to describe "product aesthetics" and "aesthetic experience". *Product aesthetics* refers to what products present to the senses whereas *aesthetic experience* relate to aspects of cognitive responses concerning how pleasing the processes are with respect to designing an object. According to Crilly et al.

[11] consumers are not only involved in purchase decision-making but are included in the ongoing process of visual consumption from when they notice the product for the first time to when it is being discarded. The semiotics perspective on product design is that products are being represented as signs, which are to be interpreted by the users. [3]



Figure 1: Basic model of communication (adapted from Shannon)

More explicitly, Shannon described a basic system of communication comprising of five elements, which are source, transmitter, channel, receiver and destination. In this communication model of Shannon, the information source produces a message, which is enclosed into a signal and transmitted across a channel. The receiver decodes the signal and the message arrives at the destination. (See figure 1). When contextualizing this model of communication to design, the producer and designer are the “source” and are responsible for the design and manufacturing of the product. The designer also plays the role of translator and transmitter of the message, which is the product. The channel can be seen as a context or platform for the product to interact with the consumer. The consumer who engages with the product through sensory perception and consecutive response can abstractly be perceived as the receiver of the design. The aptitude of response might be noted as the destination [11].

4.2 Designs as a Process of Communication

Crilly et al. [11] has elaborated on Shannon’s model by introducing a framework of “Design as a Process of Communication” The framework suggests a more in depth and reflective understanding of use, context, and product and design practice. In this design communication process the designer plans how the design should look like, be manufactured and placed in the environment, which can be comprehended by the consumer to respond to it. (See figure 2 below).

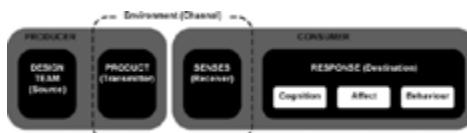


Figure 2: Basic frameworks for design as a process of communication.

On the producer side, the basic framework is divided into source (design team) and transmitter product. How the product is being perceived by the senses of the receiver is contextualized in a certain environment through specific channels of communication). The design team according to Crilly et al [11], Bloch [12], and Simon [13] comprises of stakeholders who are engaged in design, engineering and management activities. According to Hannah [14] the characteristic of the product to be transmitted is characterized by its geometry, dimensions, textures, materials, colours, graphics and detailing. With respect to the perception of product form, vision is considered to be the primary sense for receiving the transmitted message. From a consumer perspective, the “response” to the received message can be categorized according to cognition, affect and behaviour. Cognitive response refers to the judgments that the user or consumer makes about the product based on the information perceived by the senses [11]. This response comprises of three elements, which are semantic interpretation, symbolic association and aesthetic impression. These elements do not operate independently, but influence one another. Semantic interpretation refers to aspects of utility that can be conveyed to some extent by the visual form of the product. Symbolic association assumes that products may evoke ‘thoughts, feelings and associations which one links to the

commodity, or presumes that others must associate with it. Aesthetic impression refers to the activity of perceiving the object as pleasure in itself, irrespective of other value judgments. Affective response refers to the semiotic content of a product as part of a consumer's psychological response. Behavioural response influences the way potential consumers behave towards the product. It is influenced by the social setting, cultural background and experiences of the consumers.[12] [15]

