SEMANTIC DISCONTINUITIES: INVESTIGATING DESIGNERS' PRODUCT EXPRESSIONS VERSUS USERS' PRODUCT IMPRESSIONS

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I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

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ABSTRACT

SEMANTIC DISCONTINUITIES: INVESTIGATING DESIGNERS' PRODUCT EXPRESSIONS VERSUS USERS' PRODUCT IMPRESSIONS

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The doctoral thesis investigates issues in design communication between a designer's semantic intention and users' initial experience of a product, with a focus on visual qualities. The starting argumentation is that there can exist a level of discontinuity between meanings as intended to be expressed (by the designer of a product) and meanings as actually construed (by target users of that product). The primary purpose of the research is to develop and implement a methodology to identify where, and to what extent, semantic discontinuities related to connotative meanings are present in product design. A new experimental 'Semantic Expression/Impression Comparison' method (SEIC method) is developed and implemented to explore the main subject of the thesis. The SEIC method is applied to an empirical study considering 3 chairs and 3 lamps, designed and produced by three well-known Swedish designers. In total, four data collection and analysis stages are presented: 1) designers' intended visual expressions, 2) users' initial visual impressions, 3) users' evaluations of designers' intended visual expressions, and 4) designers' evaluations of users' realized visual impressions. The qualitative approach to data analysis leads to the creation of

Semantic Discontinuity Maps, revealing that designers are able to influence users' product perceptions, in many cases being considerably successful in eliciting their intended product expressions. However, users' overall impressions are not limited to only positive experience (as preferably intended by designers), but also include negative and indifferent experiences, which are usually outside of designers' intentions or expectations. Quantitative analysis of semantic discontinuity data is used to generate Banded Discontinuity Profiles, showing that the studied designers are generally successful in maintaining semantic intent within close tolerances (76 %), but are unable to successfully communicate semantic intent in approximately one-in-four instances (24%). A follow-up micro-analysis is presented and used to illuminate whereabouts design effort should be placed to better realize semantic intent through product visual form.

Keywords: Product Sensorial Qualities, Product Semantics, Design Intent, User Experience, Communication.

ÖZ

SEMANTİK DEVAMSIZLIKLAR: TASARIMCILARIN ÜRÜN İFADELERİNİ KULLANICILARIN ÜRÜN İZLENİMLERİNE KARŞI İNCELENMESİ

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Bu doktora tezi ürünün görsel nitelikleri üzerine odaklanarak bir tasarımcının semantik niyeti ve kullanıcıların ilk deneyimi arasındaki tasarım iletişim konularını inceler. Başlangıç tartışması; ifade edilmesi amaçlanan anlamlar (ürünün tasarımcısı tarafından) ile gerçekten yorumlanan anlamların (ürünün hedef kullanıcıları tarafından) arasındaki devamsızlık düzeyinin varolabilmesi üzerinedir. Araştırmanın temel amacı çağrışımsal yan anlamlara bağlı olarak semantik devamsızlıkların kökeni ve derecesini ürün tasarımında araştırmak için bir metodoloji geliştirilmesi ve uygulanmasıdır. Tezin ana konusunu araştırmak için yeni bir deneysel 'Semantik İfade /İzlenim Karşılaştırması "yöntemi (SİİK yöntemi) geliştirilmiş ve uygulanmıştır. SİİK yöntemi, üç tanınmış İsveçli tasarımcılar tarafından tasarlanan ve üretilen 3 lamba ve 3 sandalyeyi değerlendirerek, ampirik bir çalışmada uygulanmıştır. Toplamda dört veri toplama ve analiz aşamaları sunulmuştur: 1) tasarımcıların amaçladığı görsel ifadeleri, 2) kullanıcıların ilk görsel izlenimleri, 3) tasarımcıların amaçladığı görsel ifadelerin kullanıcılar tarafından değerlendirilmesi, ve 4) kullanıcıların gerçekleşen

görsel izlenimlerinin tasarımcılar tarafından değerlendirilmesi. Verilerin kalitatif analizi ‘Semantik Devamsızlık Haritaları’ yaratılmasına yol açar; böylelikle tasarımcıların kullanıcıların ürün algılarını etkiliyebilmelerini, birçok durumda amaçlanan ürün ifadelerinin ortaya çıkarılmasında oldukça başarılı olmalarını açıklar. Ancak, kullanıcıların genel izlenimleri sadece olumlu bir deneyim (tasarımcıların tercih ettiği gibi) ile sınırlı değildir, aynı zamanda tasarımcıların hedefleri ve beklentileri dışında olumsuz ve ilgisiz deneyimleri de kapsamaktadır. Semantik devamsızlık verilerin kantitatif analizi ‘Birleşik Devamsızlık Profilleri’ oluşturmak için kullanılır. Bu analizin sonucu tasarımcıların genelde yakın bir toleransla (% 76) semantik hedeflerini iletmekte başarılı olduklarını, ve fakat yaklaşık dörtte bir oranında (% 24) iletişim hatası olduğunu göstermektedir. Ürünün görsel formu yoluyla daha iyi bir şekilde semantik hedeflerin gerçekleştirilebilmesi için tasarımın nereye odaklanması gerektiğini gösteren bir takip mikro-analizi sunulur ve kullanılır.

Anahtar Kelimeler: Ürünün Duyusal Nitelikleri, Ürün Anlambilimi, Tasarım Amacı, Kullanıcı Deneyimi, İletişim.

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INTRODUCTION

1.1 Background to the Study

The concept of experience, or more specifically ‘user experience’, influences designers’ viewpoints and activities (Hekkert & van Dijk, 2011). It is considered that experiences gained through objects need to improve people’s quality of life, since material consumption on its own is no longer seen relevant or sufficient (Hassenzahl, 2011). In other words, a design object should bring satisfactions to people beyond just material ownership and consumption.

In the current era, where effort is focused on ‘designing for experience’, the traditional definition of a product’s physical properties being condensed to the motto ‘form should follow function’ is seen as too simplistic and narrow. We know that people have increasingly high expectations from everyday products, and look for new desirable experiences to satisfy their needs beyond functionality. People’s willingness to pay for products – their determinant of affordability - is today shaped by complex experiential criteria that extend far beyond fitness for purpose.

This situation urges designers to generate creative designs for new purposeful and meaningful experiences derived from product acquaintances and interactions. Today’s designers must put effort into better ‘connecting’ with the target users of their products and better capturing target users’ attention through careful definition of product attributes, so that a product is liked for the reasons that the designer intended. By this movement, design research on the relationship between design intent and user experience has become important in the area of design theory and practice.

In the domain of industrial or product design, the designed object is the first and

essential medium of communication, in that it carries the intentions of its creators whilst also moderating users' interpretations and experience. Despite different perspectives arguing the communicative function of design (for example, from the theory of product language, semiotic theory, semantic design, and aesthetic theory), there exists a common ground where products are viewed as a medium through which messages / meanings may be constructed by designers and subsequently construed by users (Vihma, 1990; Muller, 2001; Krippendorff, 2006; Crilly et al., 2008a). In this respect, it is evident that a design object communicates or expresses certain qualities to people who see it or who come into contact with it.

The research reported in this thesis is concerned with situations in which there exists a *discontinuity* between the message intended to be expressed (by the designer of a product) and the message as actually construed (by target users of that product). Such a discontinuity is said to be possible (or even probable), since one person's (user's) interpretation and response to a product in an environment and context of use will inevitably differ from another user's interpretation and response. Furthermore, Accordingly, in theory and in practice (Crilly et al., 2008a; Khalaj & Pedgley, 2014), differences between users' product appraisals reveal mismatches to what the originating designer had wished for his or her product.

1.2 Research Aim

The aim of the research reported through this thesis was to conceive and develop an *evaluative design research tool/method* that could help to identify where, and to what extent, the aforementioned semantic discontinuities are present in product design. This could be termed a new 'semantic expression/impression comparison method'. It could be applied by design researchers, practicing designers and design educators as a systematic approach to the appraisal of product semantics, highlighting stronger and weaker areas of semantic communication. Parallel to the development of the tool/method, it was considered vital to evaluate its credibility and effectiveness, as well as to contribute to emerging empirical insights in the area of semantic discontinuity. To this end, a specific case study of *Swedish Lamp and Chair Designs* was made.

Thus it can be appreciated that the research is positioned within the general field of design communication, with an emphasis of *efficacy* of communication (i.e. is what is intended to be communicated by designers – through product visual qualities – actually communicated to target users?).

Ultimately, differences between semantic intent and realization are theorized to result in a lower level of attractiveness or an undesirable meaning of a product to potential users, which inevitably would undermine the commercial success of that product. The doctoral candidate had previous experience in this area through his Master of Science studies, which took an alternative empirical approach to that developed for this thesis (Khalaj & Pedgley, 2012a; Khalaj & Pedgley, 2012b; Khalaj & Pedgley, 2014).

1.3 Overview of Discontinuities in Design Communication

The central issues of discontinuity raised within the context of design communication are as follows. How large can semantic intent/realization discontinuities be? From where do they originate? And how can designers reduce the number or severity of discontinuities, so that physical qualities of products more effectively communicate their intended product expressions?

In order to understand how intentions embedded in design objects are interpreted, it is first necessary to become accustomed to theory behind the communicative function within design. A principal matter is that how we make sense of objects is to a large extent influenced by the search for communicative intentions. Based on a categorization of 'types of media' by Fiske (1990), an artifact together with its physical qualities fits into a category of *'representational media'*, being creative in nature and not reliant on the presence of the designer (as originator) to convey messages.

To this end, it is helpful to identify the kinds of semantic messages that designed objects are intended to communicate, in the form of non-verbal *expressions* that originate from a product's physical features and sensorial characteristics. In other words, the physical properties of an object and their associated sensorial characteristics are considered as physical manifestations of messages and semantic content intended to be conveyed by the designer. The physical and non-physical

interaction between the product and its intended users shapes those users' initial impressions and experiences of the product.

Crilly et al. (2008b) argue that although the interpretation and experience of a product are subjective and may differ among users within different contexts, the designers of that product may still have influence over target users' interpretations, because the physicality of the product is a means to express designers' intentions (i.e. from the designer's perspective, there is intent to bring about 'an intended interpretation' – even though in some cases the intent may be to arouse ambiguity or a plurality of interpretations). As a result, there is by no means a certainty of a linear relationship between the product interpretation intended by the designer and the actual product interpretation of the user.

The literature is clear on the fact that designers, as creators of new design concepts, have the quite enviable ability to influence or shape users' experiences. Although user experience is subjective and is shaped strongly by individual 'stories' created through conversations between users and their use of products within complex contexts (Hassenzahl, 2011), it is clear that steering people towards noticeable, meaningful and pleasurable experiences from a product is a chief responsibility of the designer.

In principle, designers' decisions on the sensorial qualities of a product are defined by considering the types of interaction between a nominal *target user* and envisaged usage scenarios. Sensorial qualities of a product, spanning visual, tactual, auditory, olfactory and gustatory modalities, are a vital aspect of the designer-product-user communication process; they are used for baseline descriptions of product features, from which product character may be judged. Designers' intentions may be said to be *influential* if the physical product attributes consistently trigger similar thoughts in target users as those proposed by the designer. Within the context of communication, if there is no relation between a designer's intended expression and target users' impressions, then we can claim that the issue of 'user experience' is too dynamic and cannot be traced to the designer's intentions.

A user's interpretation of product physical qualities may differ according to the stage that has been reached in the user-product relationship, since each stage brings different

contexts and expectations. However, designers may reasonably expect to evoke intended interpretations in target users within intended contexts. Figure 1.1 has been constructed to illustrate an overview of design communication as approached in this thesis, based on a model (Crilly et al., 2004) that originally did not incorporate different phases of the user-product relationship (attraction, engagement, attachment).

The implication from Figure 1.1 is first that the tangible features of a product are considered within the control of the designer, who seeks to achieve and communicate certain intentions that may be deciphered from physical qualities intrinsic to the product. By materializing a product with chosen sensorial qualities, the designer aims to endow a product with intended *semantic attributes* or *characteristics* – almost without exception with the purpose of evoking positive impressions – which may then lead to extended use through engagement and attachment.

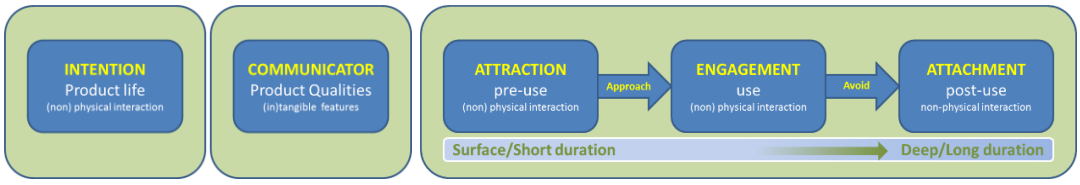

Figure 1.1 Modification of the design communication model (Crilly et al., 2004) to include different phases of the user-product relationship

Within Figure 1.1, divisions of *pre-use*, *use* and *post-use* experiences of a product are included. This is because after having used a product, it is expected that users' interpretations and experiences will differ from those held when evaluating the same product for a relatively short period at the pre-use (or even pre-purchase) phase. This point is important since the vast majority of our investment in time and effort with a product is during ownership and use, and not during the pre-use phase. These discussions highlight the importance of dividing user experiences into different phases of the user-product relationship, defined as attraction, engagement and attachment. It is assumed that user experience becomes more complex over time, commencing with a surface level of experience and progressively deepening.

At the stage of attraction, a target user will have physical and non-physical encounters with a product. He or she may 1) detect sensorial qualities of the product; 2) perceive associative attributes of the product; and 3) express his/her first feelings. From this perspective, the sensorial qualities of a product are considered to play a pivotal role towards positively influencing users' initial experiences and first product impressions.

As discussed, designers give symbolic meanings to their designs through expressive properties, and expect their designs to be interacted in certain ways to induce certain impressions. Accordingly, product designers and researchers should consider the idea of expressive qualities of a product in the context of *communication*, rather than *personal expression*. Essentially this means studying the relationship between *intended product expression* and *actual impression* and making links to the interactions and experiences that a product will (or could) deliver. Therefore, the main subject of this study is the relationship between the concepts of *intended expression* and *initial impression* in product design. 'Expression' is about the way designed objects are construed by their designers, whilst 'impression' is about the way designed objects are interpreted by users (see Hallnäs, 2011). Considering the main argument of this study, designer intention versus initial user experience, the principle of 'expression' reveals a designer's intention behind a product's physical qualities, while the principle of 'impression' reveals users' initial experiences of product physical qualities through multisensory interaction channels – including visual.

1.4 Problem Statement

Although it is assumed that the ultimate goal of most designers is to create user-product attachment by achieving a memorable product quality over an extended time (Schifferstein and Zwartkruis-Pelgrim, 2008), this goal cannot be achieved without first arousing a positive initial impression from a product and thus stimulating a purchase decision or a decision to use an already-purchased product over subsequent periods of time. From this viewpoint, the basic problems are identified that require further investigation and empirical research, as follows.

It is argued that designers have *responsibility* to influence intended users' initial impressions and experiences of a product. This acknowledges that there may exist

discrepancies between design intent and realization. Therefore, a practical approach to investigate original designers' successes in communicating intended product expression and experience is required. Moreover, in practice the relationship between intended experience and actual experience remains relatively unexplored. Studies of post-manufacture product experience are invariably discussed in isolation from the original designer's intent. Consequently, no concrete knowledge exists on: a) a rigorous methodology to detect and measure semantic discontinuities; b) the origin and degree of discontinuities that may exist between intended expression and initial impression; and c) the significant role of particular product qualities (within or across product sectors) as a medium to successfully express designers' intentions. The principal sensory modality implicated in this present research was vision, and therefore the exploration of product visual form and its associated meanings. Shifting the focus from subjective or intuitive product generation to communicative and interactive dimensions of product experience provides an initial and important contribution to the ultimate direction fed by this study: *how to better stimulate intended user impressions / experiences*.

1.5 Research Questions

The doctoral research was built on three main research questions.

RQ1. *How can a designer's success in communicating intended product expressions be measured?*

RQ2. *To what extent do people's experiences of meaning, derived from the visual qualities of a product, align with what was intended by the originating designer of that product?*

RQ3. *What can designers do to lessen any gaps between intended product expression and initial product impression?*

Investigating these questions required deep knowledge on the relationship between a) the individual designer as the decision maker or generator of a product's physical qualities, and b) the target users who come into contact with the product. The following supportive research questions helped guide the study.

RQ1b. *What kind of evaluation approaches could provide useful and concrete knowledge on designers' successes in communicating intended visual expressions?*

RQ2b. *Are designers able to trigger intended experiences originating from a product's visual qualities?*

RQ2c. *Where do the origins of discontinuity exist, between designers' intended expressions and target users' impressions in relation to a product's visual qualities*?

1.6 Structure of the Thesis

The outline of this thesis is presented in Figure 1.2. Following this Introduction chapter, the remaining four chapters are formalized as follows:

Chapter 2 discusses the theory behind design communication, centered on a physical product as a mediator that carries a designer's original intentions whilst influencing target users' experiences. After presenting some of the foundational frameworks, different aspects of user-product interaction and experience are investigated. It also presents an initial study which explore multisensory evaluations of product meanings. Accordingly, the focus of the study – the communication of meanings via product visual qualities – is introduced and elaborated on.

Chapter 3 covers methodology relevant to an investigation of the origin and degree of semantic *discontinuities* between an *intended expression* to be left by a product (from designers) and the *actual impression* left by that product (on users). The considered methodology is based only on the 'pre-use' phase of the user-product relationship (see Figure 1.1), considering visual appraisals of physical products.

Chapter 4 presents the outcomes of the empirical study for Swedish lamp and chair designs. Guidelines for implementation of the analysis methodologies are discussed.

Chapter 5 discusses the main stages of the developed methodology for detecting semantic discontinuity in product design. It includes discussion on the adaptation of the proposed methodology to be considered for design research, design practice, and educational contexts.

Chapter 6 summarizes and argues the significance of the developed methodology and the findings of the empirical work, in order to challenge and validate the arguments proposed in the thesis. It also reviews opportunities for further research on the main subject areas.

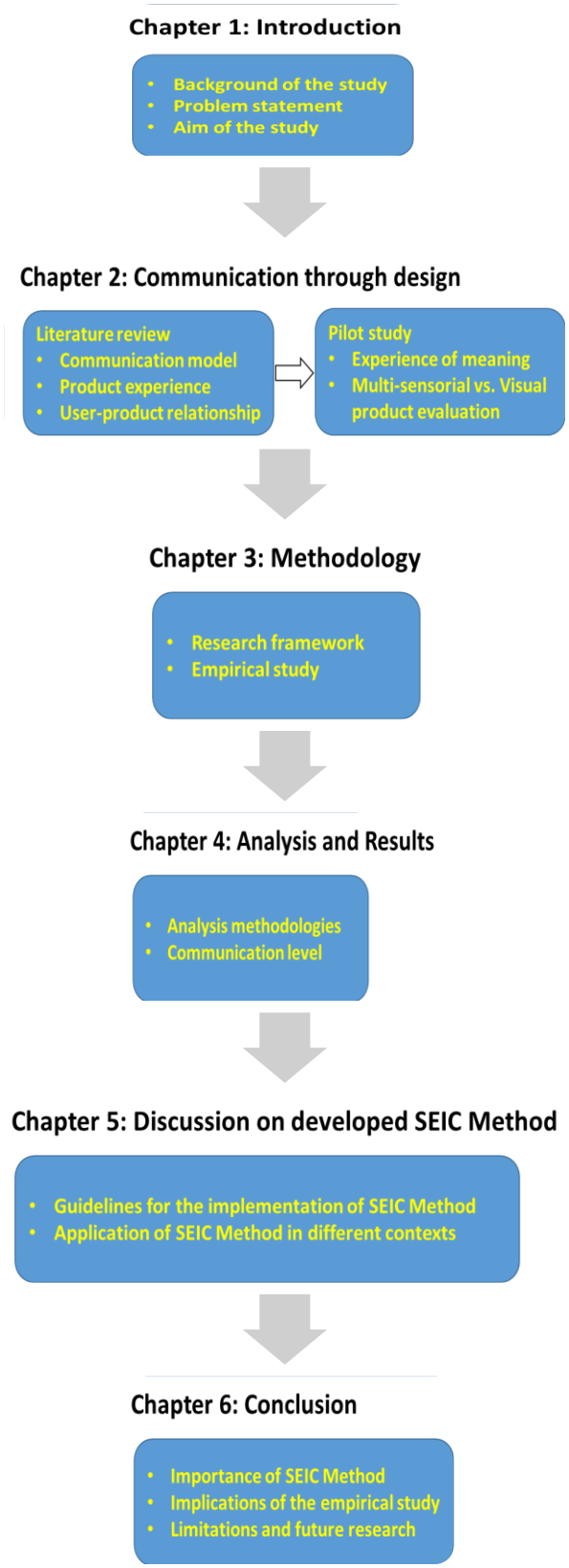

Figure 1.2 Structure of the thesis

CHAPTER 2

COMMUNICATION THROUGH PRODUCT DESIGN: LITERATURE REVIEW AND PILOT STUDY

This chapter comprises a detailed examination of how products are able to communicate certain meanings to people and, conversely, how designers are able to build those meanings 'into' the product in the first place. The literature review that is reported in this chapter therefore aims to bring together principles of design communication, product semantics, designers' expressions, and users' impressions, to lay important theoretical foundations for the research. Towards the end of the chapter, a pilot study is reported, which sought to understand the relative importance of visual and multi-sensorial product appraisals in assigning figurative meanings to products.

2.1 The Communicative Aspect of Design

According to Muller (2001) a product is considered to have a practical function together with communicative function. Most products have a main practical function, which is assumed to be the rationale for the product existing. The communicative function, however, deals with language, semiotic and aesthetic contents/messages of product design (Muller, 2001; Gros, 1983; Ehrnberger et al. 2012). Communication theory as applied in the domain of product design considers the communication process between designers (as creators of intended messages) and users (as receivers or interpreters of those messages) through the various detectable aspects of products. Products, in effect, become physical representations / manifestations of a designer's intended message (see Pierce, 1955; Fiske, 1990; Vihma, 1995; Karjalainen, 2004).

Communication theory is built around the principle that communication takes place between 'senders' and 'interpreters', where messages are conveyed through

communication channels. Fiske (1990) identified two basic 'schools of thought' that define approaches to the study of communication, applicable in the context of design: the '*process school*' and the '*semiotic school*'.

The 'process school' treats communication as the *transmission of messages*. It is concerned with how senders encode ('write') intended messages in 'transmissions', how receivers decode ('read') those messages, and the presence of any 'noises' that may distort the original message. This school of thought sees communication as a linear or one-way relationship, *from* senders *to* receivers. According to Fiske, if received messages do not match transmitted messages, the communication is considered unsuccessful or a failure. In this respect, by studying the component stages of the 'communication processes', it can be plausible to try to identify at what stage the failure in communication occurs.

In contrast, the 'semiotic school' considers communication as the *production and exchange of meanings*, involving an important triad of 'signifier' (something giving rise to a message, e.g. a traffic light), 'signal' (the message itself, e.g. a *green* traffic light) and 'signified' (what the message means or implies, e.g. *safe for traffic to move through*). The semiotic school is concerned with denotative and connotative levels of meanings constructed within a cultural context. This model of communication focuses on the message and *how it is interpreted*. It is about communication of text and context. In this school of thought, 'readers' with different socio-cultural backgrounds often exhibit different interpretations and thereby find different meanings in the same text. For example, in the case of the traffic light, some drivers – rightly or wrongly, and for various contextual reasons – also move through a *red* traffic light, even though they would acknowledge that it is not indicated safe to do so. Accordingly, what characterizes the 'semiotic school' of design communication is that the presence of differences between designers' intended meanings and users' (interpreters') actual meanings indicates an acceptable level of diversity in interpretation rather than a communication failure. In other words, for *product design,* it is acceptable to 'read' many different messages from the design of a product and not be 'wrong' if those interpretations have a mismatch to the original design intent.

For the work developed in this doctoral study, the 'semiotic school' was adopted, to

intentionally discuss and expose possible variance in interpretation of product meanings/messages rather than highlight failures to transfer intended messages. The following section develops the principles of design communication further, making reference to various 'models of communication in design' to highlight how design researchers see the complementary 'roles' of designers and target users with respect to their respective conception and interpretation of product meanings/messages.

2.2 Models of Communication in Design

One of the fundamental models within the process school is Shannon and Weaver's mathematical theory of communication (Shannon & Weaver, 1949), which shows how a message is encoded and decoded. Through this process, a source (a message to be conveyed) is encoded into a signal by a person acting as a transmitter of the message. The signal is then transmitted across a channel to another person, the receiver. The receiver decodes the signal into the original message and the communication from source to destination is completed. Within the channel between transmission and reception exist 'noise sources' (alternatively termed 'influencing factors') that can distort the purity of the message on its way to the receiver. The noise is neither managed nor intended by the source (Figure 2.1).

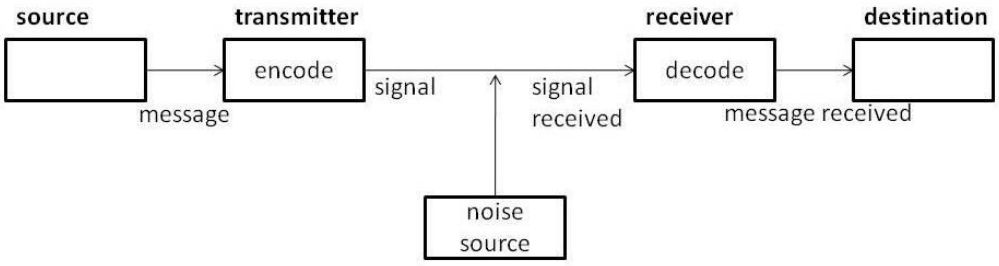

Figure 2.1 Shannon and Weaver's model of communication (adopted from Fiske, 1990)

Shannon and Weaver's model has seen direct influence on theories of design communication, where a designed object is seen as a transmitter of a message (Crilly et al., 2008b). Monö (1997) presented an extended model based on that of Shannon

and Weaver, which considers the process of communication of messages from the source (a designer's intentions) to the target (intended users' interpretations) – as presented in Figure 2.2. The model illustrates the susceptibility of a message to become obscured, changed or 'disturbed' on its way to the target.

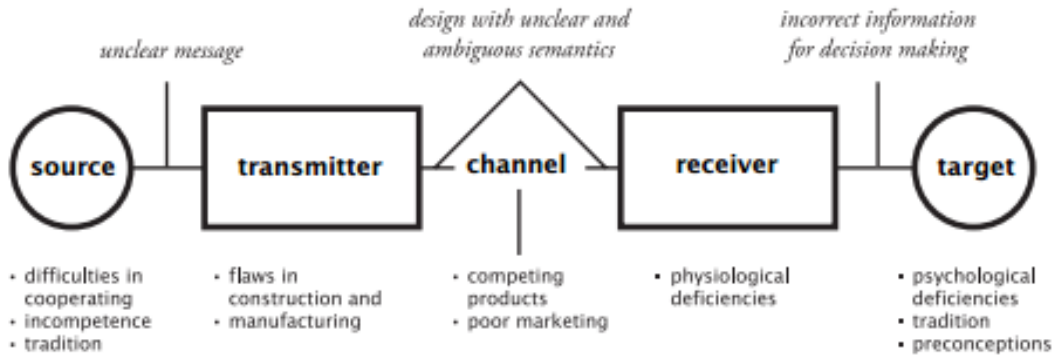

Figure 2.2 Communication of design messages with potential factors of disturbance (Monö, 1997)

To help explain users' varied responses to a product, Crilly et al. (2004) developed a basic communication model between designers and users, connected through the medium of a designed product (Figure 2.3). Their framework is composed of five elements: *design team, product, environment, senses,* and *response*. The design team, as the source of the message, decides on product qualities and what they should convey. The product, as the transmitter of the message, contains the physical product attributes tasked with conveying the message. The environment, or channel, is the physical space where user-product acquaintance and interaction takes place. Note here that the channel within which the product is perceived and interpreted can differ from that used or envisaged during product development. The user's sensory receptors form the first point of contact for receiving (or constructing) messages from the product within the channel. It is known that in the perception of a product, vision is more prominent sense than touch, taste, smell, and hearing (Crilly et al., 2004; Ulrich, 2007; Fenko et al., 2010a; Fenko et al., 2011; Fenko & Schifferstein, 2012). At the end of the continuum is the user's response or evaluation of the sensorial information received. Cognitive, affective, and behavioural resposes of the user are reflect the

different ways in which users will interpret and act on the messages that they read from a product. Accordingly, the user assumes a double role in the continuum; that of receiver and destination.

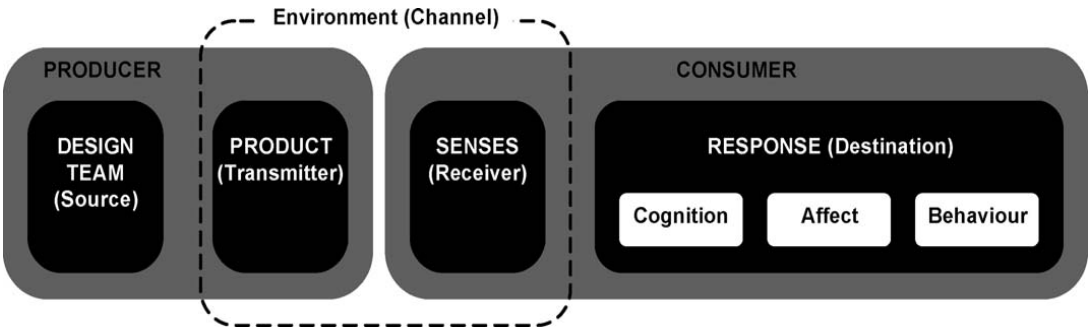

Figure 2.3 Basic framework for design as a process of communication (Crilly et al., 2004)

In the domain of design and branding, Karjalainen (2004) developed a communication model conceptualizing the transmission of brand identity through product design references (Figure 2.4). The focus in that work was on design as an effective medium for communicating strategically important predefined meanings to customers. Within this model, it is also conceded that although a company tries to convey intended brand messages, there is always the possibility that meanings and content are not picked-up as intended because customers 'interpret' differently. Accordingly, a brand is created through the interaction between, on the one hand the identity of the company communicated through designs, and on the other hand the image perception of customers. Here it is obvious that Karjalainen's approach to communication is more close to the semiotic school of thought because, as demonstrated, both identity and image have an effect on each other. This may be the reason why Karjalainen preferred to use 'interpreter' or 'perceiver' instead of the more terminal 'receiver'. Karjalainen's perspective on communication of meanings between constructer and interpreter – instead of sender and receiver – is in fact a specific example of how a product can be regarded as a carrier of intended meanings (in this case meanings that define a brand identity).

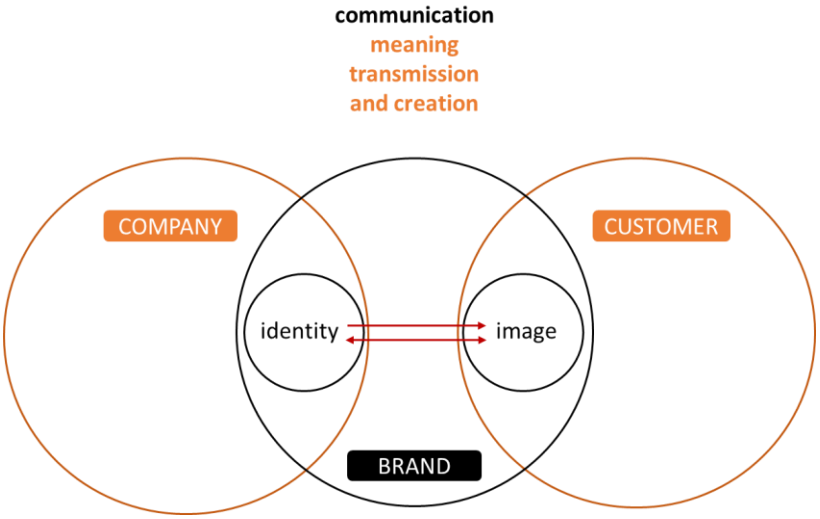

Figure 2.4 Strategic communication model in branding (Karjalainen, 2004)

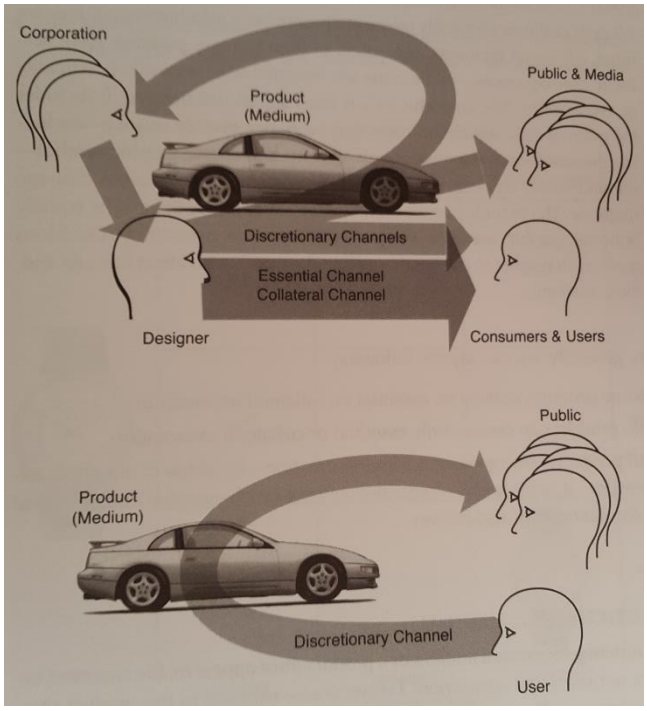

Figure 2.5 Channels of communication (Coates, 2003)

Coates (2003) also discusses different channels of communication in product design, seeing a product as a medium of communication not only between a designer and a targeted (informed) 'end user' but with other audiences too (such as the public, media and employees) (Figure 2.5). One of the more intriguing channels identified by Coates is the 'discretionary channel' that exists through which a product carries information *from target users to the public*. This channel relates to self-image and wider audience evaluation of individuals' product choices: it reveals how a discerning user's interpretation of a product can affect the viewpoints of the public. Among the other channels, Coates focuses on the importance of the channel between the designer's intended information and users' interpretations, which affects product qualities and performance.

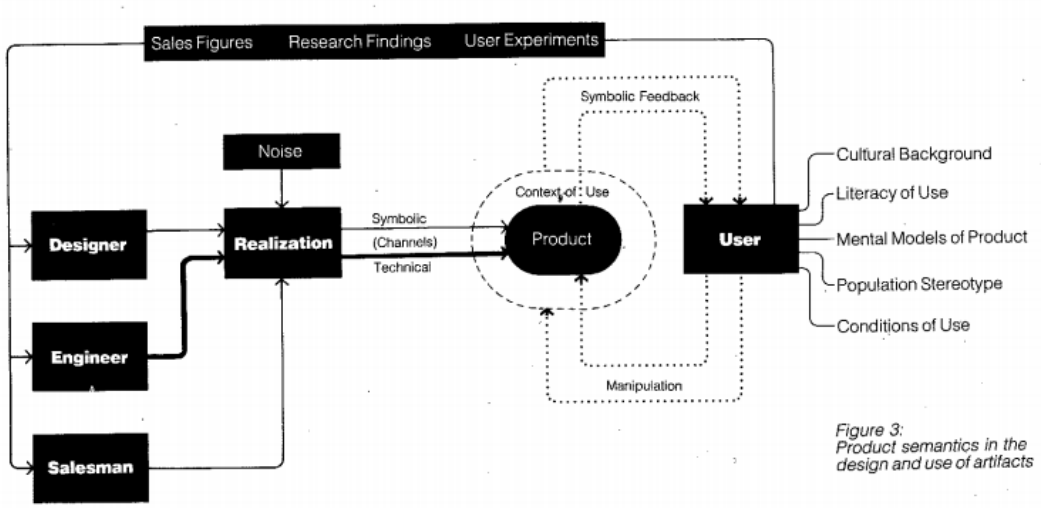

Figure 2.6 Product semantics in the design and use of artifacts (Krippendorff & Butter, 1984)

Krippendorff and Butter (1984) developed one of the fundamental and most influential models of design communication, which sought to reconcile the product design process with end user experiences (Figure 2.6). The model incorporates different factors that define the realization of intended semantic qualities of a product, together with factors that influence users' interpretations. An important point to be considered is that this model introduces the subject of *feedback* from users, both in the context of design development (back to the design team) and in the context of

product use (thus developing a language of use around a product). Krippendorff and Butter's model reveals how the study of users' interpretations of products has potential to positively affect the communication of design intentions.

Further concentrating on design communication from the designer's perspective, in this case within the specific context of product functionality, the communication model offered by Norman (1988) is a combination of what he terms the 'design model', the 'user's model' and the 'system image' (Figure 2.7). The design model refers to the designer's conceptual model of how product functionality ought to be communicated through the attributes of a product. The user's model of how a product functions, based on its obvious attributes, is created and refined over time through product experiences. The designer tries to influence users to interpret and use the product in a preferred way through the product 'system image', defined as the visual attributes of the product that suggest how it should be used. Thus, the system image should be appropriate and understandable to users. For effective communication, the design model should closely match the user's model. Otherwise, in cases where discrepancies exist between the designer's and user's interpretations of a product, there is potential for intended messages not to be communicated and hence for the design communication process to break down.

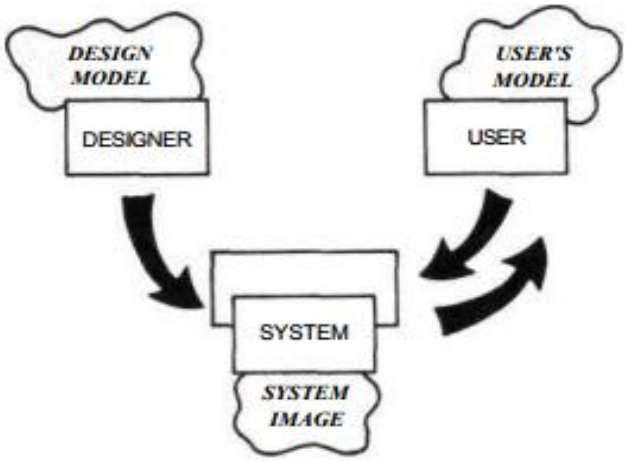

Figure 2.7 Model of design communication (Norman, 1988)

In related work, Crilly (2011b) prepared a new model on design communication that focused on users' interpretations of product behavior (Figure 2.8). This model acknowledges and respects users' awareness and capacity to view a system that has been designed with intentions. It highlights that users have the capacity to *infer* original design intent; that is, how the designer of the system has expected users to experience and interact with it. Investigating design communication between intentions and interpretations, by considering this approach, could reveal to what extent users' inferences of design intent are important or dominant when interpreting product behavior. Crilly (2011a) explains that users may try to infer the reasons behind a design especially when those reasons relate to how a designed product works and behaves.

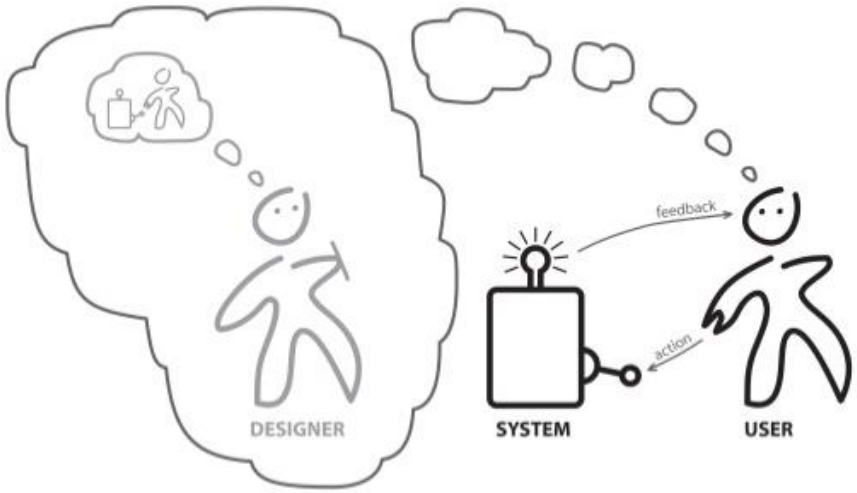

Figure 2.8 User's inference of design intent (Crilly, 2011b)

In earlier work, Crilly et al. (2008b) developed an integrated communication model of design that combined critical issues raised in communication literature (Figure 2.9). In this model, focused on design as an interpersonal communication, familiar terminology is used that argues how an artifact *mediates* between an individual designer (as *originator*) and an end user (as *interpreter*). As demonstrated in the model, the intentions of the individual designer and the actual interpretation of the individual user are manipulated through their personal characteristics at the first step. A designer expresses his/her intentions in an artifact while considering the possible

ways in which target users should (or might) interpret the representation (work-in-progress) of the artifact to be eventually realized. The representation of the artifact and such reflection upon it may help the designer to revise his/her intentions. Although the artifact is eventually realized in accordance with the representation, there is a possibility for changes to arise during production. An individual user also may experience the realized artifact in different way than intended, because of external influences, e.g. marketing, distribution and retail promotion.

If we combine the later work on *inferences* (Crilly, 2011a), we can comprehend that mismatches between design intent and reality can exist not only from what a user *experiences*, but also from what a user *thinks that the designer intended them to experience* (even though they may not have experienced it). These subtleties may under some circumstances be important in design studies; however, for the purposes of this present study, the concern is on the first kind of mismatch: between designers' intents and users' experiences.

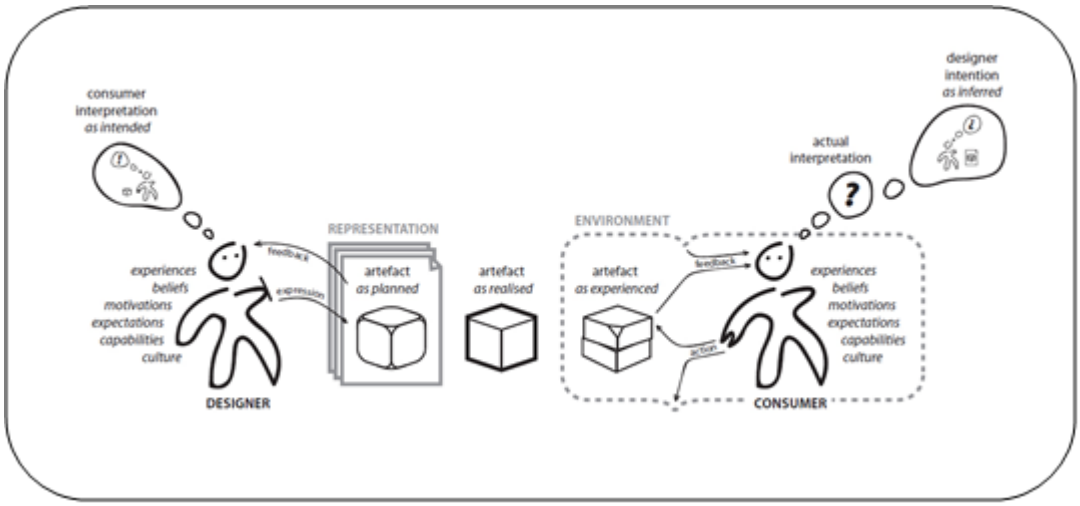

Figure 2.9 Integrated communication-based model of design (Crilly et al., 2008b)

Concentrating on the designer's role within the communication-based model of design (Crilly et al., 2008b), it can be said that through the product development process, designers interpret a design brief and form their own conceptual intentions. Designers' intentions have authority over product sensorial qualities and product expression

through tangible and intangible features. Designers try to communicate their intentions to target users through the medium of the product, keeping in their mind that their designs will always be open to interpretation by users (Crilly, 2005). In this workflow, designers might need to devise innovative and exclusive qualities to attract users' attentions and create subtle or pronounced discriminations between products. It is clear that almost exclusively, designers intend to induce *positive impressions* in users. However, there is no certainty that users will experience the product as intended – positively or negatively - by designers (Hassenzahl, 2003; Crilly, 2008b).

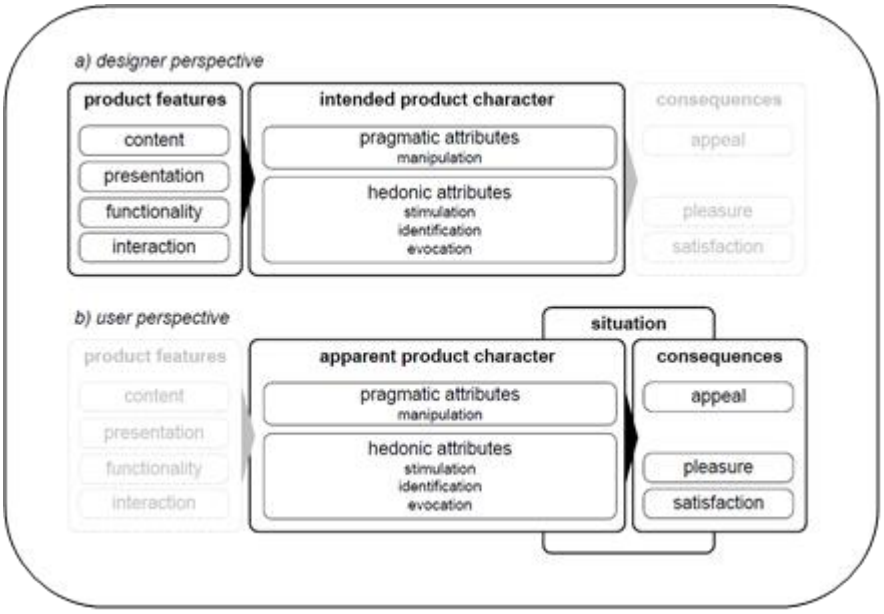

Figure 2.10 Key elements of the model of user experience from (a) a designer perspective and (b) a user perspective (Hassenzahl, 2003)

The model in Figure 2.10 developed by Hassenzahl (2003) represents the relationship between how a designer intends a product to be interpreted (the designer perspective) and how it is actually experienced by users (the user perspective). Product features communicate product character, which may be subdivided into pragmatic and hedonic attributes. Pragmatic attributes refer to functional needs, whereby a product should be judged as both useful and usable for the achievement of a certain task. Hedonic attributes relate to non-instrumental goals or aspirations of users and if successful help to stimulate desirable *impressions*, provide identification, and provoke memories or

previous experiences. Hassenzahl argues that a designer decides on including certain product features so as to achieve and communicate an intended product character. Accordingly, from the user's perspective, the detection of an apparent product character allows inferences to be made about the intentions of the product's creator. Hassenzahl maintains that a commendable design should properly convey both pragmatic and hedonic attributes of product character. Therefore, the achievement of a certain product character is a central theme for an industrial designer, incorporating instrumental and non-instrumental needs and desires of users so as to achieve desired consequences, triggering positive emotional responses, satisfying expected requirements, and delivering a pleasing (or pleasurable) experience.

Literature in design communication reveals that there exist potential differences between the individual designer's intentions and the end users' interpretations and experiences (Ahmed & Boelskifte, 2006; Chamorro-Koc et al., 2008; Crilly et al., 2008b; Hassenzahl, 2003; Lindh, 2010; Jin & Boling, 2010). The literature is also clear on the fact that designers, as creators of new design concepts, have the quite enviable ability to influence or shape users' initial impressions and experiences (Hassenzahl, 2011; Hekkert, 2011; Hekkert & van Dijk, 2011). The notion that designers can influence, but not dictate, meaningful experiences is a central philosophical matter (Wendt, 2013), and lends further weight to adopting the 'semiotic school' within design communication studies generally and this study specifically, seeing both designers and users as *interpreters* of a created artifact. To clarify: designers on one side of the communication interpret their intentions by transforming them into a physical product that achieves a certain desired product expression, and thereby conveys a message of design intent that influences users' impressions. Users, on the other side, interpret the perceived qualities of a product, based on its sensorial information, which affects their initial impressions and longer-term experiences of that product.

2.3 Product Impression and Experience

The initial impression of a product may be defined as a summative evaluation, indicative of people's attraction to, or detraction from, that product based on limited duration exposure. It is known that a user's initial impression and longer-term

experiences with a product are elicited through a combination of 'hands-off' and 'hands-on' acquaintances and interactions. Desmet and Hekkert (2007) proposed a classification of user-product experience that reveals three interrelated levels: aesthetic experience, experience of meaning, and emotional experience (Figure 2.11). Their classification has been widely adopted by design researchers.

The aesthetic response to an object is considered as the first response. Aesthetic experience refers to a person's perception and response to a product elicited through sensory receptors. In other words, the beauty of what one sees, touches, hears, etc. Ulrich (2007) discusses that an aesthetic response to a design, as a component of cognitive responses, refers to '*immediate feelings'* expressed on the basis of information received through the senses. He maintains that the aesthetic response to a product is different from other cognitive responses, since it is a rapid, involuntary, and aggregate assessment. Ulrich (2007) also points out that the aesthetic response is firstly provoked by the sensorial information provided by the *vision* system, after which it is aroused or augmented by information received through other senses. Visual dominance in aesthetic experiences is a recurring theme in literature, e.g. Schifferstein & Wastiels, 2014; Fenko et al., 2010a; Schifferstein, 2006; Krippendorff & Butter, 1984.

Aesthetic or 'sensory' experiences have a close relation to perception: "…sense is the feeling of being in contact with the world without reflection, interpretation, or explanation" (Krippendorff, 2006; p.50). In contrast, *perception* is generally defined as the *interpretation* of what has been sensed. Accordingly, perception follows the occurrence of sensation. It may be said that product perception is based on sensation, which is made possible through detection by people's sensory receptors.