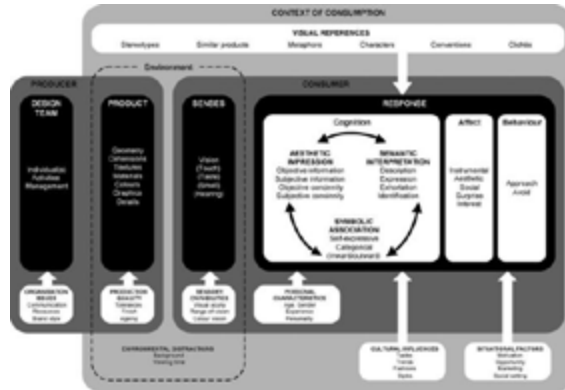


Figure 3: Framework for consumer response to the visual domain in product design

4.3 Semantic transformation as a strategic framework for design to create core brand values.

The most obvious and recognizable characteristic of a product when it is being introduced in the market, is its exterior form and everything, which is associated with it. Therefore, companies strategically employ design more frequently to create visual recognition of their brand's core values.. A good design will attract the consumer to acquire the product, communicate a certain meaning to him or her, and increase the value of use through certain experiences associated with it [12]. The ROI framework, as shown in figure 4, serves as a platform for design thinking to develop visual recognizable designs that communicate the brand's core value. According to Karjalainen and Snelders [16], the communication process, made explicit in this ROI framework, was molded through a process of a semantic transformation, which is a process of relating brand strategy and product design through acts. This framework specifies how the meaning in design is created for typical consumer's capitalizing on a three way relationship among "design features", "brand values", and "interpretation". The analysis of the "Nokia" and "Volvo" case studies [16] has demonstrated how a process of semantic transformation could enable companies to make future strategic decisions based on the following six key drivers: *lifecycle stage, renewal cycle, brand position, portfolio width, and brand heritage and product history*. In a process of semantic transformation, these drivers are significant for design managers and designer to transact brand values into product requirements, and transforming semantic values into branding strategies. To be more specific, the value of "semantic transformation" is being established by describing how qualitative brand descriptions are transformed into value-based design features, and are generated to create an intended meaning of products. The example of the "Friendly Smile" shown in many Nokia phones represents a personalized human approach, whereas the Volvo's 'shoulder' lines refer to safety, solidity and the feeling of being protected. However, with respect to the formal characteristics of form as mentioned earlier by Hannah [14] in the basic communication framework for design, Karjalainen and Snelders did not address how typical changes in geometry, dimensions, textures, materials, colors, graphics and detailing may facilitate semantic transformation.

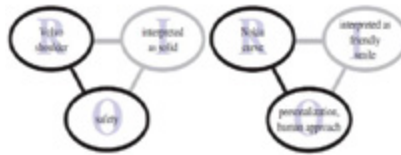


Figure 4: The R–O–I Framework for the Analysis of Brand References in Design, Applied to Volvo and Nokia.

4.4 The PPE Framework as a tool for understanding product perception

This Perceptual Product Experience (PPE) framework is a comprehensive and analytical structuring tool to enhance the understanding about product perception [17]. Product experience is subjective and specific to each perceiver, and depends on personal factors (experiences, background, cultural values and motives), product related factors (type of product, properties and characteristics, brand), and external factors (environmental, social and economic context). The purpose of the framework is to appropriately and creatively manage the design directions and guidelines in the redesign of existing and development of new products. [17] More concretely, the PPE is a tool, which translates design research on products to their relevant visual characteristics. In other words, the tool helps to appropriate and validate design experiences, which previously were difficult to measure due to the subjective nature of design. According to Young and Warell [17] the value of this framework lies in the communication, and management of design work at an operational and strategic level of designing, also contributing to the quality assurance of design processes. This framework comprises of three core modes, which are the sensorial, cognitive and affective modes of experience, and two dimensions which are “presentation” and “representation” (see figure 5). The sensorial mode embraces experiences, which are related to vision, hearing, smell\ taste, touch or balance [18]. In this context, vision can be perceived as the most highly prioritized sense. Sensory perception of the product leads to a range of experiences, including aesthetic, emotional (see, e.g., Desmet [19], Norman [20]) and pleasurable (see, e.g., Jordan [21]) experiences. The cognitive part of the product experience processes provides an understanding, organizes, and makes sense of what we perceive. It categorizes sensory input, stores, creates and retrieves information and knowledge from memory, and supports in decision making, judgment and inferences [22]. The affective mode give rise to experiences, which are affective in nature, such as feelings, emotions, and mood states, based on product perceptions (see e.g. Crilly et al.[11], Visser [23], Schütte [24]). As the affective mode is subjective and judgmental [20], it includes associations and notions that people attribute to products, such as brand associations based on personal beliefs, values and emotions [25].