According to Fiske (1990), perception is not just the reception of stimuli, but rather it is a process through which one tries to make a link between external stimuli and his or her patterns of thought. Herein perception of meaning could be relevant if external factors (stimuli) match internal factors (beliefs and thoughts). That is, a stimulus should make sense to the person perceiving. Fiske puts forward that culture is an influential factor in this matching (perception) process as "…our internal concepts or patterns of thought have developed as a result of our cultural experience" (p.26). This

approach may shed light on the idea that perception differs between cultures. Therefore we could summarize that our past experience along with cultural experience play a role like a pair of glasses through which we see the world.

Meaning is a central concern for design. Meaning in design is the focus of the area of 'product semantics', developed and presented by Krippendorff and Butter (1984; in Krippendorff, 2006). Product semantics is defined as the study of symbolic qualities of artefacts in the socio-cultural context of use (Krippendorff, 2006). Accordingly, Krippendorff (2006) claims that a product should make sense, or it should communicate comprehensible meaning to those people intended to interact with it. So it can be said that the meaning of the message of product form depends on the context of use, and that the meaning applied to a product is moderated by the message communicated.

Experience of meaning is about the interpretations and meanings that users attribute to a product, prompted for example by a product's physical sensorial qualities (Desmet & Hekkert, 2007). People's personal characteristics, previous experiences, and socio-cultural background affect their attribution of meanings. The experience of meaning is a very complex issue. Whatever a design object communicates, its meaning depends on the context of use. Objects may be stable in terms of their physical properties, but their meaning continuously changes. In this respect, it can be argued that the meaning of a product is built by interpreters' (users') knowledge that is developed through social and cultural interaction, and it can be different among users. It is about interpretations of expressive qualities and characters, which portray values hidden in the product's qualities.

Michael Solomon (1983) states that *'people don't buy things because of what they do; they buy things because of what they mean'*. In various socio-cultural and individual practices, intended meanings may be transformed into something else. As a consequence, it is relevant to explore the generation and exchange of meaning through material objects in the context of use in order to show how things are implicated in the practices of everyday life; how people use, learn from, attach to, attribute meaning, and create relationships with the objects in their lives. It is obvious that people use and manipulate objects in order to express or represent their own individual and social

lives. So, objects can be defined as a means for *differentiation* and *integration*, having potential abilities to differentiate or integrate one with his/her social context (Csikszentmihalyi and Halton, 1981).

Emotional experience involves the feelings towards or from a product, and the hedonic benefits associated with a product. Emotional experience is also developed in the context of use, depending on the time users spend interacting with the product. It is about feeling towards product qualities and sentimental values. It is assumed that emotional experience is built on aesthetic and/or meaning experiences (Desmet & Hekkert, 2007).

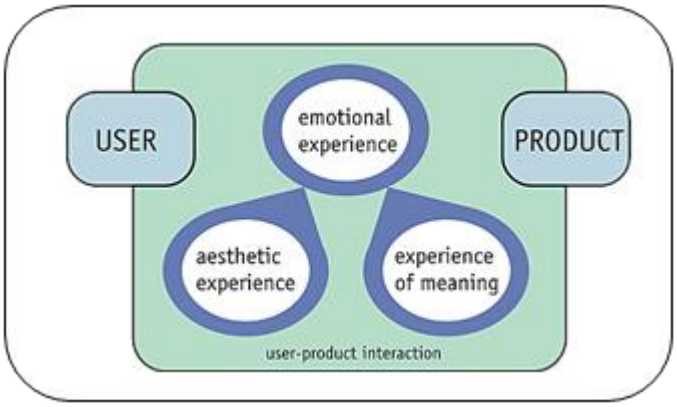

Figure 2.11 Framework of product experience (Desmet & Hekkert, 2007)

In the appraisal of a product, a user's initial experience (based on short-time exposure) is different than the experiences developed through long-time ownership of the same product (Fisher, 2004; Karapanos et al., 2009). 'An experience' is formed through the complex relationship between a person and a designed object. Therefore, what is important to be considered is that designers cannot *design* 'an experience', since it involves not only tangible and intangible properties of a product but also users' subjective feelings and impressions on an individual basis, which are not controllable by the designer. Rather, the realistic goal is to design *for experience*, in which a designer uses best available means to predict what it is that the majority of target users will in the end experience with the product. Considering user experience related to a

product's physical properties, a designer can intend desirable experiences by focusing on the sensorial qualities of a product and their role in expressing certain meanings/messages about the product. With the focus on design communication, Figure 2.12 illustrates the relationship between a designer's intended product expressions and a target user's actual impression and experience of that same product. As shown in Figure 2.12, the user's interpretation of the product could change over time and within different context of interactions. So it seems implausible to claim that designers could completely take control over users' experiences which are developed through socio-cultural interactions. For example, the perception of symbolic value may differ over time and culture, since the meaning of product forms can change in time (Muller, 2001).

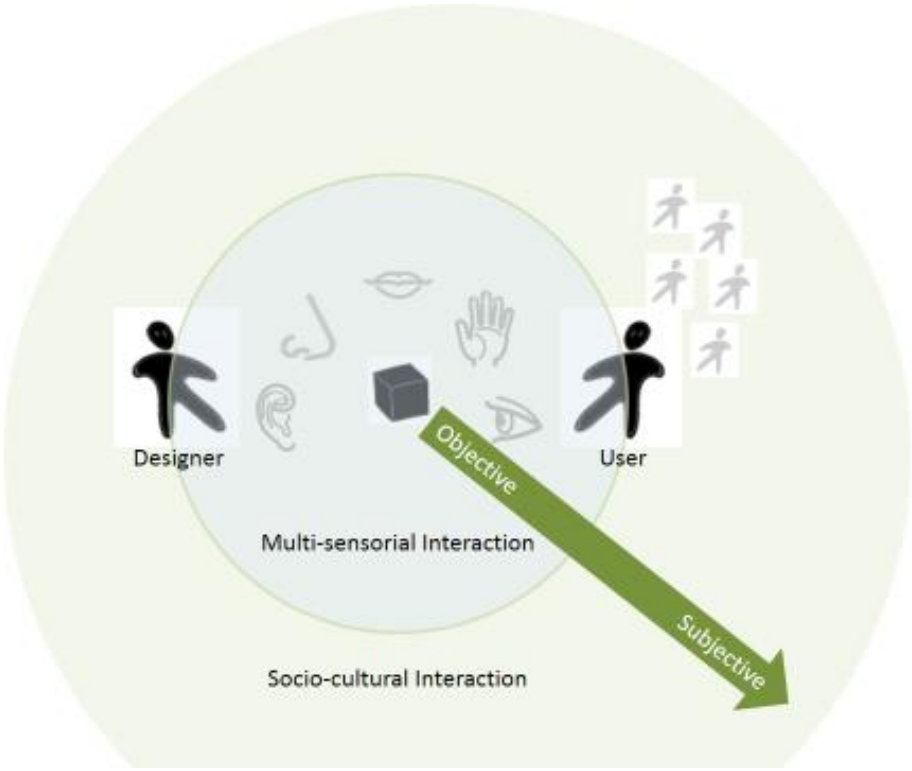

Figure 2.12 Product experience within different contexts of interaction

'Form and content' are two fundamental issues in design. From the view of semiotics studies in product design, the quality of a physical product with its sensorial properties

is considered as the *signifier* and the content or the concept conveyed through the signifier is known as the *signified*. Hjelm (2002) in her study, under the title of semiotics in product design, discusses that the *signifier* refers to the physical form of an object, or what we perceive and express through our senses, and the *signified* refers to the content, embodied messages, associated meanings, and what we feel or define when we interact with an object. She puts forward that the *signifier* is objective while the *signified* is subjective; meanings are derived from what is *signified*.

Through careful use of product semantics, designers can find ways to express themselves or their ideas through product qualities (Krippendorff & Butter, 1984; Krippendorff, 1989). Studies have revealed that sensorial product qualities and associated aesthetics are conventionally moderated by designers' personal and subjective interpretations (see Maurer et al., 1992; Berkowitz, 1987; Bloch, 1995; Hsiao & Chen, 1997; Hsu et al., 2000; Demir, 2008). Furthermore, the study by Govers et al. (2004) reveals that designers have potential skills to translate intentional product characteristics into a product. This might be the essence of a 'designer's touch'. However, Crilly et al. (2004) caution that although the value of designers' skills and experience is appreciated, justifying the aesthetic quality of a product (solely) on the basis of intuitive feeling and imagination is not a reliable or commendable approach.

In the marketing literature, there is reportedly a close relationship between users' positive aesthetic experiences of a product (again usually limited to visual appraisals) and their preferences of one form over another (Bloch, 1995; Creusen and Schoormans, 2005; Hsiao and Chen, 2006). The question may arise as to how expressive qualities of a product affect users' evaluations and preferences. Creusen and Schoormans (2005) identify six different roles of product appearance from the perspective of users, where product appearance communicates aesthetic values, symbolic values, functional behavior and ergonomic information – whilst also attracting attention and provoking categorization. However, their study demonstrated that of these six roles, aesthetic and symbolic values of product appearance are the two critical factors influencing subjects' impressions and preferences in product selection. The authors explain that when product alternatives are similar in function

and price, users prefer those products that appeal the most to them aesthetically.

In a similar approach, Bloch (1995) explains four characteristics of product form that contribute to overall product success. Firstly, product form is an effective tool to gain users' attention amongst a crowded marketplace. Secondly, it communicates information regarding functionality, strength, power, and ease of use. Thirdly, it has an impact on the quality of users' lives in a larger sense, as it is the product form (i.e. the product's outer embodiment) that users interact with most of the time. For instance, unpleasant forms may evoke distaste, while beautiful and attractive forms may evoke pleasure. Finally, product form could have long lasting effects: aesthetic characteristics of a product may have impacts on users – and indeed on the marketplace generally – that develop over many years. According to Bloch (1995), ideal form is that which has unrivalled qualities to evoke positive beliefs and positive emotional responses.

Lewalski (1988) – predating many of today's contemporary studies on hedonic and functional needs – suggested that users' expectations from products go beyond just functional fulfillment and extend to the satisfaction of 'higher level' needs. Perceived attributes of products, covering aesthetic, symbolic, and emotional experiences, can be delivered or evoked through values hidden in the physical definition of the product, i.e. its qualities of form. Lewalski argues that the use of innovative and pleasing forms is an important design tool, as people look for new and visually fresh products to overcome boredom or lack of differentiation. Therefore, product aesthetics is a key determinant of product values.

According to Walsh et al. (1988), aesthetic perceptions of design are important in two phases: before purchase and at the point of purchase. However, unlike traditional definitions of product aesthetics, today aesthetics is viewed as a form of expression across sensory modalities and is not restricted to just product appearance and styling. Furthermore, sensorial experience is increasingly considered as a key element for evaluating product expressions and interactive qualities. In current design thinking, there is ever increasing emphasis placed on the 'aesthetics of interaction' (Hummels & Overbeeke, 2010; Hallnäs, 2011; Locher et al., 2010), such that aesthetic perceptions of a product are important not only leading up to the point of purchase but

also during the use phase of a product, especially where interactivity is important and there exists an objective for users to 'feel' or 'notice' a qualitatively superior interaction. In other words, the physical qualities of a product define not only its *static (visual) aesthetics* but also its *aesthetics of (multisensorial) interaction* during use. Product physical qualities refer not only to geometrical shape, or visual properties of a product or its components, but rather to all qualities of a product that shape impression and experience through sensorial interaction across sensory modalities.

Nevertheless, within all of this emphasis on interaction qualities of product form or physical qualities, it is important to note that the individual sensory capabilities of people moderate the initial experience. Crilly et al. (2004) define sensory capabilities as 'unanticipated physiological characteristics' of the user that affect sensory perception and which may cause a product to be perceived differently to how designers intended. For example, loss of hearing, poor vision, poor dexterity and numbed finger nerves all serve as impairments to detecting sensorial information as intended by the designer.

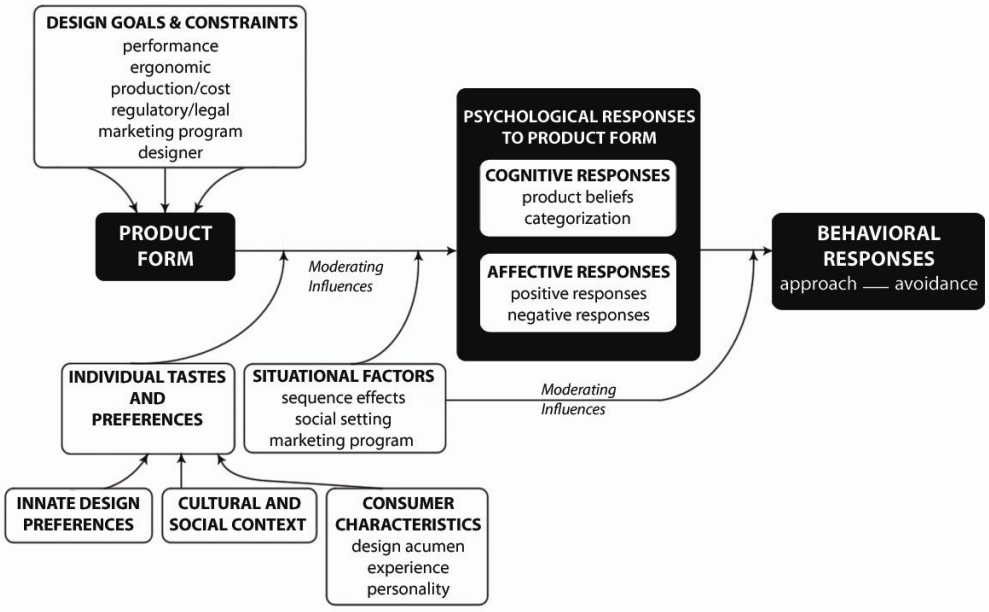

Figure 2.13 Framework for consumer response to product form (Bloch, 1995)

A review of users' types of responses on the basis of their sensorial interaction with product form may clarify what kinds of messages designers intended to communicate via the medium of product physical properties. In the study of product form from a marketing perspective, Bloch (1995) developed a conceptual model of consumer responses to product form (Figure 2.13), which underlies many studies of user interaction with products. Different types of responses to product form are remarked upon, as well as several factors affecting those responses.

As Figure 2.13 shows, Bloch points out the design goals and constraints within which product form is conceptualized and developed. The emphasis is on the critical role of the designer (or design team) as decision-makers for product form, on the basis of (1) expressing his or her own professional work and desires, (2) satisfying a producer's or company's pre-defined commercial goals and manufacturing constraints, and (3) satisfying users' needs and desires.

Bloch identifies variables including 'individual tastes and preferences' and 'situational factors' that affect consumer evaluations of product form. The individual tastes and preferences are moderated or shaped by innate design preferences, social and cultural contexts, and consumer personal characteristics. The situational factors that affect both psychological and behavioral responses to product form are discussed at three levels: sequence effects arguing whether product form fits with a consumer's collection of goods; social settings in which a product form is interacted with; and the marketing program in which extrinsic attributes become attached to a product form through advertisements.

According to Bloch's conceptual model, once a product form is presented, different types of psychological responses – cognitive and affective – are provoked in consumers. Cognitive and affective responses affect each other and may occur at the same time. Product beliefs and categorization are two important types of cognitive response to product physical form. By providing information on a product's character and specification, such as durability, technical sophistication, ease of use, prestige, and so on, product form influences consumer beliefs. Categorization is derived from 'perceived similarity' between a newly encountered product and products already experienced. Positive and negative affective reactions to product form, such as liking

or disliking, are considered as affective responses. On the continuum, *psychological* responses lead to *behavioral* responses. Although Bloch defines cognitive and affective responses under the category of psychological responses, Crilly (2005) considers them as two different categories with the classifications of cognitive response further divided into aesthetic impression, semantic interpretation and symbolic association.

Crilly (2005) developed an expanded framework for design as a process of communication, considering separately and in detail the sides of *consumer response* (Figure 2.14) and *designer intent* (Figure 2.15). Figure 2.14 illustrates the dimensions of consumer visual appraisal of a product and the contextual factors affecting the response. Similar to Bloch's (1995) framework, cognitive, affective and behavioral responses are identified in this framework.

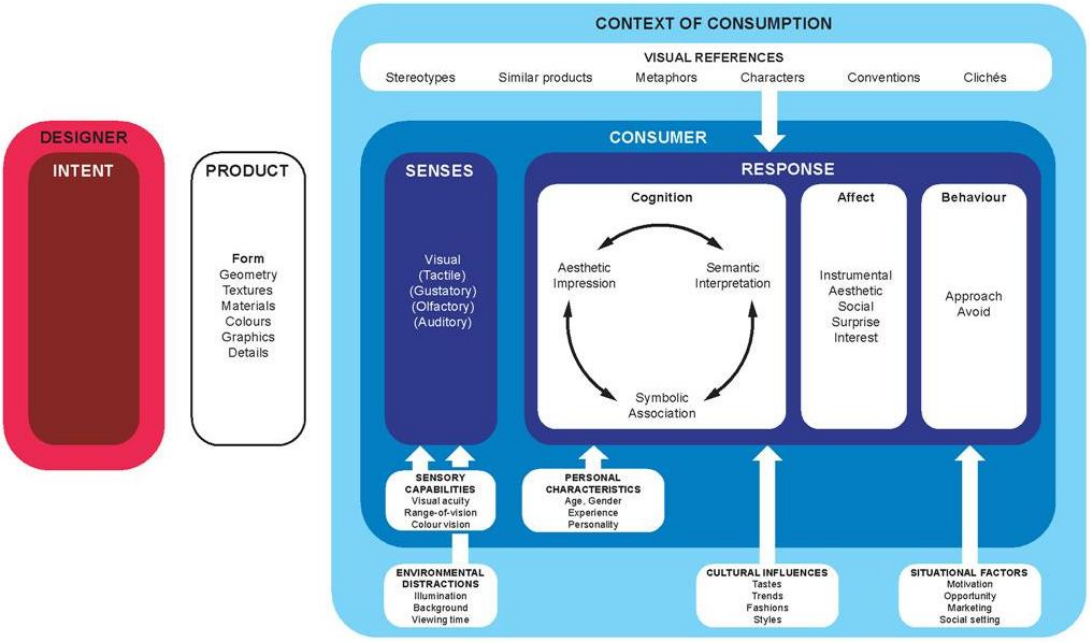

Figure 2.14 Framework for consumer response to the visual domain in product design (Crilly, 2005)

According to Crilly et al. (2004), a cognitive response to product appearance can be traced back to the appraiser's judgmental reaction towards product appearance based

on perceived qualities. It is argued that cognitive responses do not amount to objective qualities of a product. Considering the three categories that describe cognitive response, 'aesthetic impression' refers to visual attractiveness of a product, 'semantic interpretation' is the visual perception of product usability and function, and 'symbolic association' is about the meaning attributed to the product based on the 'product personality' and its value in a social context.

'Product personality' is the term used to describe the characteristics of a product that lend descriptions in the same way that a person may be described differently to another person. For people, we may refer to the clothes that they wear, their style of hair, their demeanor, their actions in given circumstances, their colour choices, the way that they talk, their accent, their choice of perfume, and so on. This can be seen as a complex mix of characteristics. For products, personality is a complex combination of product attributes including brand, style, trends, associations, interaction qualities, feedback types, materials, proportions, etc.

Turning attention to 'affective response', Crilly et al. (2004) describe how this may also encompass an emotional response. Affective responses describe user feelings and emotions *towards* a product and *by* a product. Similar to Bloch (1995), Crilly et al. (2004) argue that cognitive and affective responses are connected to each other and each system of response influences the other. Crilly et al. (2004), present five categories (instrumental, aesthetic, social, surprise, and interest) to describe affective response. These categories were previously proposed by Desmet (2003) for the emotional responses elicited by a product. Instrumental emotions "such as disappointment or satisfaction" are based on the perceptions of whether or not a product helps users to reach their goals. Aesthetic emotions "such as disgust or attraction" arise from a product's potential to please or displease our senses. Social emotions "such as indignation or admiration" are based on the extent to which a product is perceived to match established or aspired social values. Surprise emotions "such as amazement" result from the perception of novelty within a product. Lastly, interest emotions "such as boredom or fascination" are driven by the perception of "challenge combined with promise" within a product (in Crilly et al., 2004; p.553).

Making use of Bloch's framework, Crilly et al. (2004) also maintain that cognitive

and affective responses moderate behavioral responses to a product, which can be either an approach to, or avoidance of, that product. Approach behaviors reveal an attraction whilst avoidance behaviors represent the opposite.

Crilly et al. (2004) identify internal and external factors that moderate users' perception and responses to product visual form, and thereby have potential to affect the ability to communicate messages as intended to end users. Internal factors are a user's sensory capabilities and personal characteristics. While sensory capabilities moderate the sensory perception, personal characteristics moderate the response. Personal characteristics refer to age, gender, experience, and personality of the user.

In the context of use, external influencing factors are identified: environmental distractions, cultural influences, situational factors, and visual references. Except for environmental distractions, which moderate the sensory perception, these external factors influence the response. The perceptions of visual stimuli are moderated by how and when it is represented.

The cultural context in which a user interacts with a product may differ from that anticipated by the designer. Accordingly, elements in a cultural context including tastes, trends, fashions, and styles may moderate the type of responses to product visual form. The user's motivation in evaluating product form, the opportunity to continue the consumption process, the marketing programme supporting a product, and the social setting within which a product is used are all considered situational factors that have the potential to influence user responses.

Visual references are sources that can help users understand and interpret sensorial information emanating from a product. In the context of interaction, a newly encountered product is compared with other concepts, referring to the visual references. Accordingly they may influence user response to a product. Examples of visual references include stereotypes, similar products, metaphors, characters, conventions, and clichés. Crilly et al. (2004) point out that visual references are pooled together through an individual's experiences.

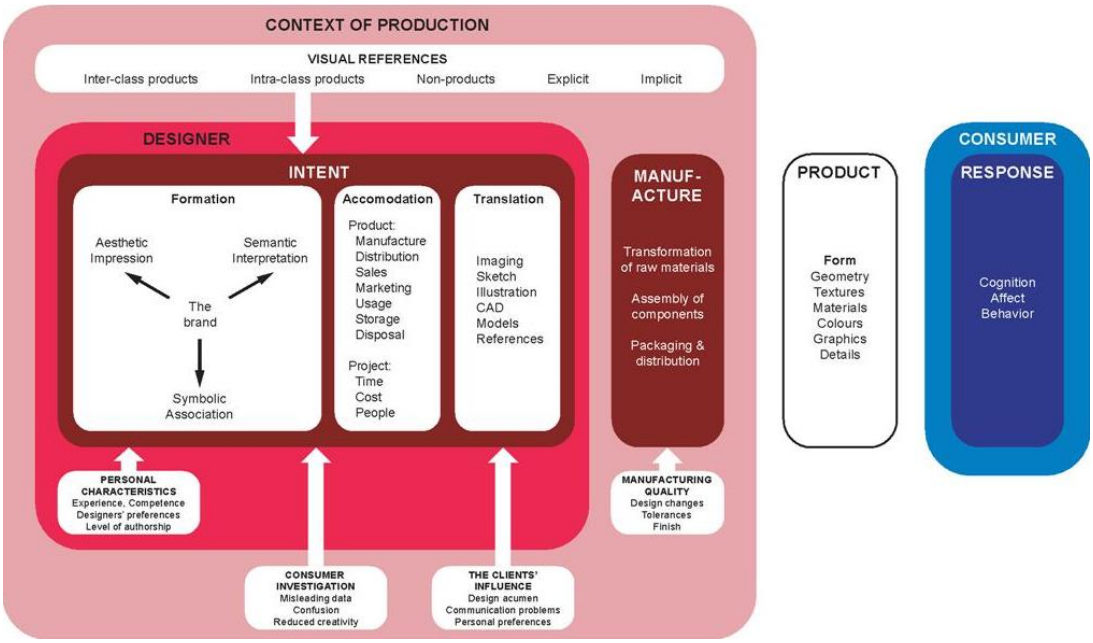

Figure 2.15 Framework for designer intent regarding visual domain in product design (Crilly, 2005)

Figure 2.15 demonstrates the 'other side' of the complex communication process through product form: designer intentions for the creation of that product form, together with contextual factors affecting the intent and thereby the definition of form-based product messages. The figure is useful in providing a broad view of the factors that designers contend with in order to generate product form and convey intended meanings through that form.

Crilly (2005) observes that product visual form is determined through a combination of designers' intentions with technical, commercial, personal and political pressures. Accordingly, the designer (or design teams) translate their intentions (here classed as aesthetic, semantic, and symbolic aspects of intent) into a physical form that also accommodates design constraints. The three aspects of intent are influenced by the brand that will be marked onto the product. Following the designer intent is the stage of product manufacture, through which intentions are realized in a final physical form to be presented to users.

In Crilly's (2005) account, designers' intentions or objectives in relation to product visual form relate to the specific responses they wish to evoke. It is clear that almost

exclusively, designers intend to induce positive impressions in users. In addition to intentional factors, there are some influencing factors that moderate the generation of product form, such as visual references as the source of inspirations, designers' personal characteristics and preferences, insights gained from user research, and clients' preferences.

2.4 Progression of Product Acquaintance and Implications for Design Studies

In the review of literature presented so far, it is clear that the level of acquaintance that people have with a product is a considerable factor on the kinds of appraisals that can be reasonably made or expected in user-product design studies. In a previous study by the author (Khalaj & Pedgley, 2014), different stages of product acquaintance were characterized, for the purpose of discussing and planning user studies aiming to probe product appraisals, user experience and characteristics of user-product interaction. This previous work had direct implications for how to go about empirical studies to examine mismatches between intended product expression and realized product impressions. Figure 2.16 visually summarizes the work, giving a proposition of how users experience product qualities as they transition from near-zero acquaintance ('pre-product' stage), through low-level acquaintance ('pre-use' stage) to considerable acquaintance ('use' stage) of the user-product relationship.

At the 'pre-product' phase, *preconception* is the main trigger for experiences. Since no actual product exists (only the 'idea' of a such-and-such product), users have little or no idea about the product's qualities. Their evaluation is based on expectations and anticipation. The 'pre-use' phase is divided into three categories: visual appraisal of a product representation or image (for example online or in a catalogue); visual appraisal of a physical product (i.e. the materialized design); and multisensory appraisal of a physical product (e.g. full 'hands-on' manipulation). To clarify, both *visual appraisals* refer to users' evaluations of a product based only on visual perception and in the absence of physical interaction. Visual appraisal can invite us to investigate the physical product further and to lead to interaction (hands-on evaluation). Conversely, pre-use *multisensory appraisal* refers to users' evaluations of a product stimulated by physical interaction with the product and exploration beyond just visual qualities.

Once the level of acquaintance reaches a *product use* stage, which in the context of a consumer-oriented study would represent a 'post-purchase decision' – and hence beyond the boundaries of 'initial impressions' – the characteristics of interaction change from being explorative to being task-oriented. Criteria such as usability, comfort, performance, efficiency and compatibility become prominent in product appraisals and exert considerable influence on user experiences (Cagon & Vogal, 2002; Demir & Erbug, 2008).

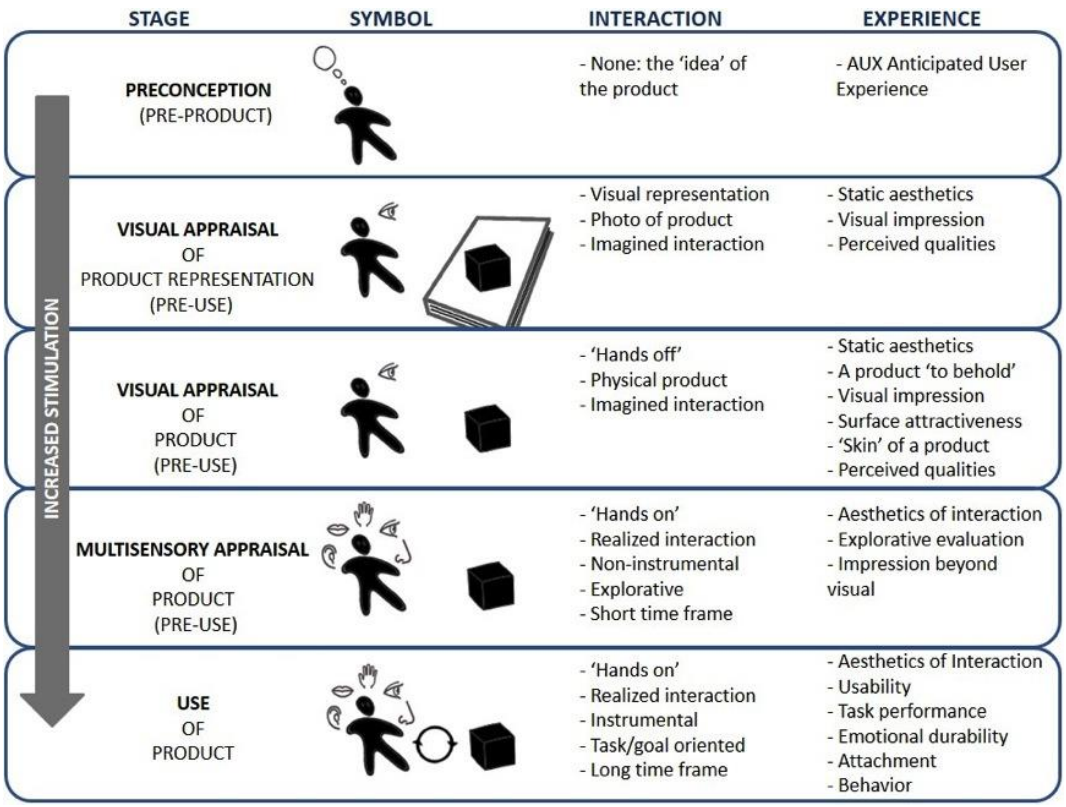

Figure 2.16 Progression of product acquaintance tied to stages, interaction characteristics and user experience traits (Khalaj and Pedgley, 2014)

For this present study, the *use* stage of product acquaintance was purposefully ruled out of contention for research, since it was considered too far removed from impressions and, methodologically, it would necessitate user studies based around longitudinal tasks/goals relying more on product functionality than designer expression through product form. With this in mind, the focus was decided to be on

the degree to which designers' *intended product expression* could be detected in users' *initial semantic interpretations of product impression* (Krippendorff, 2006; Karjalainen, 2004; Karjalainen, 2007; Coates, 2003) and, hence, traced back to multi-sensorial qualities of the product (Figure 2.17).

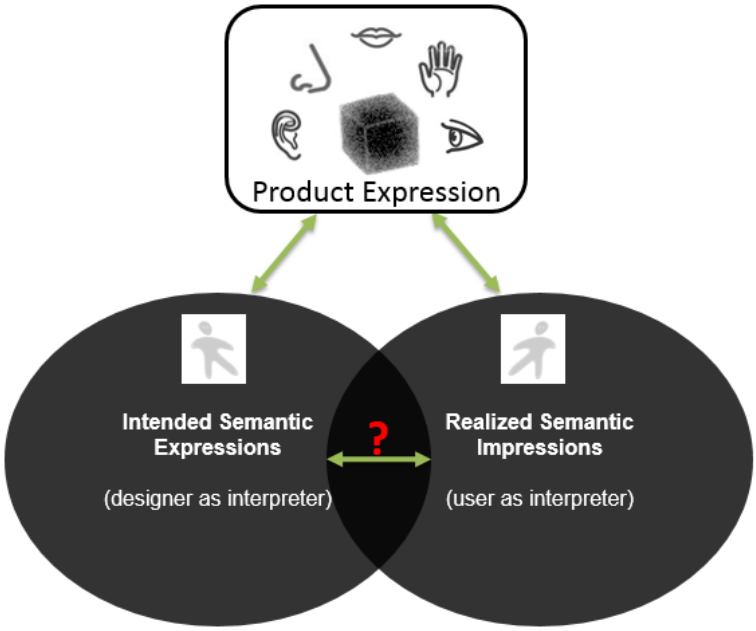

Figure 2.17 Intended semantic expressions vs. realized semantic impressions within the context of multisensorial interaction

Previous empirical work by the author in this area had focused on the second stage of acquaintance in Figure 2.16 (visual impression of product representation), where catalogue images of products were the main stimuli for experiments (Khalaj & Pedgley, 2014; Khalaj, 2009). To strengthen and make more lifelike the appraisal process for users, for this present doctoral research it was considered necessary to focus on the third stage of acquaintance in Figure 2.16 (visual appraisal of product) – where the *physical artifact* itself was available for appraisal.

Reflecting on the arguments and components of design communication theory as applied to products, presented throughout this chapter, the 'semiotic school of thought' was chosen for adoption in the fieldwork that would follow, since it allows for a

plurality of product impressions to coexist rather than one 'correct' impression and all other failed interpretations. This was considered closer to the real-life experience of making product appraisals, and upholds the value that the 'consumer is always right'.

The consideration of '*semantic transformation*' (Karjalainen, 2004; 2005) – referring to how and what kind of meanings are tried to be transformed into a physical product –was placed outside the scope of the study. So, rather than focusing on design processes for defining product form, the intention was to explore intended semantic expressions that are realized in a final product. In this regard, any noises or distortions that may affect the realization of initial semantic intent can be ignored. For the generation and analysis of product appraisal and user experience data, the classification system proposed by Desmet and Hekkert (2007) was adopted, with emphasis placed on product aesthetic and figurative meanings/ expressions (Figure 2.17).

2.5 Investigating the Necessity for Multisensorial Evaluation: A Pilot Study

One of the limitations of previous empirical studies into semantic discontinuities is the lack of multi-sensoriality possible when using only product visual representations (e.g. photos, illustrations) as experiment stimuli. More telling user experiences and deeper product impressions can be contemplated to exist in cases where users are asked to look at, touch, feel, pick-up, hold, smell and otherwise interact with a product. Researchers have carried out studies to investigate the differences among sensory modalities with regard to product perception. The study by Dagman et al. (2010) looked at uses of vision, tactility and vision+tactility, and showed that a product's tactile attributes can be anticipated by visual explorations and vice versa. So, an "expectation effect", defined as the effects of visual prediction of tactile experience should not be ignored (Yanagisawa & Takatsuji, 2015). Dagman et al. (2010) and Yanagisawa & Takatsuji (2015) point out that although descriptive adjectives (as verbalized product experiences) are usually specific to a single sense, there exist some descriptive adjectives that are seen to be repeated in both visual and tactile evaluations. Schifferstein et al. (2010) argue that the high percentage of descriptive adjectives used to express product experience comes about because the visual sense is so dominant in people's product appraisals.

What was unclear for this present research was whether physical interactions with a product could be used to probe more deeply users' initial impressions of a product. For example, users' minds might already be swayed by the dominant visual modality defining the physical appearance of a product. Therefore, a pilot study was carried out to determine the respective roles of visual and multi-sensorial appraisals of product form and their effect on users' initial impressions. One important aspect of the pilot study was to see if product semantic characteristics could be differentiated by both designers and users, considering evaluations using different sensory modalities.

So as not to create a very large workload, the pilot study was carried out in the local language (Turkish) and only the main findings following analysis were translated into English (and reported later in this chapter). The study was devised to investigate designers' and users' visual and multi-sensorial evaluations of product connotative meanings. Four main stages were involved (Figure 2.18), paired as (i) an interview with the designer of a product (stages 1+2), and (ii) an interview with five potential purchasers/users of that product (stages 3+4).

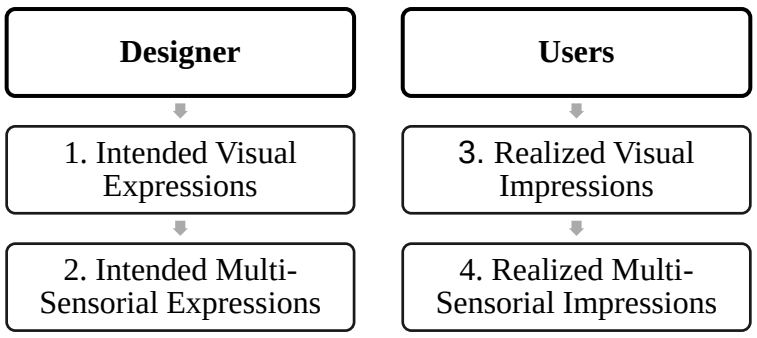

Figure 2.18 Structure of the pilot study

2.5.1 Evaluation Terminology for Product Semantics

It is assumed that when one interacts with a visually appealing product, one is found to interpret its expressive qualities and characteristics, which portray semantic values hidden in the product sensorial qualities. In research studies, product semantic expressions/messages are elicited through descriptive adjectives/phrases.

Krippendorff (2006) argues that without adjective constructions, it would be difficult for one to distinguish the qualities of things.

Table 2.1 Classification of product meanings

*	CONNOTATIVE MEANINGS: Figurative expressions, personality characteristics, and social values attributed to a design (i.e. product-centric). e.g. Young, Feminine, Modern, Cute.
	SENSORIAL MEANINGS: Literal descriptions of product physical properties (i.e. product-centric). e.g. Shiny, Hard, Cold, Rough.
	MEANINGS OF INTERACTION: Interpretations of functional product properties and usability (i.e. interaction-centric). e.g. Durable, Easy To Clean, Comfortable, Sturdy.
	AFFECTIVE MEANINGS: Emotive associations or effects of a design evoked within a person who interacts with it (i.e. user-centric). e.g. Love, Anger, Surprise, Warmth.

Meanings pertaining to product sensorial qualities are expressed on different 'levels' (Osgood et al., 1957; Krippendorff, 2006; Hsiao & Chen, 2006; Khalaj & Pedgley, 2014) and are summarized in Table 2.1. In order to investigate a product's semantic expressions aroused by sensorial qualities, the pilot study sought to investigate meaning attribution within the first category of Table 2.1 ('connotative meanings'). The other categories, although relevant to forming product impressions, brought diversions or complications: 'sensorial meanings' were too tied to sensory perception and literal material descriptions; 'meanings of interaction' were too concerned with task-based performance rather than explorative impression; and 'affective meanings' were too user-centric, in the sense that the focus of study is on the user and not on the appraisal of the product. Therefore, the pilot study sought to uncover and use as a stimulus those adjectives that referred to semantic attributes and characters that can be labeled to a product's sensorial qualities.

Sensorial experiences from a product rely on the ‘information’ that each sensory modality provides. So the relationship between sensorial features/qualities and associative meanings is highly relevant. In this regard, it is important to understand the differences between these two subjects, and to avoid the use of evaluative adjectives that essentially directly describe sensory information. For example, a product can be appraised as ‘rounded’ in form (sensory information), which may be interpreted as ‘feminine’, ‘playful’, ‘in fashion’, etc. (sensory association). Studies by Fenko et al. (2010b) reveal that most associative meanings of physical product apply multi-sensorially. In other words, any descriptive word (adjective) has potential application across sensory modalities. For example, a product can be ‘visually masculine’ but ‘tactually feminine’, and vice versa. This leads to the position that it is not necessary to distinguish different pools of adjectives/meanings for different sensory modalities when considering associative meanings.

Within a pool of adjectives to describe associative meanings, care must also be exercised over using such adjectives in ‘figurative’ or ‘literal’ ways. For instance, such adjectives as ‘hot’, ‘strong’, ‘cold’, and so on have literal (e.g. cold / dispassionate) and figurative (e.g. cold / low temperature) uses. The literal ways – directly related to the way we sense a product and not the way we perceive it as a character – were therefore not considered applicable for the pilot study.

Language use during verbal product appraisals was also known to be a problematic issue. In particular, the effects of grammatical gendering of nouns (Ramos and Roberson, 2010) may lead appraisers to attribute gender characteristics to inanimate objects and, hence, affect users’ interpretations of personality characteristics. Considering a ‘chair’ as an example, the grammatical gender of a chair in German is masculine: ‘der stuhl’, while in Spanish it is feminine: ‘la silla’. So, there is an expectation that when German speakers are asked to describe personality characteristics of a chair they may use such descriptive words as ‘mature’, ‘serious’ and ‘strong’, whilst Spanish speakers might use words such as ‘attractive’, ‘hot’ or ‘soft’. Fortunately, such grammatical gender issues are not relevant in either Turkish or English languages, so this point did not become a methodological issue when devising the pilot study.

2.5.2 Adjective Cue Card

Individual designers' and target users' semantic attributions were extracted in the pilot study through discussion sessions, with a particular emphasis on understanding in 'which sense' each adjective had been used. It was considered helpful to provide designers and target users alike with a cue card of descriptive adjectives, as a stimulus to overcome expected linguistic constraints and 'mental blocks' to verbalization. Participants were in the first instance asked to volunteer adjectives that formed their product appraisals, and then after a certain time (when the participants were seen to be struggling to volunteer descriptions) the cue cards were introduced to kickstart discussions. The advantage in this approach is that designers' and users' interpretations are in no way limited to evaluations against a predefined list of adjectives, which had been a limitation of previous work (Khalaj, 2009). Instead, the 'pool' of adjectives on the cue cards helped guide designers and users to effectively express their intentions and impressions.

The collection of descriptive adjectives provided by Mugge et al. (2009) was used to populate the cue cards (Table 2.2). Mugge et al. explain that their the collection of descriptions was selected from a comprehensive set of 1124 adjectives related to personality characteristics, consulting with six experts having knowledge in marketing, consumer behavior, psychology, and design. They argue that these adjectives can be applicable to all product categories. Since in the pilot study, participants would not be directly appraising products on a scale tied to the descriptions in Table 2.2, it was considered unnecessary to verify the applicability of the descriptions to the specific product sector chosen for the pilot study. However, English-Turkish translation and checks on the cultural applicability of the descriptions were needed prior to the pilot study experiment sessions commencing.

Accordingly, the collection of original/translated descriptive adjectives provided by Mugge et al. (2009) was reviewed independently by three academic staff from METU Department of Industrial Design, using a pro-forma questionnaire (Appendix A). The questionnaire aimed to refine the list provided by Mugge et al. (2009) for the local Turkish market and local expressions for figurative meanings or characteristics from the perspectives of Turkish designers and users (Table 2.3).

Table 2.2 Universal product characteristics identified by Mugge et al. (2009)

EXAMPLE CONNOTATIVE MEANINGS				
Aggressive	Conspicuous	Happy	Old-fashioned	Unattractive
Aloof	Corny	Honest	Open	Uninteresting
Attractive	Creepy	Idiosyncratic	Pathetic	Unreliable
Boring	Cute	Immature	Pleasant	Untidy
Bourgeois	Decent	Inconspicuous	Precise	Well-groomed
Businesslike	Dominant	Informal	Predictable	Wild
Calm	Easy-going	Insular	Provocative	Popular
Careless	Eccentric	Interesting	Reliable	Pretty
Casual	Energetic	Lively	Reticent	Relaxed
Chaotic	Excessive	Masculine	Sensible	Romantic
Charming	Exuberant	Mature	Serious	Sensitive
Cheerful	Feminine	Modest	Showy	Sweet
Cheerless	Flexible	Nice	Silly	Terrific
Childish	Friendly	Obtrusive	Strict	Young
Consistent	Funny	Odd	Tough	

Table 2.3 Cue card A-Z list of Turkish descriptive adjectives

Acayip	Enerjik	Kasvetli	Sakin
Agresif	Erkeksi	Kendine özgü	Samimi
Aptal	Esnek	Keyifli	Saygın
Aşırı	Gayrı resmi	Kışkırtıcı	Sert
Bakımlı	Genç	Komik	Sevimli
Baskın	Gösterişli	Makul	Sıkıcı
Canlı	Günlük	Modası geçmiş	Soğuk
Çekici	Güvenilir	Mütevazi	Tahmin edilebilir
Ciddi	Güvenilmez	Müthiş	Tatlı
Çılgın	Güzel	Mutlu	Toy
Çocuksu	Hoş	Neşeli	Tuhaf
Dar görüşlü	Hoşgörülü	Net	Tutarlı
Dikkatsız	İlginç	Olgun	Ürepertici
Dürüst	İlginç olmayan	Popüler	Uyumlu
Duyarlı	İtici	Rahat	Vahşi
Düzensiz	Kadınsı	Rahatsız edici	Zarif
	Karmakarışık	Romantik	Zavallı

2.5.3 Interview Sessions – General

The product for the pilot study was chosen from amongst the graduation projects of final year Industrial Design undergraduates at METU. Considering aesthetic value and interactive dimensions of all product examples exhibited at the 2013 Degree Show, a prototype of an enlargeable sofa made from intended final materials was selected (Figure 2.19).

The original designer and five design students (as representatives of potential purchasers/users) were recruited for the interviews. The sofa was presented within an exhibition hall, amongst other exhibits, such that the intended context of use was ignored. The interviews were conducted in two stages: first with the original designer, followed by sessions with users – in both cases, considering multi-sensorial ('hands-on') evaluations that followed initial visual-only ('hands-off') evaluations. During the multi-sensorial evaluations, participants were requested to explore the sofa considering different sensorial aspects of the design. Beforehand, participants were briefed about different types of product meaning based on the classification on Table 2.1. They were requested to focus only on connotative meanings. As mentioned, priority was given to the capture of volunteered descriptive adjectives/meanings, after which the cue card was introduced as a stimulus for any additional applicable adjectives/meanings.

2.5.4 Interview Session with the Designer

During the visual evaluations, the designer was asked to discuss about the expressions she intended to communicate through the visual qualities of the sofa, and to identify expressive adjectives or figurative meanings that best fitted to her visual product intents.

During the multi-sensorial evaluations, the designer was asked to discuss about the expressions she intended to communicate through multi-sensorial qualities of the sofa that would come apparent during product interaction. She was asked to identify expressive adjectives or figurative meanings that best fitted to her multi-sensorial product intents. The designer was asked if her intended multi-sensorial expressions were in some way different to her intended visual expressions.

Figure 2.19 Prototype enlargeable sofa, designed by Oya Deniz Senyurt

2.5.5 Interview Sessions with Potential Purchasers/Users

During the visual evaluations, users were asked to discuss about their initial impressions of the sofa, based on its visual qualities, and to identify adjectives or figurative meanings that best fitted to their visual impressions.

During the multi-sensorial evaluations, users were asked to discuss about their impressions of the sofa based on its multi-sensorial qualities. For this, users were asked to interact with the sofa – touching it, sitting on it, moving the side sliding parts, etc. As with the visual evaluation, they were asked to identify adjectives or figurative meanings that best fitted to their multi-sensorial impressions. In addition, users were asked if their original (visual-based) impression had changed as a result of multi-sensorial evaluation.

2.5.6 Results and Discussion

The designer's intended expressions and users' initial impressions of the sofa are gathered in Tables 2.4 and 2.5.

The results of pilot study showed that for both the designer and the five users, the adjectives used for the visual and multi-sensorial appraisal sessions were essentially identical. This was an important practical finding, calling into question the need for

hands-on product interaction when the purpose is to elicit connotative meanings from people. What was observable during the pilot study was that all participants found it difficult to talk about 'new meanings' for the product revealed only through multi-sensorial interaction. There was no specific aim or need to understand why multi-sensorial appraisals led to very few 'new meanings'; however, the majority of participants put forward that the substantial portion of a product's character could be determined through the initial visual appraisal. The difficulty of linking interaction and connotative meaning was apparent too, which essentially reveals a difficulty in expressing how one feels, or feels about, a product interaction. For example, during the multi-sensorial appraisal, participants offered a few adjectives referring to the usability of sofa. However, usability (and other characteristics falling under 'meanings of interaction' in Table 2.1) were outside the scope of the doctoral work.

The pilot study confirmed that visual properties/qualities of a product (in this case furniture) are dominant in people's attribution of product figurative meanings. It can also be said that the pilot study participants were not able to differentiate connotative characteristics of a product based on different stages of acquaintance. Connotative characteristics essentially stayed the same. In general, participants had a common tendency to refer to usability and quality of interaction when asked about the *meaning* of the product. In the beginning they found it difficult to construe product semantic expressions and impressions. However, this difficulty eased off when exposed to adjectival examples, which made it clearer and easier exactly what 'kind' of product meaning was being probed during the study. In this regard, the cue cards containing a pool of adjectives were found to be an invaluable stimulus for participants to assist in their verbalization of connotative expressions and impressions. Since the pilot study was concerned only with the ability (or not) for participants to verbalize their product impressions, no techniques for identifying semantic discontinuities were implemented or trialed.

Table 2.4 Designer's intended expressions

	Visual Appraisal	Multi-Sensorial Appraisal
Designer	Rahat/ *Özgür* (FREE) Uyumlu (COMPATIBLE) Genç (YOUNG) Keyifli (CHEERFUL) Cana Yakın (FRIENDLY)	Rahat/ *Özgür* (FREE) Uyumlu (COMPATIBLE) Genç (YOUNG) Keyifli (CHEERFUL) Cana Yakın (FRIENDLY)

Table 2.5 Users' initial impressions

	Visual Appraisal	Multi-Sensorial Appraisal
User 1	Zarif (elegant) Degişik/Özgün (Different/Unique) Sade (Simple) Çekici (Attractive)	Zarif (elegant) Degişik/Özgün (Different/Unique) Sade (Simple) Çekici (Attractive)
User 2	Tahmin edilebilir (Predictable) Rahatsız edici (Inconvenient) Modası geçmiş (Old-Fashioned) Net (Net/Clear) -	Tahmin edilebilir (Predictable) Rahatsız edici (Inconvenient) Modası geçmiş (Old-Fashioned) Net (Net/Clear) Ucuz (Cheap)
User 3	Kararsız (Indefinite/ Indecisive) Sert (Tough) Kasvetli (Cheerless)	Kararsız (Indefinite/ Indecisive) Sert (Tough) Kasvetli (Cheerless)
User 4	Kadınsı (Feminine) Kasvetli (Cheerless) Gösterişli (Showy) Ciddi (Serious)	Kadınsı (Feminine) Kasvetli (Cheerless) Gösterişli (Showy) Mutsuz (Unhappy)
User 5	Genç (Young) Samimi (Friendly) Tutarlı (Consistent) -	Genç (Young) Samimi (Friendly) Tutarlı (Consistent) Sert (Tough)

The key learning from the pilot study was that for a study of product semantic mismatches, based on comparisons of product expression and impression, it was not necessary for participants to make hands-on multi-sensorial evaluations. In other words, considering Figure 2.16, any subsequent studies in this area need only be conducted on the basis of the third stage (visual appraisal of product – pre-use). For the main study of this doctoral work, it was therefore decided that no multi-sensory evaluation would be undertaken.