Figure 5: Framework of perceptual product experience (PPE framework)

The presentational and representational frameworks, which were derived from the core modes, illustrates ‘pleasurable’ as well as a ‘meaningful’ dimensions. The dimension of presentation is concerned with the direct, ‘pure’ sensual stimuli, non-interpretative side of the experience, i.e. experiencing the product for ‘what it is’. The experience sub-modes in the dimension of presentation are described in the following: (i) *Impression* which is purely sensorial experience of becoming aware of a product as a result of it being sufficiently ‘different’ to stand out, be noticed and attended to. This is referred to as ‘active selectivity by

Arnheim [26], p.20. (ii) *Appreciation* is about recognition of aesthetic values through our senses and cognitively processing them. Part of the appreciation is the composition and order of perceived stimuli Muller [27]. The pleasurable experience of visual composition of detail and unity in product design can be established through coherence and resemblance between elements within each structural level of the visual composition, as well as between the hierarchical levels of holistic and atomistic structure of form [28]. (iii) *Emotion* is the affective response evoked by the combination of product stimuli, subjective concerns and an appraisal [19]. According to Visser [23], emotion is involved in the control of activity and thus influences decision making [29].

The indirect and interpretive aspects of the core mode, “representation “considers product experience as a meaning-making phenomenon that can be described by the following three sub-modes: ‘recognition’, ‘comprehension’, and ‘association’. (i) *Recognition* is based on familiarity, resemblance or similarity, and requires comparisons with previous precedents. In other words, it is dependent on the existence of pre-established references stored in long term memory (Simon [30], p.132; Solso, [31], p.78). Recognition of product type and brand requires resemblance to other products through similar sensorial elements. In the visual domain, such elements are known as ‘signifiers’ [32], or ‘design cues’. (ii) *Comprehension* is about making ‘sense of things’, such that products are “understandable to their users” [8]. Through comprehension, we understand characteristics such as level of quality, way to operate it, and the properties and essential characteristics of the product. (iii) *Association* is about communication of, e.g., values, origin and heritage, and is dependent on how we associate subjective and socio-cultural references with meaning through symbolic signs within target market groups with similar values and aspirations [33]. Hereby, meaning is created and interpreted from two perspectives; from the point of view of the manufacturer, who uses the product to convey strategic brand messages and build brand values [34]; and from the point of view of the customer or user, who communicates personal values and preferences through ownership or use of the product.

In both Warell’s and Crilly’s frameworks, principles for gestalt and formal aesthetics are connected to the cognitive sub-mode at the consumer –response level. However, Warell’s PPE framework more specifically considered and discussed formal aesthetics from an analytical perspective, addressing the recognition - impression as well as the comprehension – appreciation lines of communication between the designer and user. However, this analytical perspective towards formal aesthetics does not proactively drive meaning making within the PPE framework’s association – emotion mode by proposing transitional changes in geometry, dimensions, textures, materials, colors, graphics and detailing.

4.5 Framework of Product Experience.

Hekkert [35] distinguished three levels of product experience: aesthetic pleasure, attribution of meaning, and emotional response. These experiences have been further elaborated and researched from a sensorial perspective and integrated in a general framework for product experience [36]. The three distinct components of product experiences interaction which are aesthetic experience, experience of meaning, and emotional experience applies all affective responses in human-product interaction.

- At the aesthetic level, it is important to consider a product’s capacity to satisfy one or more of our sensory modalities. A product can be beautiful to look at, make a pleasant sound, and feel good to touch, or even smell nice. The generated “Affect” is determined by the degree to which a perceptual system manages to detect

structure, order, or coherence and assess a product's novelty/familiarity. Hekkert, Snelders, & Van Wieringen, [37].

- At the level of meaning, cognitive processes, like interpretation, memory retrieval, and associations through for example metaphors, are significant for assessing the personal or symbolic significance of products. At this level, the experience corresponds with Crilly et al. [11] cognitive response categories 'semantic interpretation' and 'symbolic association, underlining that cognitive processes are vulnerable to individual and cultural differences.
- At the emotional experience level, the personal significance of a product is more important than the product itself, different individuals appraise the same product in different ways and experience different emotions. As emotions are cognitive, unconscious and functional, they establish a person's position vis-à-vis a certain environment, pulling him or her toward certain people, objects, actions, and ideas, and pushing him or her away from others. With respect to human-product interaction, pleasant emotions pull us to products that are (or promise to be) beneficial, whereas unpleasant emotions will push us from those that are (or promise to be) detrimental for our well-being [19].