CHAPTER 3

METHODOLOGY FOR DETECTING SEMANTIC DISCONTINUITIES

Many issues were raised in developing a methodology to empirically investigate original designers' and target users' evaluations of product semantic expressions and impressions, since there were few precedents for a study linking original designers' intentions to target users' experiences.

3.1 Methods used in Previous Studies on Semantic Gaps in Designer and User Appraisals

Although there have been strong theoretical studies on the relationship between designer intent and user experiences (e.g., Crilly et al., 2004; Crilly et al., 2008b; Crilly, 2011b), relatively few complementary empirical studies have been conducted to examine practical implementation. Hsu et al. (2000) laid important foundations in this respect, exposing potential differences between designers' and users' perceptions, but critically, in common with much research that followed, they did not obtain data from the original designers of the products they studied. The *semantic differential method* (developed by Osgood et al., 1957) was adopted for their study, systematically asking designers and users separately to rate perceptions of physical product samples according to *predefined* bipolar descriptive adjectives, using a Likert scale. The quantitative analysis of the data revealed that there exists considerable differences between designers' and users' perceptions of the same product, indicating the possible presence of a 'designerly way of perceiving'.

On the other hand, a study by Hu et al. (2013) used survey methods to explore discrepancies and semantic gaps between designers' and users' product appraisals. Their survey aimed to collect data on product impressions and expressions in the

context of automobile styling. Users' semantic interpretations were investigated through participant discussions, so as to collect a wide range of semantic descriptive words. Separately, designers were asked to discuss about semantic intent that they *expected* to communicate to users through automobile styling and aesthetics. However, the designers (who were experienced automobile stylists) were recruited especially for the study, and were not the original designers of the automobiles. This comparison of intended semantic descriptions with perceived semantic descriptions, as with Hsu et al. (2000), showed that there existed semantic gaps between designer and user appraisals. One of the strengths of the study by Hu et al. (2013) is that the participants' semantic descriptions were extracted from their actual interpretations of automobile styling, rather than selected from amongst a limited number of predefined semantic descriptions. It is thought that this approach may be more effective in capturing 'true impressions' and 'true expressions' rather than the easier-to-administer but more inherently constrained Semantic Differential method.

Ahmed and Boelskifte (2006) in their study on intended and perceived product character, identified the presence of differences between *original design intent* and actual consumer experience, again using the systematic Semantic Differential method. However, they did not enter discussion on the *extent* (only presence) of mismatches and their particular subject matter (product 'character') was quite narrow in focus. The closest prior work to this present study is the candidate's Master's thesis work (Khalaj, 2009; Khalaj & Pedgley, 2014), in which the Semantic Differential method was used to uncover mismatches between original design intent and a broad base of user experiences, within the specific context of high-end seating furniture. From the methods developed and applied in that work, it was possible for the first time to grasp the 'size' of potential mismatches and to reveal whereabouts the designer(s)-to-user(s) relation breaks down with regard to intended and realized experiences.

Considering the previous work just mentioned, for this present study six important principles were sought to be integrated into the fieldwork data generation and analysis, which were foreseen as important to advancing theory and findings about semantic discontinuities and extending understanding beyond the boundaries of prior art.

1. Intended expression (connotative meanings): only consider the views of the 'original designer' of a product.
2. Realized impression (connotative meanings): consider a plurality of views of target users/consumers.
3. Reject the use of the Semantic Differential method, in favour of collecting volunteered and unconstrained semantic descriptions as independent adjectives.
4. As opposed to product images / representations, where product attributes and scale can be difficult to communicate, use physical products as experiment stimuli to promote naturalistic and up-close product evaluations.
5. Reveal the *origin* and *extent* of any semantic expression-impression discontinuities, not just the *presence* of such mismatches.
6. Attempt to link semantic descriptions to identifiable attributes of product visual form, in the sense of connections between (i) designers'/users' verbal figurative descriptions, and (ii) materialized product features that trigger those descriptions (Rahman, 2012).

Each of these principles were predicted to bring methodological challenges for which solutions would need to be found: (i) securing designers with similar portfolios willing to talk through their design intent; (ii) securing 'target users/consumers' willing to participate in a design research study; (iii) processing and analyzing the diverse user impressions that volunteered descriptions would inevitably allow; (iv) devising new experiment protocols to probe connotative meanings from visual contact with exhibited products; and (v) methods of quantifying (and hence easily comparing) the extent of any detected discontinuities.

3.2 Research Method: Rationale for Data Generation and Analysis Steps

The starting rationale for the research method to be applied to the main empirical study was that the 'semiotic school of thought' on design communication allows for a semantic discontinuity to exist between original designers' intended semantic expressions and end users' actual semantic impressions. Hence, given the 'right' research method and tools, the degree of semantic discontinuity should be discernable and accounted for. This section describes the decisions on what the 'right' research

method and tools should be, in light of the five principles listed in section 3.1.

Based on recommendations following the pilot study (in Chapter 2), the proposed research method involves only the 'pre-use' phase of the user-product acquaintance, with designer and user 'visual' (not multi-sensorial) appraisals being carried out in the presence of a physical product. This was because sight had been established as the dominant sense receptor for interpreting a product's connotative meanings. The proposed research method consisted of four stages (Figure 3.1), which are summarized in text form in Tables 3.1. Quantitative and qualitative data analysis methods are distributed across the four stages: quantitative analysis where *discontinuity values* are sought; qualitative analysis where *semantic representation* and discussion is paramount.

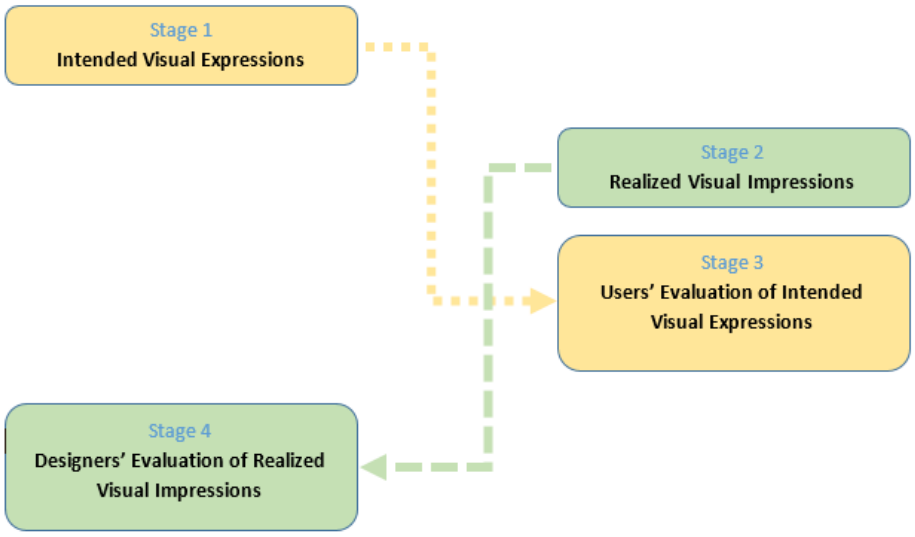

Figure 3.1 Four-stage research method for investigation expression-impression semantic discontinuities

One of the main concerns in setting up the empirical study was the practicality and validity of Turkish-English translations during data generation and analysis. Experience in earlier related studies comparing design intent and impression from the

perspective of semantics (Khalaj & Pedgley, 2014) had suggested that translations were best avoided so as to minimize meanings literally being 'lost in translation'. Furthermore, the translation process adds considerable further data checking and processing. Accordingly, it was decided to run the empirical study in English.

Although the research method to be adopted in the main study was developed for *academic* research intended to investigate and cross-compare the work of *multiple designers*, this would not preclude its adoption either by students or design professionals, as an evaluative tool within a specific product development cycle.

Table 3.1 Stages of the empirical study

Stage 1: Intended Visual Expressions	
Purpose	To identify product semantic expressions that designers aimed to communicate to target users
Participants	3 professional designers
Appraisal of…	6 physical products
Data Collection	Interview: • Designers were probed to describe intended semantic expressions through adjectives and the 'sense' in which the adjectives were used • Product visual qualities conveying each adjective were identified Likert Scale Grading: • Clarity / perceptibility of each adjective was evaluated on a scale
Data Analysis	Quantitative (Connotative meaning summaries)
Stage 2: Realized Visual Impressions	
Purpose	To identify users' actual semantic impressions based on visual appraisals
Participants	36 users/consumers
Appraisal of…	6 physical products (same as Stage 1)
Data Collection	Interview: • Users were probed to describe semantic impressions through adjectives ('first-order adjectives') • The sense in which the adjective was being used was asked to be explained by providing supportive or synonym adjectives ('second-order adjectives') • Product visual qualities conveying each first-order adjective were identified
Data Analysis	Qualitative (Semantic cluster maps)
Stage 3: Users' Evaluation of Intended Visual Expressions	
Purpose	To investigate to what extent users could perceive the semantic expressions intended by original designers
Participants	36 users/consumers (same as Stage 2)
Appraisal of…	Original designers' expressive intent
Data Collection	Likert Scale Grading: • Clarity / perceptibility of each adjective (from Stage 1 – connotative meaning summary) was evaluated on a scale • Product visual qualities conveying each adjective were identified
Data Analysis	Quantitative (Banded discontinuity profiles)
Stage 4: Designers' Evaluation of Realized Visual Impressions	
Purpose	To investigate the opinions of original designers after exposure to information on users' actual impressions
Participants	3 professional designers (same as Stage 1)
Appraisal of…	Users' realized impressions
Data Collection	Questionnaire: • Designers were exposed to semantic cluster maps from user studies of their products (from stage 2), to reach an opinion on the reasonableness of users' actual impressions in contrast with intended expression.
Data Analysis	Qualitative (Content analysis)

3.2.1 Collaboration with Chalmers University, Sweden

The decision to carry out the study in English had consequences for the practical conduct of the research in Turkey, since the use of English amongst the general Turkish population is not high. As an alternative, and building upon important contacts made with Chalmers University (Division of Design and Human Factors), the empirical study was carried out in Sweden, with the collaboration of Chalmers University staff. The decision brought the following benefits:

1. Intellectual: staff had worked in related areas and were willing and able to support a study into semantic discontinuities;
2. Design culture: high sensitivity paid to product form and materialization in Scandanavian design;
3. Language: high standard of English amongst the Swedish general population;
4. Participants: accessibility to Swedish designers through Chalmers University contacts.

After analyzing Swedish designers' portfolios, it became clear that most designers had a common point in contributing to chair and lighting sectors. Visual qualities and materialization are especially striking for these two product types, implying the communication of a wide variety of product meanings. Therefore, 'new-designed' chairs and lamps were chosen as the product sectors to be used in the empirical study. It was important to use 'new-designed' products (i.e. those that had not settled and become familiar in the marketplace), to avoid users' volunteered impressions being conditioned through prior exposure and familiarity. According to these two product sectors, a list of candidate product designers was prepared, using the following criteria.

1) The designer must have designs of at least one chair and one lamp;
2) The designer must have the products physically available to talk through during interview sessions;
3) The designer must be willing to donate or arrange delivery of the physical product of their design for use in user studies over an extended period of time.

As a result of the designer screening, invitation and selection process, three pairs of products (one lamp, one chair) from three individual freelance designers (Markus Johansson, Jonas Forsman, Sami Kallio) were selected as the basis for the empirical study (Table 3.2). As well as fitting the selection criteria, these freelance designers have enviable experience and reputation in product design, especially in the furniture sector. Each product was nominated by the designer as having a strong character tied to particular intended expressions.

Table 3.2 Chairs and lamps used in the study

Products designed by **Markus Johansson**		
	"NEST"	"CIRRATA"
Products designed by **Jonas Forsman**		
	"ARC"	"PARASOL"
Products designed by **Sami Kallio**		
	"5Y"	"WOODSTOCK"

3.2.2 Stage 1 – Intended Visual Expressions

Under this stage, individual designers' intended semantic expressions were explored. As a reminder, the *methods* and *processes* by which designers build meanings into products was not within the scope of this study. The discussion within the interview sessions aimed to understand designers' intended expressions from the 'realized' (produced) products. In other words, the intended semantic expressions during the product development process – whether or not they were duplicated in the end product - were not probed in the study. The interview included questions about the intended characters and values 'hidden' in the visual qualities of designers' realized products, and through which particular product features the designers hoped to convey these expressions/messages. The following questions/statements were used to guide the discussion-based interviews.

- ***Please discuss the semantic expressions that you intended to communicate through the visual qualities of your design.*** (Beforehand, designers were briefed about different types of meanings, using the classification defined in Table 2.1, so as to assist the verbalization of intended expressions/connotative meanings and to avoid other types of meanings; this was a process of learning by designers).
- ***Which adjectives do you think best describe your intended visual expressions?*** (Designers were asked to initially volunteer adjectives/connotative meanings that summarized their intended product expressions. Then they were provided with a cue card of example adjectives (Table 2.2). A maximum of 5 adjectives was requested).
- ***Please discuss in which sense you are using the adjectives.*** (Designers were asked to confirm that they were using adjectives in a positive sense, and were asked to provide a synonym for each adjective so as to clarify intentions).
- ***Please identify specific visual features/qualities of your design that helped convey each adjective.***
- ***Using the 5-point scale, please give a score for how descriptive each of your chosen adjectives is, within the context of your overall intended product visual impression.*** (Designers were asked to indicate their score using a 5-point Likert scale evaluation sheet, ranging from 'non-descriptive' to 'fully

descriptive' – see Appendix B. This approach was an alternative to asking for, and using, bipolar adjective pairs. The preference for singular adjective evaluation was to remove the modulation of meaning that occurs as a result of exposure to a bipolar pair (Mugge et al., 2009). For example, the meaning attributed to 'fashionable' can be different if paired with the close, but different, bipolar adjectives 'outmoded' or 'timeless' (and thus the meaning 'fashionable' becomes more specific through the presence of the bipolar pair). Moreover, in a previous study carried out by the author (Khalaj, 2009), it was revealed that both designers and users tended to interpret products through single descriptive adjectives rather than a 'sliding scale' between bipolar pairs.).

The interviews were conducted in the designers' own offices and were audio-recorded with permission. Each interview – including the Likert Scale grading – took approximately 45 minutes. The data analysis method (connotative meaning summaries) and associated results are presented in Chapter 4.

3.2.3 Stage 2 – Realized Visual Impressions

At this stage, target user/consumer participants were asked about their semantic impressions based only on visual appraisal of the products. However, prior to commencing Stage 2 (and later Stage 3) for the main study, an initial trial study was considered to examine draft interview questions and the fruitfulness of the collected responses, and to decide how many participants would be needed. The Parasol lamp (designed by Jonas Forsman) was taken as the product to be evaluated during the trial study. Dr. Li Wikstrom (department staff member at Chalmers University), having considerable experience in the area of product semantics, took part in the study to evaluate the experiment set-up and protocol. The trial study and its subsequent evaluation raised several points that ultimately improved the conduct of Stages 2 and 3.

The number of participants suitable for the study was discussed with Dr. Li. Since the interview session was found to generate qualitative and deep data, it was considered appropriate to secure 12 participants to reach a valuable data set. It was also discussed that the focus of the user studies would not be on trying to ascertain the frequency of

specific mentioned adjectives (actual impressions), but rather to try to gauge semantically how wide those impressions were. A marketing-based study by Griffin & Hauser (1993) showed that from an interviewee pool of 30, having interviewed 12 participants it was found that 80% similar data could be obtained (i.e. close to saturation). This threshold was considered sufficient for identifying semantic discontinuities, whilst a limit of 12 participants (per product pair evaluation) was viewed as manageable. In total, 36 participants (18-36 age range) were recruited for Stage 2 (12 participants for each 'product pair', divided into 6 students from Chalmers' *Product Development* department and 6 students from Chalmers' *Architecture* department). Because of their studies, all of the participants therefore possessed an elevated sensitivity to design and an understanding of how meanings can be attached to three-dimensional form. As soon-to-be graduates, the participants would also have good earning potential. In combination, these traits made the students reasonable potential users/consumers for the six products chosen for the study.

A total of 72 product evaluation sessions were made (6 products x 12 participants) for Stage 2. To eliminate any order effect, half of the participants first evaluated the chair of their allocated designer, with the remaining half first evaluating the lamp. The possibility of a gender effect on results was not investigated; however, an equal gender distribution (6 males / 6 females) for the evaluation of each 'product pair' was made, essentially aiming to alleviate any gender bias. Each participant evaluated only one product pair, with the full participant distribution described in Figure 3.2.

User	Department	Product Pair	Gender
U1	Product Development	Lamp → Chair	Male
U2	Product Development	Lamp → Chair	Female
U3	Product Development	Lamp → Chair	Male
U4	Product Development	Chair → Lamp	Female
U5	Product Development	Chair → Lamp	Female
U6	Product Development	Chair → Lamp	Male
U7	Architecture	Lamp → Chair	Male
U8	Architecture	Lamp → Chair	Female
U9	Architecture	Lamp → Chair	Female
U10	Architecture	Chair → Lamp	Male
U11	Architecture	Chair → Lamp	Female
U12	Architecture	Chair → Lamp	Male

User	Department	Product Pair	Gender
U13	Product Development	Lamp → Chair	Female
U14	Product Development	Lamp → Chair	Male
U15	Product Development	Lamp → Chair	Male
U16	Product Development	Chair → Lamp	Male
U17	Product Development	Chair → Lamp	Female
U18	Product Development	Chair → Lamp	Female
U19	Architecture	Lamp → Chair	Male
U20	Architecture	Lamp → Chair	Female
U21	Architecture	Lamp → Chair	Male
U22	Architecture	Chair → Lamp	Female
U23	Architecture	Chair → Lamp	Male
U24	Architecture	Chair → Lamp	Female

User	Department	Product Pair	Gender
U25	Product Development	Lamp → Chair	Male
U26	Product Development	Lamp → Chair	Female
U27	Product Development	Lamp → Chair	Male
U28	Product Development	Chair → Lamp	Female
U29	Product Development	Chair → Lamp	Female
U30	Product Development	Chair → Lamp	Male
U31	Architecture	Lamp → Chair	Male
U32	Architecture	Lamp → Chair	Male
U33	Architecture	Lamp → Chair	Female
U34	Architecture	Chair → Lamp	Male
U35	Architecture	Chair → Lamp	Female
U36	Architecture	Chair → Lamp	Female

Figure 3.2 User/consumer participant distribution across product pairs for Stage 2 and 3

Product pairs were set-up for evaluation in separate plain white rooms, ignoring the context of use. This test environment was chosen to help participants to concentrate on, and interpret, each of the products without external interruption or distraction – especially given that interactions with the true usage environment was not an aspect of product appraisal within the scope of the study. After evaluating the first product, participants were taken to another room to evaluate the second product. Accordingly, the products were not placed next to each other (as a pair) but instead were isolated to concentrate evaluations on just that single product. It was considered that if participants were presented with products in a single location, they would have opportunity to make comparisons, which in turn could bias their evaluations of each product. The lamps were placed in a quite dark room and on a table, to show the effect of the intended illumination when switched on. This was an important part of communicating product expression as intended by the designer, considering that the interplay between emitted light, shadows and the luminaire itself must be taken together as the visual qualities of a lamp.

The chairs were placed in an empty room surrounded by white partition walls. In both cases, the floor was covered with a neutral grey carpet (Figure 3.3). The participants were purposefully prevented from touching (i.e. interacting with) the products. However, they were allowed to make visual explorations by walking around the exhibited products and being able to view the products from multiple angles.

Figure 3.3 Product presentations in different spaces

A typical session for evaluating a pair of products took between 40 and 50 minutes. The evaluation of the second product took a shorter time, since participants had become clearer about the running of the interview sessions and their purpose. The interviews were audio-recorded, having obtained participants' permission. Participants were given 100kr gift cards as an incentive and appreciation of their involvement, funded by the division of Design and Human Factors at Chalmers University. Participants' initial visual impressions were probed through the following questions/statements.

- ***Please indicate and explain your initial impressions of the product, based on its visual qualities.*** (Users were briefed about different types of meanings (Table 2.1), and it was explained that 'connotative meanings' were the focus of this study. As with designers, there was a 'sensitizing period' during which users needed to 'get used' focusing on connotative meanings and avoid mentioning other types of meanings. In other words, it was not especially easy for participants to spontaneously offer connotative meanings, despite being 'design students' – it required effort and thought).
- ***Which adjectives do you think best describe your visual impressions?*** (Target users, as with designers, initially volunteered their own adjectives. Then they were provided with a cue card of example adjectives (Table 2.2), as a stimulus for further suggestions and/or to overcome linguistic constraints. A maximum of five adjectives was requested. The adjectives provided here were termed 'first-order' adjectives.)
- ***Please discuss in which sense you are using the adjectives.*** (Users were asked to indicate if they were using adjectives in a positive or negative sense, and guided to provide further explanations – and ultimately a synonym – for each adjective, so as to clarify the meaning behind their impressions. The adjectives provided here were termed 'second-order' adjectives.)
- ***Please identify specific visual features/qualities of the product that prompted you to mention each 'first-order' adjective.***

The user impressions collected at Stage 2 were anticipated to be wide in both vocabulary and semantics, since all impressions would (at least initially) be self-initiated volunteered descriptions. An objective was therefore to be able to properly

deal with this dispersion of potentially 'messy' qualitative data. The data analysis method (semantic cluster maps – a new semantic analysis method developed specifically for dealing with the Stage 2 data complexity) and associated results are presented in Chapter 4.

3.2.4 Stage 3 – Users' Evaluation of Intended Visual Expressions

At this stage, which directly followed Stage 2 and was carried out in the same surroundings and context, the same participants were asked to make an evaluation of designers' intended visual expressions (as adjectives), by indicating a score on a Likert Scale grading sheet. Additionally, an equal number of other adjectives – not mentioned by designers for the product under evaluation – were included in the grading sheet. In this way, participants were not able to decipher which of the adjectives on the grading sheet related to 'true' or 'false' intended expressions, thereby providing a hidden control group within the experimental design. This provided an opportunity to check whether mismatches between impression and expression would be more numerous and more intense for *non-intended ('false')* adjectives than *intended ('true')* adjectives. Accordingly, to complete a pool of true and false adjectives, *all intended adjectives* coming from *all three chairs* and *all three lamps* were used in the respective evaluations of chairs and lamps. Users' evaluations of intended visual expressions were probed through the following questions/statements.

- ***Using the 5-point Likert Scale, please give a score for how descriptive each adjective is, within the context of your overall visual impression of the product.*** (The scale also included a 'not applicable' option, so that participants could indicate any adjectives they considered not present in their impression of the product, or which they didn't understand see Appendix B. By evaluating the adjectives systematically using the scale, the intention was to generate data that could reveal the level of clarity or perceptibility of a product impression from users' perspectives, thereby creating numerical data to quantitatively calculate levels of mismatch with designers' intent for product expression.)
- ***Please identify specific visual features/qualities of the product that influenced your evaluations for each adjective.***

The data analysis method (banded discontinuity profiles) and associated results are presented in Chapter 4.

3.2.5 Stage 4 – Designers' Evaluation of Realized Visual Impressions

At this stage, designers were asked to offer their opinions on users' actual visual impressions of their products, after exposure to the semantic cluster maps generated in the Stage 2 analysis. The purpose of the stage was to investigate the reaction of the original product designers, and to see if semantic characters mentioned by target users were within (or outside) the scope of designers' intended product expressions. Stage 4 was carried out nearly six months after the first interview sessions (Stage 1). The break was necessary to cover the time in preparing the semantic cluster maps of users' actual impressions. Designers were approached for their participation via e-mail. A questionnaire was prepared (Appendix C), for which designers were introduced to the logic behind the semantic cluster maps and then prompted on the results that they held, through the following open-ended questions:

- ***Please discuss your overall interpretations of users' impressions. Are you happy about users' impressions; are they reasonable? Do the semantic characteristics listed match with your expectations?***

- ***Within the context of your overall intended visual expressions, which of the adjective/meaning clusters do you think are within the 'scope' of your original thinking? Please confirm your evaluation by mentioning the first order adjective of the cluster.***

The data analysis method (content analysis) and associated results are presented in Chapter 4.

CHAPTER 4

ANALYSIS AND RESULTS

This chapter presents the analysis procedure and results of the main empirical study of the thesis. As mentioned in the research methodology (Chapter 3), the main study was divided into four stages (Figure 3.1): *Stage 1 - Designers' intended visual expressions; Stage 2 - Users' realized visual impressions; Stage 3 - Users' evaluation of designers' intended visual expressions;* and *Stage 4 - Designers' evaluation of users' realized visual impressions.* The following sections discuss the analysis methods and results considered for each of the Stages. Stages 1 & 3, and 2 & 4, are methodologically paired, and this is reflected in the reporting structure of the chapter, which is divided into two main parts. The first part of the chapter is dedicated to the analysis of quantitative data (main study Stages 1 & 3), whilst the second part of the chapter is dedicated to the analysis of qualitative data (main study Stages 2 & 4). The level of communication between the individual designer's intended expressions and the collective target users' initial impressions through each of the products is argued separately, and then the results are cross-compared over the 6 product examples and 2 product types so as to help reach answers to the originally proposed research questions.

The qualitative data generated in the study refer to connotative meanings, involving figurative expressions, personality characteristics, and social values that the participants voluntarily attributed to the visual form of products. The quantitative data refer to participants' ratings of the descriptive intensity of connotative meanings present in products, using a 5-point Likert scale.

4.1 Analysis of Quantitative Data (Stages 1 & 3)

Figure 4.1 shows the relationship between designers' and users' appraisals of the six products studied in Stages 1 and 3 of the main study. Firstly, the clarity or perceptibility of each original designer's intended expressions – from the designer's perspective – are studied on a 5-point Likert scale (Section 4.1.1). Later, target users' impressions of each product are analysed, based on the same 5-point Likert scale. Finally, a cross-comparison is performed to identify the level and origin of any discontinuities between intended expression and realized impression (Section 4.1.2).

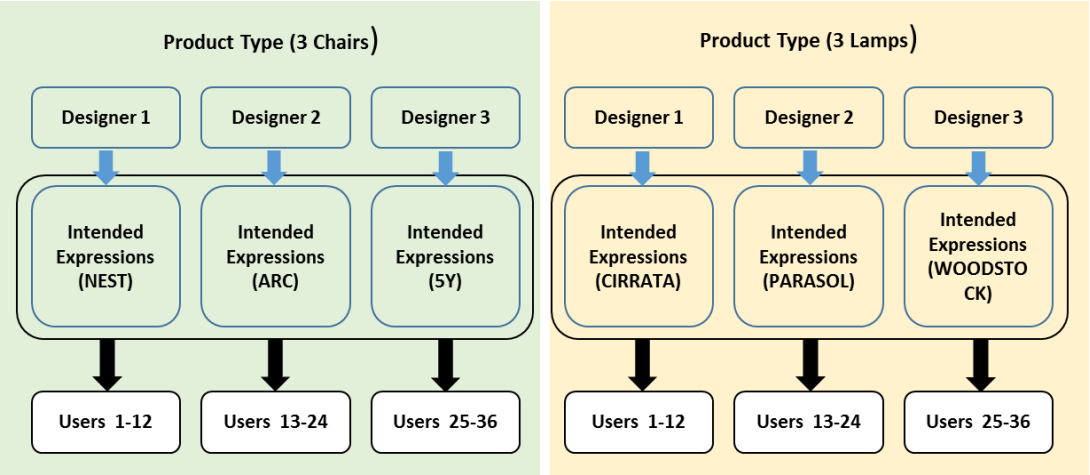

Figure 4.1 Distribution of designer and user appraisals of products for main study Stages 1 and 3

4.1.1 Stage 1 – Designers' Intended Visual Expressions

Within this section, designers' intended expressions of materialized (manufactured) products are explained in detail on a product-by-product basis.

4.1.1.1 Intended Expressions of NEST Chair

The product NEST is designed by Markus Johansson. According to Markus, the NEST chair breaks from traditional form and shape, being made of a free form combination of 30 wood rods. It is a kind of experimental work to find an exciting design language.

Following discussion, Markus communicated his intended expressions and the product visual properties through which his design intent was expressed. These are

listed below under simple adjective/phrase headings. In addition, Figure 4.2, provides a self-evaluation of the designer's overall intended expression, using the 5-point Likert scale, to create a Connotative Meaning Summary. The figure interprets to what extent the designer's intended expressions are present (descriptive) within the materialized product.

INTERESTING:

For those people who see the product for the first time, it is 'interesting' as it makes people explore the product more. This is in the sense that the product arouses curiosity about its *construction* and *how the wooden sticks are connected*.

ATTRACTIVE:

The product overall shape attracts someone's attention, because that person may find it as something cool, nice and appealing. The specific *pattern* and *form constructed by the wood rods* to define a seating unit make it especially attractive.

UNINVITING:

This refers to the product's visual behavior characteristics. It is somehow uninviting because of the *directions and the positions of the sticks*. The Swedish word 'Sticka' best describes this behavior, which tells that the product visually pokes someone who comes into eye contact with it. In the beginning, the product visually pushes one away. It is not inviting in character. But tactually it is inviting. Therefore, it is expected that one would not go directly to take a seat, but instead there would be a period of first exploring and appraising the sticks.

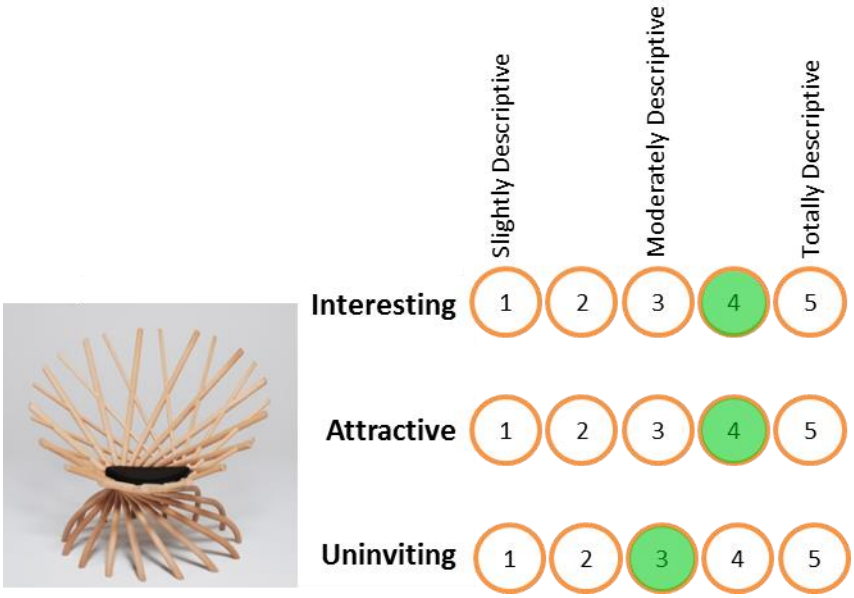

Figure 4.2 Connotative Meaning Summary based on designer's self-grading of component expressions for NEST chair

4.1.1.2 Intended Expressions of CIRRATA Lamp

Another product designed by Markus Johansson is the CIRRATA lamp. The lamp represents an inventive form, resembling the existing form of deep sea creatures. So the visual qualities and the formal characteristics of the lamp provide a good harmony with sea inhabitants. The lamp also challenges methods of forming and processing the material Corian. The advantage of this material is the fact that it can take almost any shape through thermoforming of sheets. In the case of CIRRATA, the material is shaped around wooden bases to achieve the unique form. The following simple adjective/phrase headings were offered by the designer as collectively representing his intended expression for the product. Figure 4.3 provides a self-evaluation of the designer's overall intended expression, using the 5-point Likert scale, to create a Connotative Meaning Summary. It shows the extent to which the designer's intended expressions are present (descriptive) within the materialized product.

DANCING:

The lamp looks like an Octopus, a body with many arms that sweep alongside. It resembles a character as dancing and floating, which is mainly based on the visual

movements of static form. The *shape of each arm* supports this, with attention given to *the way each arm sensitively touches the ground*. The *reflective light inside the lamp head* gives a suggestion that the product is a moving character.

CHARMING:

The lamp is charming in the sense that it is cute and sweet. The product possesses pleasant characteristics of an *organic rounded shape*, with a *hidden light* that emphasizes its characteristics in the dark.

PRECISE:

The lamp represents and expresses a well-thought through and accurate work. Through the experimental work, much attention was put on the *construction and material qualities* to achieve a *perfect form* and *uniform patterns* on the body.

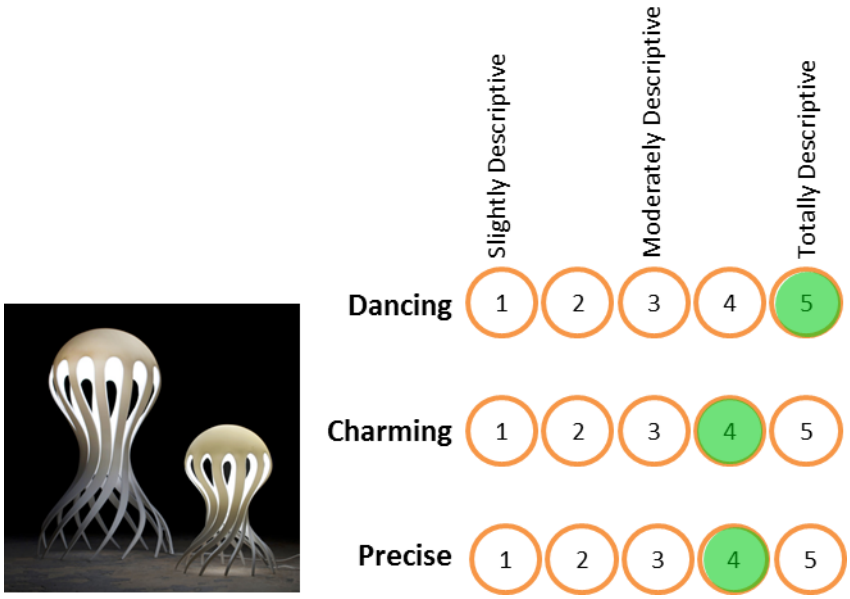

Figure 4.3 Connotative Meaning Summary based on designer's self-grading of component expressions for CIRRATA lamp

4.1.1.3 Intended Expressions of ARC Chair

The folding chair named ARC is designed by Jonas Forsman. The chair incorporates a unique folding mechanism, while conjoining the backrest and armrest to provide a comfortable form. It adopts a minimalistic approach to design. The backrest and seat of the chair are made of lacquered wood. The crossed legs are made of steel tubing and the connectors are made of plastic. As well as the product's simple functional behavior, it possesses minimalistic visual characteristics. The following simple adjective/phrase headings were offered by the designer as collectively representing his intended expressions for the product. Figure 4.4 provides a self-evaluation of the designer's overall intended expression, using the 5-point Likert scale, to create a Connotative Meaning Summary. It shows the extent to which the designer's intended expressions are present (descriptive) within the materialized product.

SIMPLE:

The chair is quite simple in the sense that it is *pure* and *unexaggerated*. It is a simple definition of a form. During the product development, *only necessary shapes and elements* were considered.

DISTINCT:

It presents a well-defined *combination of different elements and materials*. Details were considered to provide a *precise construction*. The graphical appearance of the *crossing legs*, which are connected to the simply shaped backrest and seat, is intended to offer a difference.

HONEST:

The product is honest in the sense that it says what it is. It can be *clearly understood*. *Straight shapes* and the *basic level of detail* emphasize its honest characteristics.

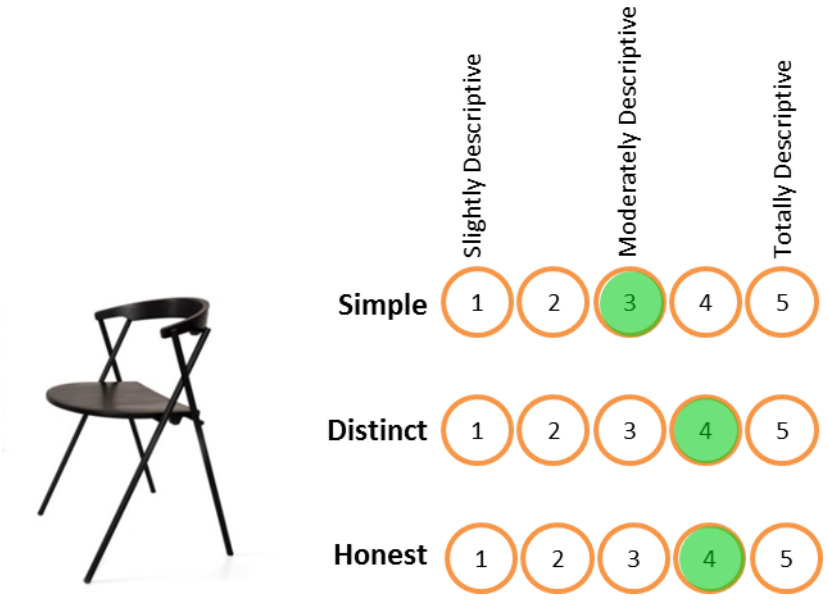

Figure 4.4 Connotative Meaning Summary based on designer's self-grading of component expressions for ARC chair

4.1.1.4 Intended Expressions of PARASOL Lamp

The second product of Jonas Forsman studied for the research was the PARASOL lamp. The starting point for the design was to take advantage of reflected light, based on the observation that reflected light is softer and more gentle than direct light. The lamp is made of a few simple elements. LED lighting is placed in the base. Light is reflected and controlled by a screen that is connected to a narrow body by a ball-shaped magnet. Accordingly, the screen can be adjusted to achieve a preferred light direction. The following simple adjective/phrase headings were offered by the designer as collectively representing his intended expression for the product. Figure 4.5 provides a self-evaluation of the designer's overall intended expression, usşng the 5-point Likert scale, to create a Connotative Meaning Summary. It shows the extent to which the designer's intended expressions are present (descriptive) within the materialized product.

HONEST:

Following long-term visual interaction, the lamp can be considered honest and understandable regarding its functionality and how its form elements come together.

At first its honesty can be questionable. But it is still functionally and operationally clear because it *shows the source of light* and uses only *simple geometric shapes*.

CALM:

The lamp is intended to be calm and also provide relaxation by using *reflected light*. The characteristic of the light, the *white relaxing color* of the product finishing, the *symmetrical design*, and the *stable base* help to define the product as very calm.

SENSITIVE:

The lamp has a sensitive character, both emotionally and physically. The characteristics of the *screen on the top*, the *soft elements* and the *thin stem* in the middle of the lamp convey a sensitive and delicate product.

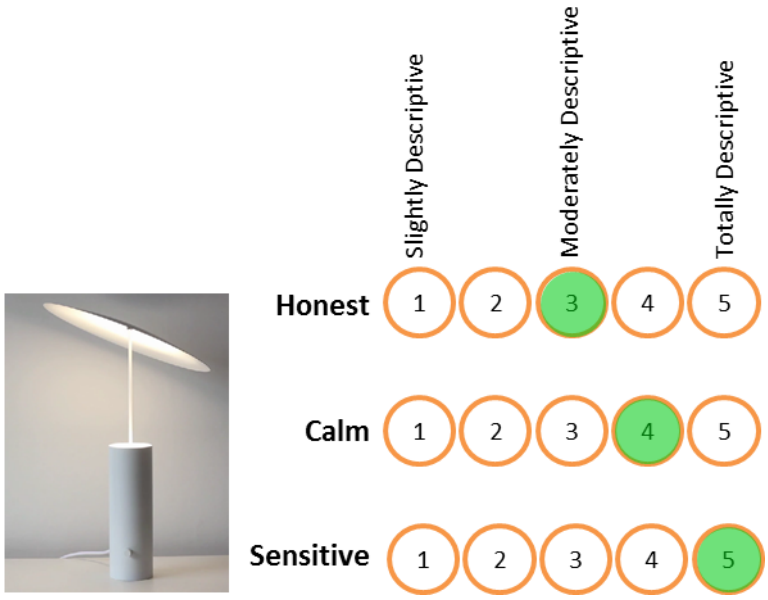

Figure 4.5 Connotative Meaning Summary based on designer's self-grading of component expressions for PARASOL lamp

4.1.1.5 Intended Expressions of 5Y Chair

The 5Y chair designed by Sami Kallio represents an experimental work. The design is a new definition for common 'Winsor' chairs. The 5Y chair gives a reminder and respect for the past, but at the same time looks forward. The most inventive part of 5Y is its backrest, considering its appearance and function. The graphical patterns of the backrest provide a concrete shape and support. Five inverted-Y shape elements are connected together with metal pins to create a strong but lightweight backrest. The pins are visible on the back and front of the backrest. The product is made of solid wood and form-pressed veneer. Except for the upper half of the backrest, the entire chair is colored pink. It somehow conveys the main design idea, representing the continuity of the design from past to present. The following simple adjective/phrase headings were offered by the designer as collectively representing his intended expressions for the product. Figure 4.6 provides a self-evaluation of the designer's overall intended expression, using the 5-point Likert scale, to create a Connotative Meaning Summary. It shows the extent to which the designer's intended expressions are present (descriptive) within the materialized product.

FEMININE:

The chair visually expresses woman-like characteristics. The *pink color* is often associated with femininity. The front view of the chair resembles a *woman's body*. The backrest also represents a type of *pattern found on a panty*.

ATTRACTIVE:

The chair is appealing, and recognizable. It may draw attention of audiences because of its *visual form*, curiosity for the reasons behind the *unfinished pink color*, as well as the *construction* and *material choices*.

HONEST:

The chair is honest for those who visually appraise it. The product is understandable and *clear about its construction*, material and how it is made. There are *no secret elements* or unclear functionality.

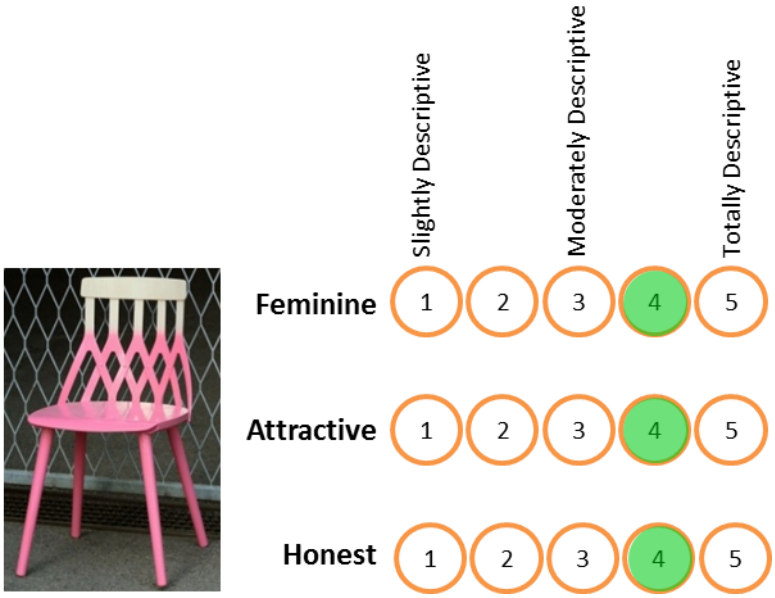

Figure 4.6 Connotative Meaning Summary based on designer's self-grading of component expressions for 5Y chair

4.1.1.6 Intended Expressions of WOODSTOCK Lamp

The second product of Sami Kallio studied for the research was the WOODSTOCK lamp. This vibrant and reflective table lamp represents a minimalistic and Scandinavian approach to design. It combines handcrafted and industrial aesthetics. The product is made of only a few materials, using solid wood with natural patterns for the body and a fixed steel screen to hide and reflect an LED lighting fixture on the table. The following simple adjective/phrase headings were offered by the designer as collectively representing his intended expressions for the product. Figure 4.7 provides a self-evaluation of the designer's overall intended expression, using the 5-point Likert scale, to create a Connotative Meaning Summary. It shows the extent to which the designer's intended expressions are present (descriptive) within the materialized product.

PLAYFUL:

The lamp is quite playful, since it has some specific but affective playful qualities.

The combination of the product *colors* make it to look childlike. The *visual characteristics of the wing bolt* on the top of the product invite touch and play. The product also invites exploration to find out *whereabouts the source of the light is placed*.

HAPPY:

The lamp is happy in itself. It doesn't look sad. It reminds one of the '*Mickey Mouse*' character. The *amusing wing bolt*, its nice *color combination*, and the *softness of wooden body* combine to leave the product happy.

SIMPLE:

It has a minimal design, emphasizing plainness and clarity. The *materials are used in their natural ways*. The wooden body's *characteristics are clear*. The *function of each element is evident* and understandable.

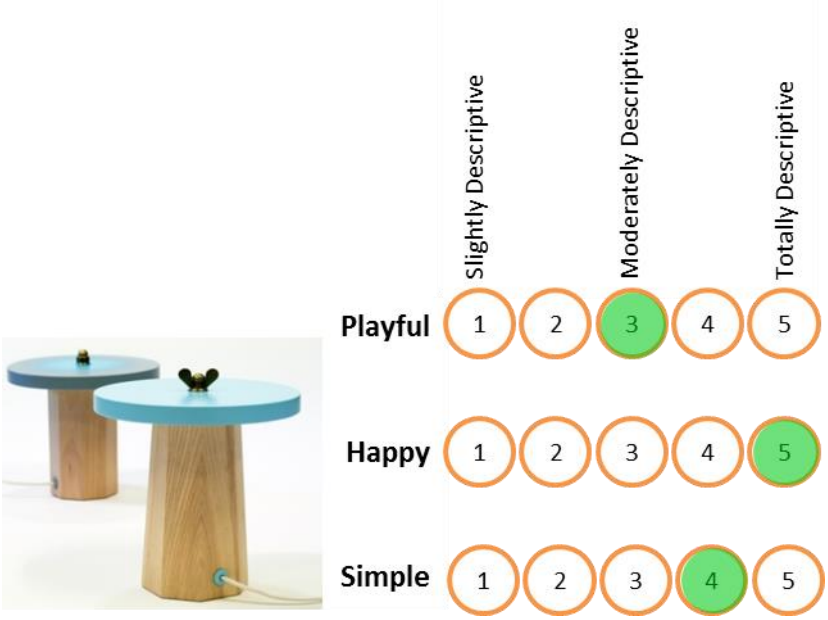

Figure 4.7 Connotative Meaning Summary based on designer's self-grading of component expressions for WOODSTOCK lamp

4.1.2 Stage 3 – Users' Evaluation of Designers' Intended Visual Expressions

This section integrates the results of the quantitative data generated by target users' evaluations of designers' intended visual expressions. Data were collected by users rating a collection of adjectives on a 5-point Likert scale, based on the extent to which they felt each adjective described the visual form of the product under evaluation. Full details of the methods are contained in Chapter 3, including the use of 'true' and 'false' adjectives. This section therefore focuses directly on whereabouts, if any, semantic discontinuities between expression and impression existed. Target users' gradings on the 5-point Likert scale, as standalone data, are not especially useful, but instead become insightful when directly compared with designers' evaluations. The analysis is divided into two principal sections, to cover the three lamps and the three chairs separately.

4.1.2.1 Identification of Semantic Discontinuities for Three Lamps

The cross-comparison comprised two steps. The first step (macro-analysis) explored *overall levels of discontinuity* between intended expressions and realized impressions. The second step (micro-analysis) elaborated the *origin of identified discontinuities*. The results of the analyses are presented as various forms of Banded Discontinuity Profiles, illustrating the distribution of different degrees of semantic discontinuity compared with the product expression intended by designers.

Step 1: Macro-Analysis to Establish Levels of Discontinuity

Users' gradings on the 5-point Likert scale were examined. A grade of zero (0) was given in the case of users grading with the term 'not-applicable' (NA). Accordingly, for each user's (u) evaluation, the 'distance' (difference) from the designer's (d) intended expression was calculated, leading to ten possible levels of semantic discontinuity: 'zero discontinuity' (0, where u = d), 'low-level discontinuity' (± 1, where u = d ± 1), 'mid-level discontinuity' (± 2, where u = d ± 2), 'high-level discontinuity' (± 3, where u = d ± 3), 'extreme discontinuity' (± 4, where u = d ± 4), and 'maximal discontinuity' (- 5, where u = d - 5). A 'maximal discontinuity' is relevant when the original designer had given a score of 5 to an intended expression, whist users found it not applicable (NA) for the product.

Figure 4.8 contains the Banded Discontinuity Profile for all 108 evaluations (3 lamps × 3 intended expressions × 12 participants). Except for two of these 108 evaluations (two N/A gradings), users found the intended expressions applicable (to varying degrees) to the products. Figure 4.8 reveals that most of the evaluations were close to designers' intentions. To ease the interpretation of data, a threshold of $u \geq d \pm 3$ was set to identify 'significant discontinuities'; in other words, discontinuities that reveal instances of product impression being considerably distant from the intended expression of designers. This is visualized in Figure 4.9, where discontinuity bands are separated only for $u = d$ (zero discontinuity), $u = d \pm 1$ (low-level discontinuity), and $u = d \pm 2$ (mid-level discontinuity). Figure 4.9 also exposes distribution of the direction (valence, ±) of different levels of mismatch, to create a more classical valence-sensitive histogram.

The prevalence of 'mid-level discontinuities' ($u = d \pm 2$) and 'significant discontinuities' $u \geq d \pm 3$) on the *left side* of Figure 4.9 shows that users tended to grade to the left side on the 5-point Likert scale. In other words, users evaluated designers' intended expressions as being less descriptive than designers had originally intended. Accordingly, it can be said that designers may be more positive, clear and certain about the intended expression of their products. This tendency towards users grading descriptively less intensively than designers was seen most markedly for the CIRRATA lamp; indeed, the two N/A evaluations were made for the WOODSTOCK lamp.