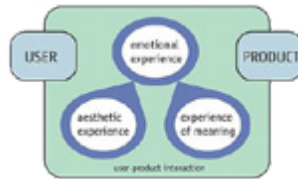


Figure 6: Framework of product experience.

In Hekkert's [35] and Desmet and Hekkert's [36] framework of product experience, gestalt and geometric principles are directly related to aesthetic experience and indirectly influences emotional experience. However, as there is no connectivity between "aesthetic experience" and "experience of meaning", gestalt and formal aesthetics does not explicitly contribute to emotional experience through meaning. Similarly to Karjalainen & Snelders, as well as Warell's framework, formal aesthetic characteristics, such as geometry, dimension, texture, material, colors, graphic and detailing have not been discussed as potential tools for developing the semantics of prospective products.

5 DISCUSSION: How can formal aesthetics influence product semantic frameworks to facilitate form driven product design?

In form development, product semantics and formal aesthetics are related, but theoretically supported by different groups of scientists. Formal aesthetics, which is represented by geometrical principles, can be used as a tool for analysing and organizing form, but should be, applied purposefully. According to Coates [38], information and concinnity in products are determined by the objective qualities of the product itself, as well as the subjective experiences of the consumer. Within the context of form giving, subjective and objective information are related to each other through gestalt theories and principles. For example, how a product is geometrically constructed and materialised through colours, textures, materials and details, in relation to its background, determines how it is being perceived by the user according to gradations of unity. Subjectivity is then stressed upon in a semantic approach, where the level of unity, supported by geometrical principles, is being further elaborated through meaning making processes. After a comparative evaluation of the four frameworks, the authors are of the opinion that none of these frameworks explicitly promotes

the use of formal aesthetics to create a deeper cognitive understanding about the semantic development of prospective products. However, implicitly the frameworks addressed formal aesthetics, but more to analytically explain why certain products are perceived to have certain meanings based on for example: geometry, dimension, texture, and material, colours, graphic and detailing. For instance, with respect to Crilly's framework of design as a process of communication, principles for gestalt and formal aesthetics connects to the cognitive sub-mode at the consumer –response level. More specifically geometry, colours, textures, materials imposed on a certain background, determines how the consumer perceives the total aesthetic impression, mainly through his or her visual senses. The aesthetic impression is then semantically interpreted and symbolically associated. Similarly, formal aesthetics and gestalt joins Warell's PPE framework at the cognitive sub-mode of the "experience" mode, and influences the other two, presentation and representation modes. In Desmet and Hekkert's framework of product experience, gestalt and geometric principles are directly related to aesthetic experience and indirectly influences emotional experience. However, as there is no connectivity between "aesthetic experience" and "experience of meaning", gestalt and formal aesthetics does not explicitly contribute to emotional experience through meaning. Karjalainen and Snelders [16] adopted a semantic transformation framework based on Pierce [39] theory of signs framework. Reference to this framework, it can be suggested that gestalt principles and formal aesthetics can be related directly to product features and their key drivers through a process of semantic transformation.

6 Conclusion

From an overarching perspective, it is suggested that creative meaning making of prospective products can be facilitated by focussing on how to use formal aesthetic variables as a toolkit in combination with semantics on products, selected design features and brand values. By making formal aesthetics and gestalt theories more explicit at the cognitive level, form characteristics, such as geometry, dimension, texture, material, colour, graphics and detailing can be used to develop and create a more in-depth cognitive understanding of products and their meanings, which are currently more reliant on semantic interpretations only. Contrary to analytical and descriptive methods for form evaluation as proposed by Crilly, Desmet & Hekkert and Warell, Karjalainen and Snelder's semantic transformation framework, could be further developed to incorporate gestalt and formal aesthetics, through the key drivers in the generation of prospective form-dominant products.

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