At the next stage of analysis, for each product, the proportion of evaluations falling within each discontinuity band was calculated, as well as the mean banding across all three lamps. Figure 4.10 illustrates the results as doughnut charts. The values indicated are percentages of the total number of evaluations for that product. The green gradient colors show zero and lower-level discontinuities, whilst the red gradient colors show mid-level and significant discontinuities. By using color-coding, the discontinuity characteristics for each product and across products can be quickly visually appraised and compared.

The headline result from these analyses was confirmation of discontinuities between semantic intent and realization amongst the lamps. From the overall mean data

(bottom right, Figure 4.10), it can be seen that approximately one third of semantic intent (30%) had no discontinuity, whereas approximately two thirds (70%) were subject to discontinuity. However, treating low-order discontinuities (u=d±1) as 'problematic' is unfair since on the original (5-point) Likert scale, a difference of one point is the inherent sensitivity of the data collection tool. So, alternatively, a more reasonable division is to consider the results as falling into two groups: zero discontinuities combined with 'low-level' (u=d±1) discontinuities; and all other ('higher-level') discontinuities (u=d≥±2). With this grouping, we see a 72:28 absence-to-presence ratio of discontinuities. This result shows that the studied designers were generally successful in maintaining semantic intent within close tolerances, but were unable to successfully communicate semantic intent in approximately one-in-four cases. This can be considered a high 'design communication problem' rate, and is deserving of more detailed analysis, presented in the micro-analysis (step 2).

The data were checked for differences between the discontinuity bands on an individual product basis (CIRRATA, PARASOL, and WOODSTOCK). Based on the summed proportion of lower-level mismatches (i.e., $u \leq d \pm 1$), it is obvious that users' evaluations for product CIRRATA (83%) were closer to designers' intentions than for products PARASOL (69%), and WOODSTOCK (64%). The difference is clearly influenced by a relatively high concentration of exact matches (u=d, 42%) for CIRRATA. The results show the greatest success in communicating design intent through visual product form is achieved by the designer of CIRRATA.

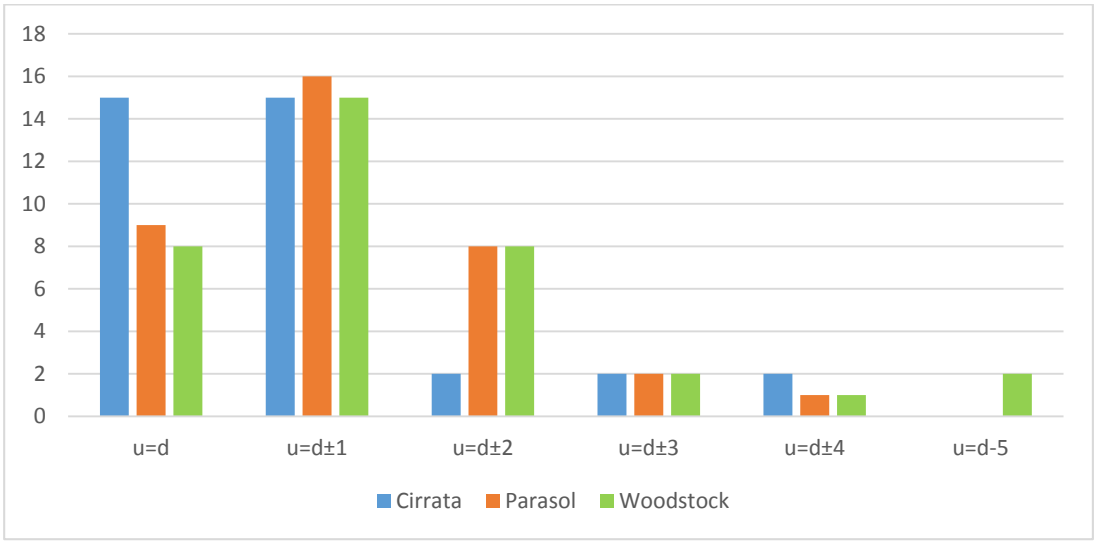

Figure 4.8 Banded Discontinuity Profile for all three lamps

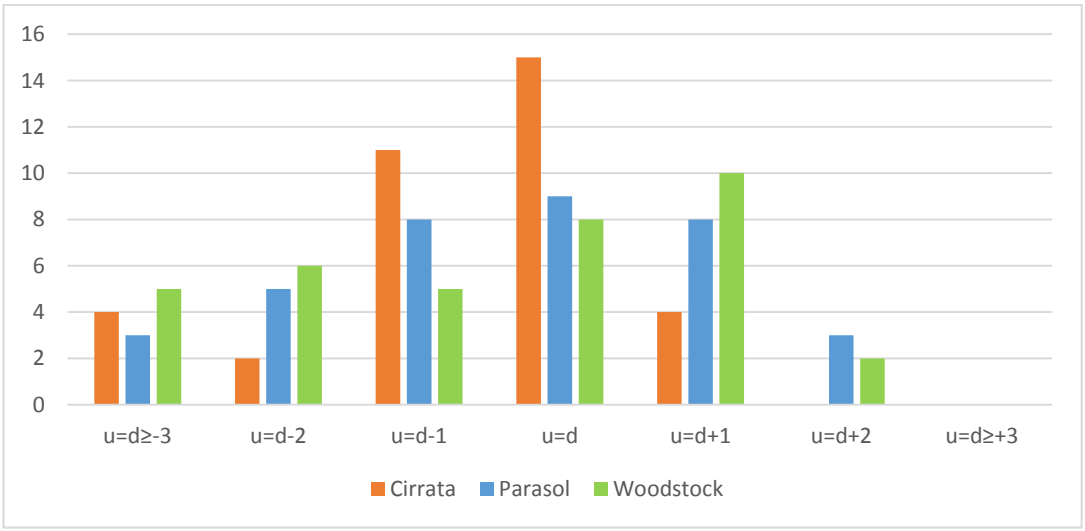

Figure 4.9 Banded Discontinuity Profile for all three lamps (valence sensitive histogram)

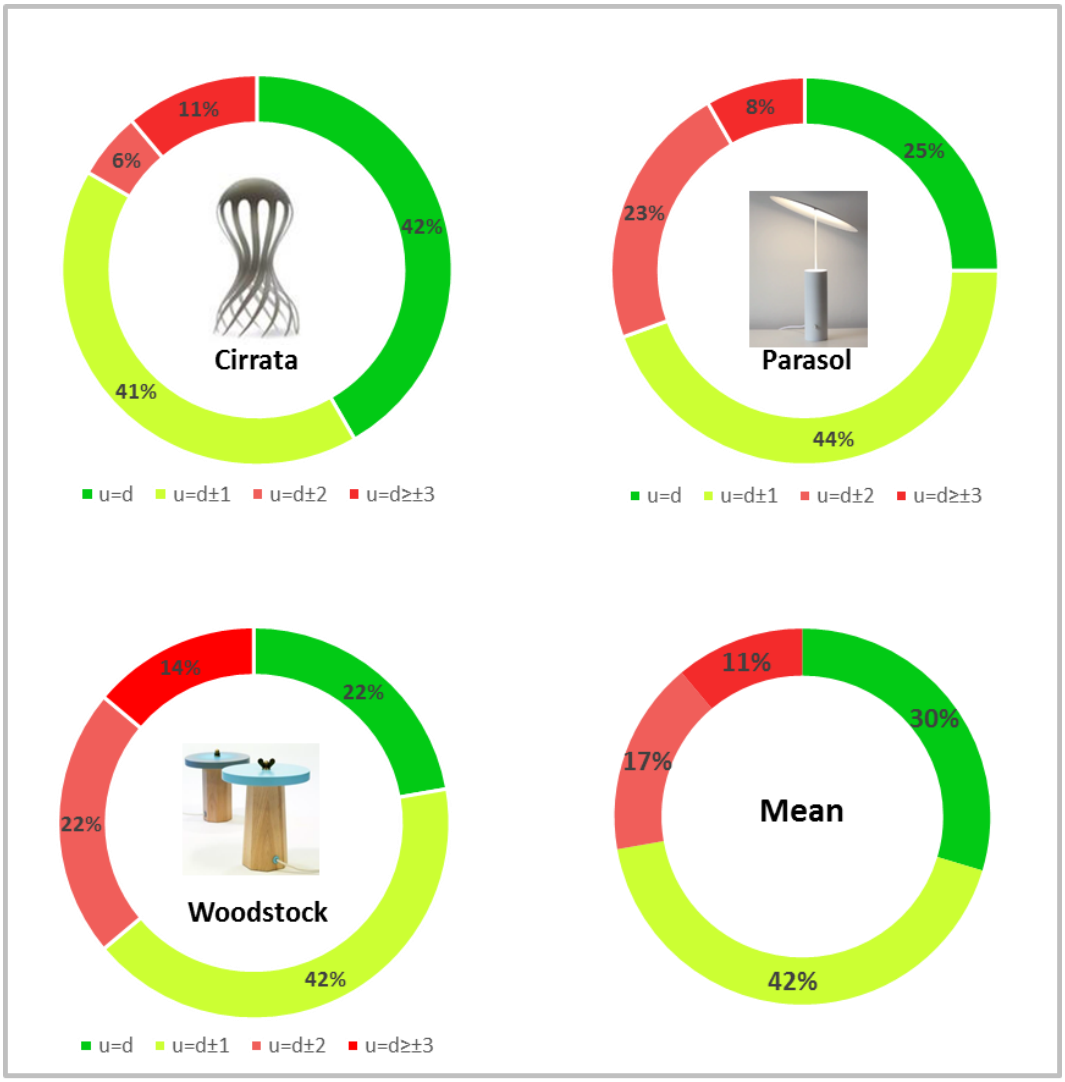

Figure 4.10 Visual representation of semantic intent discontinuities for all three lamps

Step 2: Micro-Analysis to Determine Origins of Discontinuity

The follow-up micro-analysis aimed to examine whereabouts design intent is diluted (in other words, where communication breaks down), concentrating on instances of 'higher-level' discontinuity (u=d≥±2). The analysis method developed for step 2 had the aim of uncovering precisely how users' impressions differed from designers' intended expressions. To identify 'problematic' expressions/adjectives, it was necessary to determine the general (centric) position of the twelve evaluating users' grades on the 5-point Likert scale, and compare this with the designer's intention. To best deal with the dispersion of grades amongst users, and also take into account the

zero (0) grade given for 'NA' evaluations, the *median* value of users' grades was chosen as the best centric approximation.

Figures 4.11 and 4.12 illustrate precisely how users' impressions differed from designers' intended expressions. One of the most obvious features of Figure 4.11 is that designers mostly chose to grade their intended expressions using a high score. Logically, it indicates that designers confirmed their choices of adjective using the 5-point Likert scale, and were very conscious about their intentions.

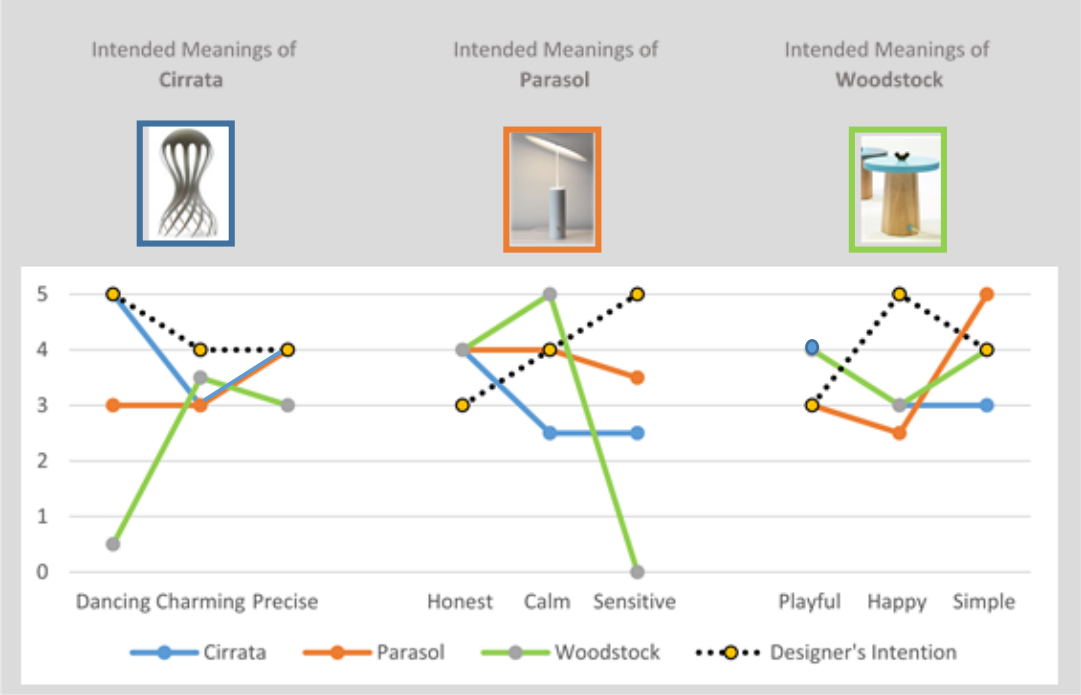

Figure 4.11 Visual representation of semantic intent discontinuities for all three lamps

One important feature of Figure 4.11 is that it presents the median results of users' evaluations of *all* intended expressions across the whole main study for lamps, including adjectives that are 'true' (intended for a particular product) and adjectives that are 'false' (intended for products other that the product being evaluated). Such cross-application of expressions was thought to help in understanding to what degree an intended expression of one product can be easily (or not) found in another product. The results are summarized in the bullet points below.

- Dancing. TRUE expression for CIRRATA (v=5, highly perceived). FALSE expressions for PARASOL (v=3, moderately perceived) and WOODSTOCK (v=0.5, barely perceived).
- Charming. TRUE expression for CIRRATA (v=3, moderately perceived). FALSE expressions for PARASOL (v=3, moderately perceived) and WOODSTOCK (v=3.5, moderately perceived).
- Precise. TRUE expression for CIRRATA (v=4, highly perceived). FALSE expressions for PARASOL (v=4, highly perceived) and WOODSTOCK (v=3, moderately perceived).
- Honest. TRUE expression for PARASOL (v=4, highly perceived). FALSE expressions for CIRRATA (v=4, highly perceived) and WOODSTOCK (v=4, moderately perceived).
- Calm. TRUE expression for PARASOL (v=4, highly perceived). FALSE expressions for CIRRATA (v=2.5, moderately perceived) and WOODSTOCK (v=5, highly perceived).
- Sensitive. TRUE expression for PARASOL (v=3.5, moderately perceived). FALSE expressions for CIRRATA (v=2.5, moderately perceived) and WOODSTOCK (v=0, not perceived).
- Playful. TRUE expression for WOODSTOCK (v=4, highly perceived). FALSE expressions for CIRRATA (v=4, highly perceived) and PARASOL (v=3, moderately perceived).
- Happy. TRUE expression for WOODSTOCK (v=3, moderately perceived). FALSE expressions for CIRRATA (v=3, moderately perceived) and PARASOL (v=2.5, moderately perceived).
- Simple. TRUE expression for WOODSTOCK (v=4, highly perceived). FALSE expressions for CIRRATA (v=3, moderately perceived) and PARASOL (v=5, highly perceived).

The differences between TRUE and FALSE grades for each adjective are listed in rank order in Table 4.1. Expressions with large differences between TRUE and mean FALSE gradings (dancing, sensitive) might be termed the most 'distinctive' or 'easiest to distinguish', as end users generally detected these expressions only in the product where it was intended. As a mixed sample of grades, however, the difference in values of TRUE

(n=9) and FALSE (n=18) grades was not found to be statistically significant (unpaired t-test, p=0.11). In other words, users were not able to discriminate, to a significant degree, those product expressions that were (unknowing to them) true rather than false. This may have simply been because users did indeed see the 'unintended' expressions within the products – perhaps quite validly. Or, this situation may be less to do with users' actual impressions and instead attributable to the Likert scale reseach tool, for which users may 'feel obliged' to rate all adjectives that are present, rather than dismiss them as not present in the product being appraised. Methodologically for future studies, it may be better to alert users to the fact that only three of the nine adjectives are 'true' for each of the three products, thereby focusing the user's task on semantic 'true/false' matching rather than 'independent blind evaluation'.

Table 4.1 Differences between TRUE and FALSE expression grades

Adjective	**TRUE grade (A)**	**Mean FALSE grade (B)**	**Grade Difference (A-B)**
Dancing	5	(3+0.5)/2 = 1.75	3.25
Sensitive	3.5	(2.5+0)/2 = 1.25	2.25
Playful	4	(4+3)/2 = 3.50	0.50
Precise	4	(4+3)/2 = 3.50	0.50
Charming	3	(3+3.5)/2 = 3.25	-0.25
Calm	4	(2.5+5)/2 = 3.75	0.25
Happy	3	(3+2.5)/2 = 2.75	0.25
Honest	4	(4+4)/2 = 4.00	0.00
Simple	4	(3+5)/2 = 4.00	0.00

Figure 4.12 provides a symbolic matrix of discontinuity bands, based on median discontinuity data for all TRUE adjectives. The outcome of this individual adjective analysis can be valuable for designers to reconsider the communication dimension of product visual expression, by revealing where designers were more/less successful in

conveying intended messages. The analysis reveals that designers were fully successful (u=d) in conveying the intended expressions of *dancing (Cirrata), precise (Cirrata), calm (Parasol)*, and *simple (Woodstock)*, while being least successful (u>d±1) in conveying the intended expressions of *sensitive (Parasol)* and *happy (Woodstock)*. The results indicate the general semantic communication success of CIRRATA, having two adjectives with zero discontinuity and none with a 'higher level' discontinuity (u>d±1).

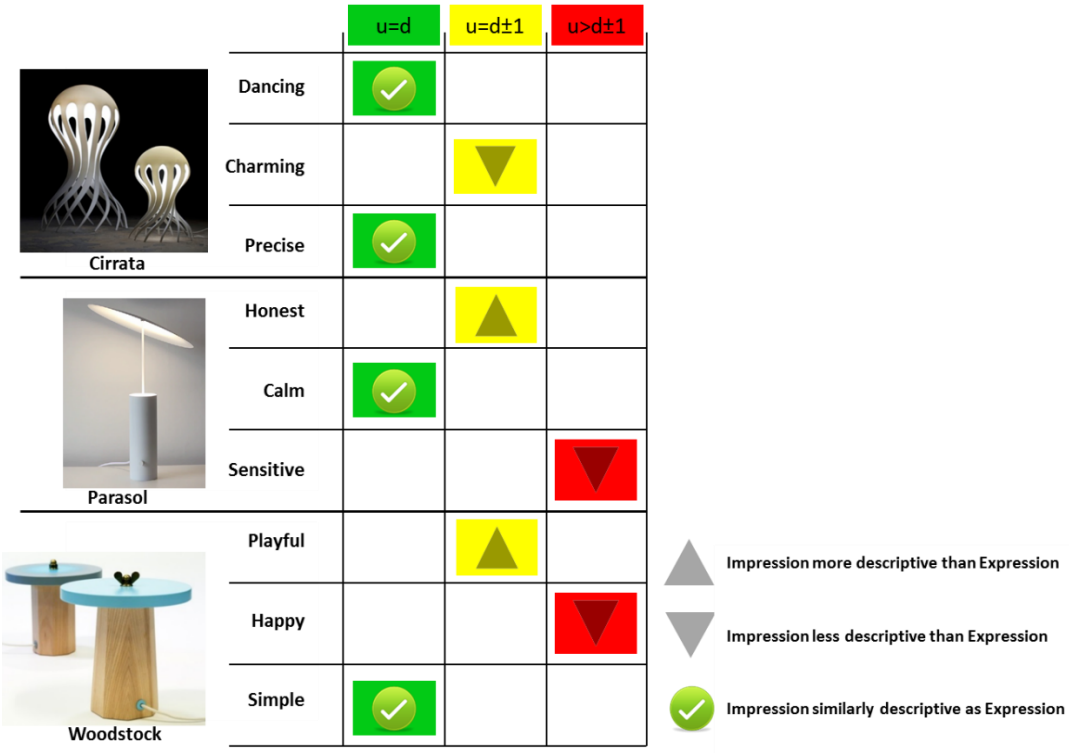

Figure 4.12 Matrix of discontinuity bands based on median discontinuity values for three lamps; colour indicates discontinuity band and symbol indicates relative change from the designer's intention

Based on the results of the micro analysis for the three lamps, the following discussion probes possible reasons for the particularly 'unsuccessful' realization of the product expressions *sensitive* (PARASOL) and *happy* (WOODSTOCK) – in both cases, where users' impression was less descriptive than the designer's expression.

According to Figure 4.13, six (out of 12) target users evaluated the expression '*sensitive*' outside of the designer's intended score for PARASOL (using u > d±1 as

the threshold). These users were coded by their participant numbers and gave grades as follows: U13 (u=d-2), U14 (u=d-2), U17 (u=d-2), U18 (u=d-2), U21 (u=d-3), and U22 (u=d-2). Closer attention to these users' evaluations indicate that most found the product PARASOL to be moderately *sensitive,* in contrast to how the designer intended the product to be highly *sensitive.*

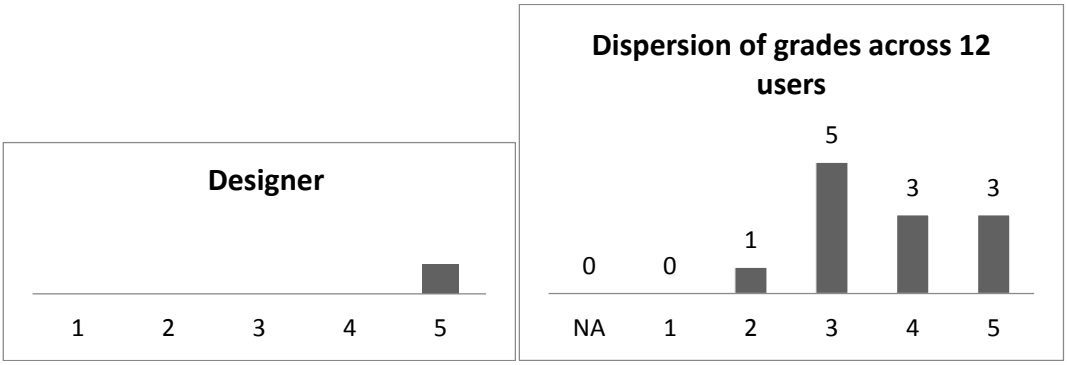

Figure 4.13 Designer and user evaluations for the problematic expression 'sensitive' (for PARASOL)

Table 4.2 below indicates specific visual features/qualities of the product PARASOL that influenced users' evaluations for the *sensitive* expression.

Table 4.2 shows that for most of the users the characteristics of the *geometric* and *industrial rough shape* of the *cylinder* lead to the adjective 'sensitive' being graded as a low descriptor. It also reveals that there is no consistency about product sensitivity between top and bottom elements of the PARASOL lamp.

Table 4.2 Product features/qualities influencing users' evaluation of 'sensitive' as a descriptor of PARASOL

User code	**Visual Features/Qualities**
U13 (u=d-2)	Geometric shapes, material quality
U14 (u=d-2)	Cold light
U17 (u=d-2)	Basic shapes, raw material without good finishing
U18 (u=d-2)	Rough industrial cut of the cylinder
U21 (u=d-3)	Geometric hard-looking shapes
U22 (u=d-2)	Straight masculine shape of the cylinder

Figure 4.14 presents the further analysis for the problematic expression *happy* for product WOODSTOCK. Nine (out of 12) target users evaluated the expression '*happy*' outside of the designer's intended score (using u > d±1 as the threshold). These users were coded by their participant numbers (Uxx) and gave grades as follows: U26 (u=NA), U 27 (u=d-2), U 28 (u=d-2), U 29 (u=d-2), U 30 (u=d-2), U 32 (u=d-3), U 33 (u=d-4), U 35 (u=NA), and U36 (u=d-3). Closer attention to these users' evaluations indicate that although the designer aimed the product to be perceived highly *happy*, while users to varying degrees did not see WOODSTOCK as 'happy'. Indeed, two users expressed that the *happy* character was not applicable to WOODSTOCK.

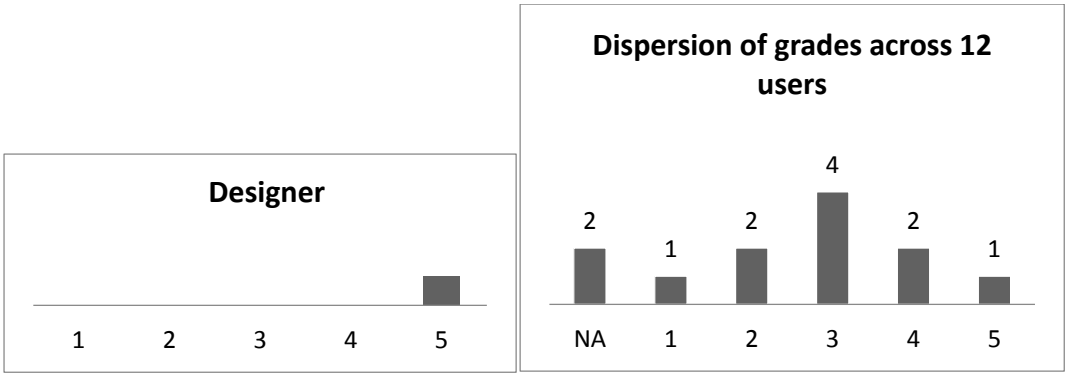

Figure 4.14 Designer and user evaluations for the problematic expression 'happy' (for WOODSTOCK)

The Table 4.3 below indicates specific visual features/qualities of the product WOODSTOCK that influenced users' evaluations for the *happy* expression.

Table 4.3 reveals diverse reasons for why *happy* was graded lower than by the designer. A range of visual qualities influenced users to evaluate 'happy' as a low descriptor of WOODSTOCK, such as the stability of the wooden body, the direction of the hidden light, and the color of screen on the top.

Table 4.3 Product features/qualities influencing users' evaluation of 'happy' as a descriptor of WOODSTOCK

User code	Visual Features/Qualities
U26 (u=NA)	-
U27 (u=d-2)	Reflective light, blue color
U28 (u=d-2)	Stable relaxed shape
U29 (u=d-2)	Heavy big body
U30 (u=d-2)	Hidden light
U32 (u=d-3)	Introverted closed form, reflective light
U33 (u=d-4)	Serious shape, simple stable shape, up-to-down light
U35 (u=NA)	-
U36 (u=d-3)	Light direction, material, old-style color

4.1.2.2 Identification of Semantic Discontinuities for Three Chairs

As with the lamps, the cross-comparison for the chairs comprised two steps. The results are again presented as various forms of Banded Discontinuity Profiles, illustrating the distribution of different degrees of semantic discontinuity compared with the product expression intended by designers.

Step 1: Macro-Analysis to Establish Levels of Discontinuity

The quantitative analysis was made in accordance with the procedure described in step 1 of Section 4.1.2.1 (for the data of three evaluated lamps).

Figure 4.15 contains the Banded Discontinuity Profile for all 108 evaluations (3 chairs × 3 intended expressions × 12 participants). Users found all intended expressions applicable (to varying degrees) to the products. The histogram also reveals that most of the evaluations were close to designers' intentions. Only 3 evaluations reveal extreme mismatches (where $u = d \pm 4$). These three unusual evaluations are related to the product expression of the 5Y chair. To ease the interpretation of data, a threshold of $u \geq d \pm 3$ was again set, to identify 'significant discontinuities'. The results are visualized in Figure 4.16, where discontinuity bands are separated only for $u = d$ (zero discontinuity), $u = d \pm 1$ (low-level discontinuity), and $u = d \pm 2$ (mid-level

discontinuity). Figure 4.16 also exposes distribution of the direction (valence, ±) of different levels of mismatch, to create a more classical valence-sensitive histogram.

The prevalence of 'significant discontinuities' u ≥ d ± 3) on the *left side* of Figure 4.16 shows that when grading, users stayed to the left side on the 5-point Likert scale. In other words, users evaluated designers' intended expressions as being less descriptive than designers had proposed. This tendency towards users grading descriptively less intensively than designers was seen most markedly for the 5Y chair.

At the next stage of analysis, for each product, the proportion of evaluations falling within each discontinuity band was calculated, as well as the mean banding across all three chairs. Figure 4.17 illustrates the results as doughnut charts, using the same graphical and numerical techniques as for the lamps. The headline result from these analyses was, as with the lamps, confirmation of discontinuities between semantic intent and realization amongst the chairs. From the overall mean data (bottom right, Figure 4.17), it can be seen that approximately one third of semantic intent (31%) had no discontinuity, whereas approximately two thirds (69%) were subject to discontinuity. However, taking the more reasonable division of 'low-level' (u=d±1) discontinuities and 'higher-level' discontinuities (u=d≥±2), we see a 81:19 absence-to-presence ratio of discontinuities. This result shows that the studied designers were generally successful in maintaining semantic intent within close tolerances, but were unable to successfully communicate semantic intent in approximately one-in-five cases. This can be considered a cause for concern in that some design communication through product visual form is not effective as intended, and is deserving of more detailed analysis, presented in the micro-analysis (step 2).

The data were checked for differences between the discontinuity bands on an individual product basis (NEST, ARC, and 5Y). Based on the summed proportion of lower-level discontinuities (i.e., u ≤ d ± 1), it is obvious that users' evaluations for product 5Y (86%) were closer to designers' intentions than for products NEST (81%), and ARC (78%). The difference is clearly influenced by a relatively high concentration of zero discontinuity (u=d, 39%) for 5Y. The results show the greatest success in communicating design intent through visual product form is achieved by the designer of 5Y.

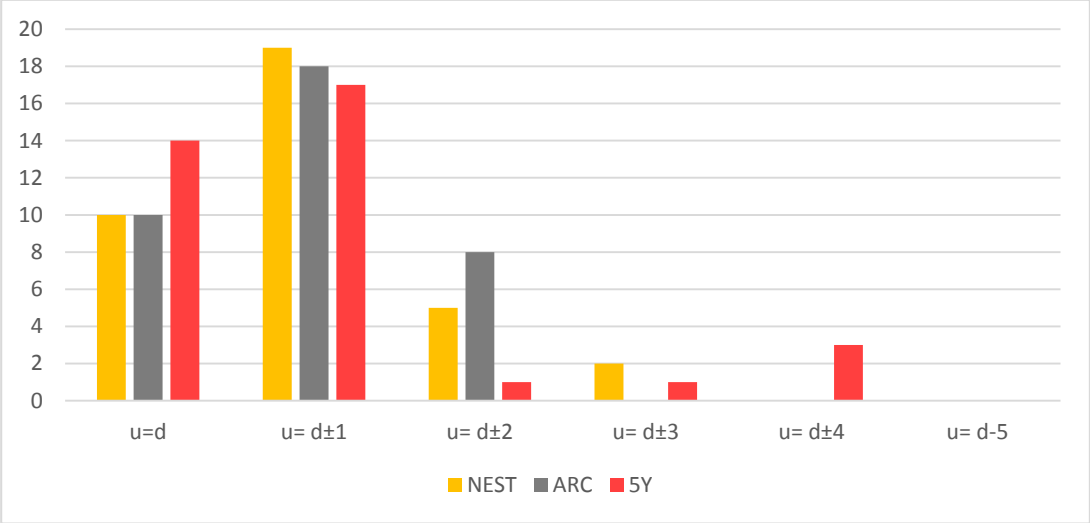

Figure 4.15 Banded Discontinuity Profile for all three chairs

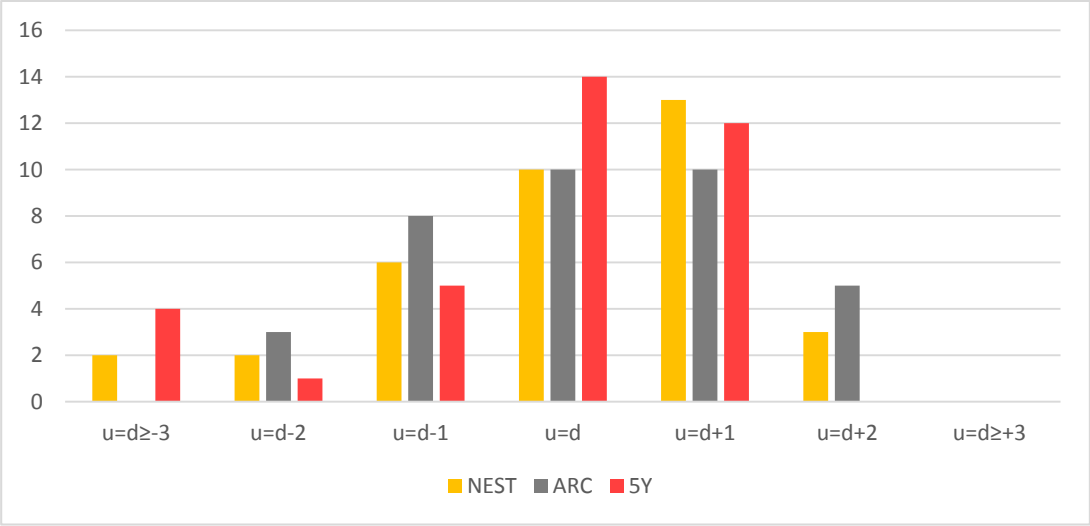

Figure 4.16 Banded Discontinuity Profile for all three chairs (valence sensitive histogram)

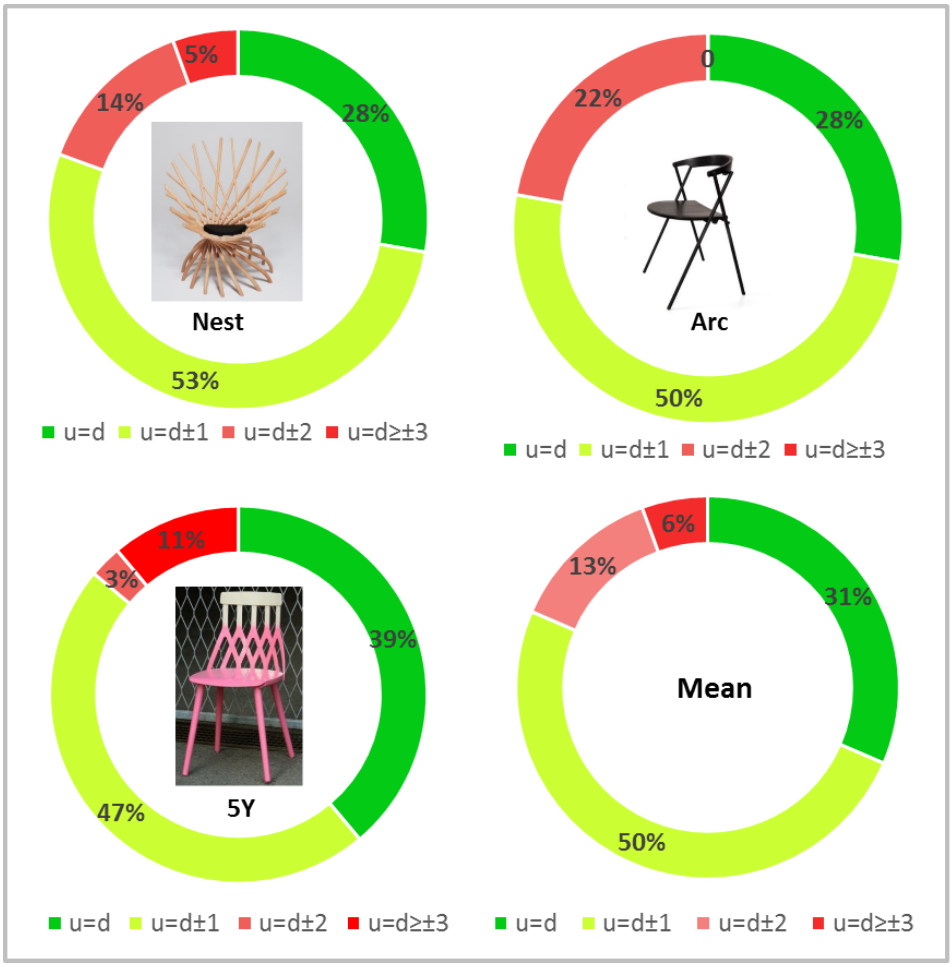

Figure 4.17 Visual representation of semantic intent discontinuities for all three chairs

Step 2: Micro-Analysis to Determine Origins of Discontinuity

A follow-up micro-analysis for the chairs was performed in the same way as for the lamps. Figures 4.18 and 4.19 illustrate precisely how users' impressions differ from designers' intended expressions. In agreement with the findings from the lamps, one of the most obvious features of Figure 4.18 is that designers mostly chose to grade their intended expressions using a high score. Logically, it again indicates that designers confirmed their choices of adjective using the 5-point Likert scale, and were very conscious about their intentions.

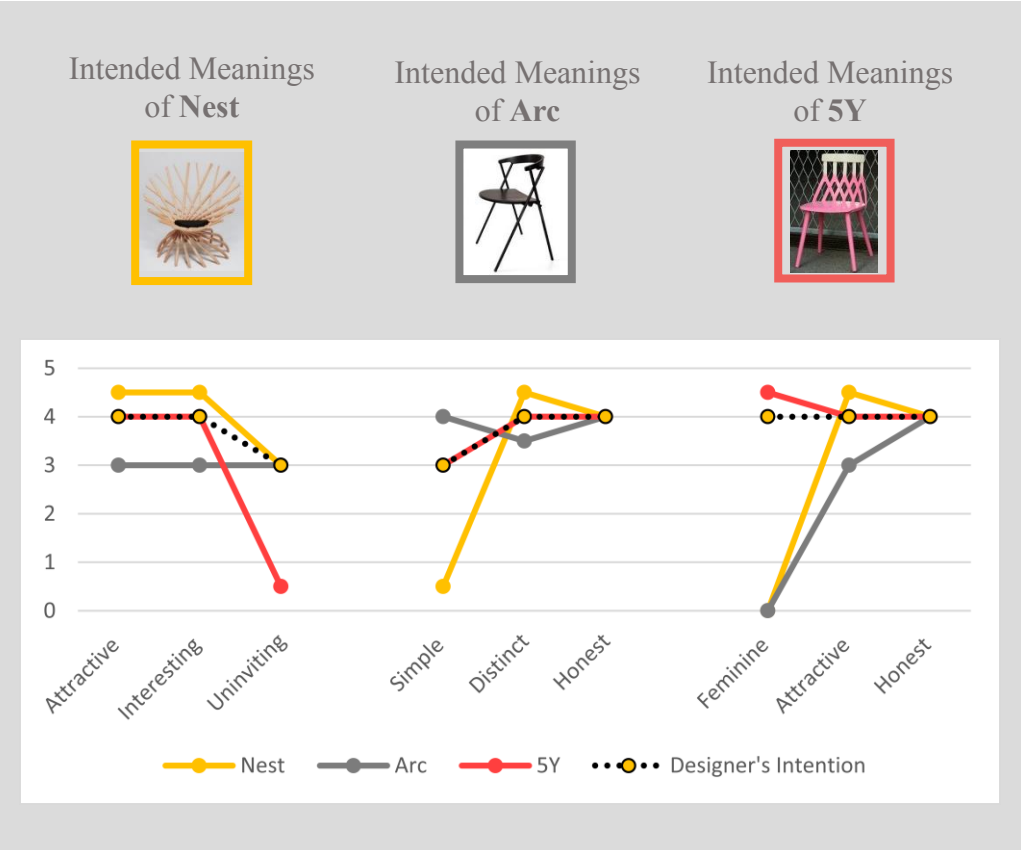

Figure 4.18 Users' evaluations of intended product expression (chairs)

As with its sister Figure 4.11, one of the important features of Figure 4.18 is that it presents the median results of users' evaluations of *all* intended expressions across the whole main study for chairs, including adjectives that are 'true' (intended for a particular product) and adjectives that are 'false' (intended for products other that the product being evaluated). Such cross-application of expressions was thought to help in understanding to what degree an intended expression of one product can be easily (or not) found in another product. The results are summarized in the bullet points below.

- Attractive. TRUE expression for NEST (v=4.5, highly perceived) and 5Y (v=4, highly perceived). FALSE expression for ARC (v=3, moderately perceived).
- Interesting. TRUE expression for NEST (v=4.5, highly perceived). FALSE

expression for ARC (v=3, moderately perceived) and 5Y (v=4, highly perceived).

- Uninviting. TRUE expression for NEST (v=3, moderately perceived). FALSE expression for ARC (v=3, moderately perceived) and 5Y (v=0.5, barely perceived).
- Simple. TRUE expression for ARC (v=4, highly perceived). FALSE expression for NEST (v=0.5, barely perceived) and 5Y (v=3, moderately perceived).
- Distinct. TRUE expression for ARC (v=3.5, moderately perceived). FALSE expression for NEST (v=4.5, highly perceived) and 5Y (v=4, highly perceived).
- Honest. TRUE expression for ARC (v=4, highly perceived) and 5Y (v=4, highly perceived). FALSE expression for NEST (v=4, highly perceived).
- Feminine. TRUE expression for 5Y (v=4.5, highly perceived). FALSE expression for NEST (v=0, not perceived) and ARC (v=0, not perceived).

The differences between TRUE and FALSE grades for each adjective are listed in rank order in Table 4.4. Expressions with large differences between mean TRUE and mean FALSE gradings (feminine, simple) might be termed the most 'distinctive' or 'easiest to distinguish', as end users generally detected these expressions only in the product where it was intended. As a mixed sample of grades, the difference in values of TRUE (n=9) and FALSE (n=12) grades was found to be statistically significant (unpaired t-test, p=0.02). In other words, in contrast to the lamps, users *were* able to discriminate, to a significant degree, those product expressions that were (unknowing to them) true rather than false. This might have been because the range of adjectives offered across all three chairs was semantically more distinct. The success of detecting ‘true’ and ‘false’ adjectives is clearly an issue that can be looked at in greater depth in subsequent research.

Table 4.4 Differences between TRUE and FALSE expression grades

Adjective	**Mean TRUE grade (A)**	**Mean FALSE grade (B)**	**Grade Difference (A-B)**
Feminine	4.5	(0+0)/2 = 0	4.50
Simple	4	(0.5+3)/2 = 1.75	2.25
Attractive	(4.5+4)/2 = 4.25	3	1.25
Uninviting	3	(3+0.5)/2 = 1.75	1.25
Interesting	4.5	(3+4)/2 = 3.50	1.00
Distinct	3.5	(4.5+4)/2 = 4.25	-0.75
Honest	(4+4)/2 = 4	4	0.00

Figure 4.19 provides a symbolic matrix of discontinuity bands, based on median discontinuity data for all TRUE adjectives. The outcome of this individual adjective analysis can be valuable for designers to reconsider in the communication dimension of product visual expression, by revealing where designers were more/less successful in conveying intended messages. The analysis reveals that designers were fully successful (u=d) in conveying the intended expressions of *uninviting (NEST), honest (ARC), attractive (5Y)*, and *honest (5Y).* No higher-level discontinuities (u>d±1) were evaluated from the data. The results also indicate the general semantic communication success of 5Y (compared with NEST and ARC), having received two exact matches.

Based on the results of the micro analysis for the three chairs, it can be said that the original designers were highly successful in communicating intended expressions to target users through the visual properties of their designed products. Moreover, the presence only of lower level discontinuities (u≤d±1) demonstrates accepted diversity in meaning attribution and does not constitute communication failure. Given the absence of higher-level discontinuities, further investigation into 'problematic adjectives' was not necessary for the sample of three chairs.

Figure 4.19 Matrix of discontinuity bands based on median discontinuity values for three chairs; colour indicates discontinuity band and symbol indicates relative change from the designer's intention

4.2 Analysis of Qualitative Data (Stages 2 & 4)

Figure 4.20 shows the relationship between users' and designers' appraisals of the six products studied in Stages 2 and 4 of the main study. Firstly, target users' overall impressions of each product are analysed and a Semantic Cluster Map is developed for each product, to visually represent connections between target users' impressions (Section 4.2.1). The Semantic Cluster Maps are compared with the original designer's intended expressions, to consider how 'close' their contents are regarding shared adjectives, phrases and meanings. Finally, in analyzing Stage 4 of the main study, the original designers' feedback on target users' impressions of each product – based on discussion around the Semantic Cluster Maps – is presented (Section 4.2.2).

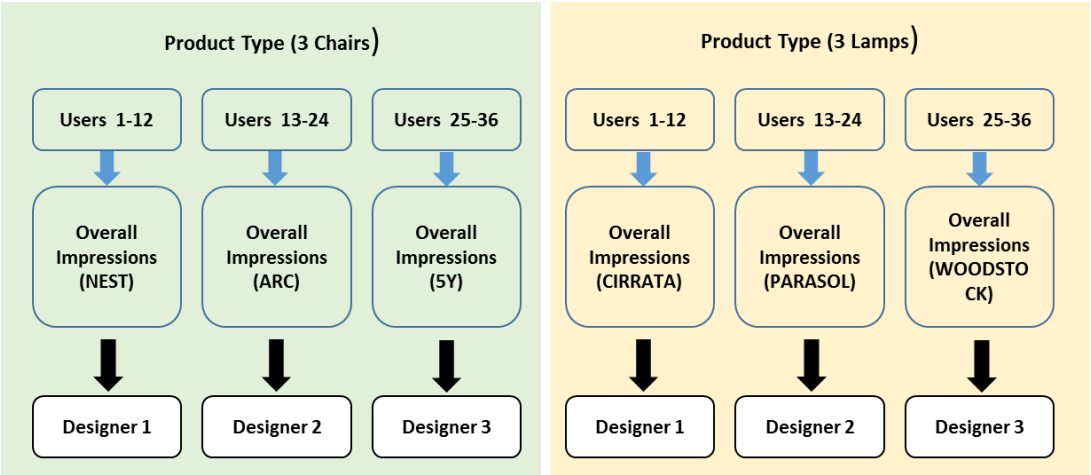

Figure 4.20 Distribution of user and designer appraisals of products for main study Stages 2 and 4

4.2.1 Stage 2 – Users' Realized Visual Impressions

Within this section, target users' realized visual impressions of materialized (manufactured) products are explained in detail on a product-by-product basis. Stage 2 resulted in qualitative data of users' impressions, comprising connotative levels of meaning, involving figurative expressions, personality characteristics, and social values attributed to a design. The data was inherently 'messy' in that it comprised a great variety of offered meanings, with an accordingly wide band of semantic relationship. A significant challenge, therefore, was to devise a method to deal with the complexity of the data and reach a concise, useful and presentable outcome. A new analysis method was developed specifically for the doctoral work, having been unable to locate a pre-existing method to reduce a pool of semantic impressions (of a design) into discrete and manageable clusters.

As a reminder of the data collection method, target user participants of each product (12 participants per product) were asked to describe their visual impressions through offering adjectives/phrases. Later, in order to understand more precisely in which sense/meaning they had used those adjectives, the participants were requested to clarify their impressions by offering synonyms for each adjective. Accordingly, these two types of adjectives were defined as 'first-order adjectives' (original adjectives/phrases) and 'second-order adjectives' (supportive synonyms). Second-

order adjectives were therefore used by the participants to support and interpret their first-order adjectives.

One of the main principles in devising the new semantically sensitive analysis method was considered to be carefully maintaining the relationship between first-order and second-order adjectives. The analysis method is explained in detail in the next section, through the results of the NEST chair. The sections for the remaining five products focus only on the results of the method.

4.2.1.1 Impressions of NEST Chair

The starting point for analysis was transcription of the audio recorded data of users' initial impressions. The participants directly and clearly mentioned first-order adjectives during the product appraisal sessions. However, second-order adjectives were more 'hidden' within discussions, elaboration and further statements, and so had to be more carefully 'extracted'. Some participants were more direct overall in their responses than others. For example, one user stated that "the chair doesn't look comfortable". On further inspection, he described how he found the product 'un-relaxed' (first-order), in that the product signified something that was 'agitated' (second-order). In other cases, users directly stated firm adjectives during their appraisals, which made identification of the first-order adjective more straightforward. For example, when a user was asked in which sense he interpreted a product as 'aggressive' (first-order), he explained that he found the product to be 'provocative' and 'chaotic' (second-order). In all cases, the unit of analysis for Stage 2 was textual data in the form of adjectives or short phrases.

Table 4.5 collates all instances of adjective use by users evaluating the NEST chair. Multiple instances refer to *multiple users* mentioning that adjective; if a single user mentioned an adjective more than once, it was counted and included in Table 4.5 only once.

Table 4.5 Adjectives attributed to the NEST chair (n=12 participants): first-order adjectives are highlighted

Accurate	**Charming**	**Eccentric**	Inviting	**Showy**
Aggressive	Charming	Effective	Inviting	**Showy**
Aggressive	**Complex**	**Energetic**	**Lively**	Showy
Aggressive	**Complicated**	Energetic	**Masculine**	Showy
Agitated	**Cool**	Energetic	**Modern**	Strange
Alive	**Cool**	Energetic	**Modern**	Striking
Aloud	**Cool**	Experimental	**Modern**	Strong
Arty	**Cool**	Exuberant	**Nice**	Summertime
Attractive	Crowded	**Fragile**	Nice	Talkative
Attractive	Dancing	**Friendly**	Novel	Tough
Attractive	Dangerous	Friendly	Novel	Unclear
Attractive	**Determinant**	Frisky	Novel	Uneasy
Attractive	Different	**Funny**	Occasional	**Unique**
Attractive	Different	Futuristic	Odd	**Unrelaxed**
Attractive	Different	**Gimmick**	Open	**Unreliable**
Attractive	Disrespectful	**Happy**	**Playful**	Unusual
Beautiful	Diva	Happy	Powerful	Unusual
Beautiful	**Dominant**	**Impressive**	**Precise**	Well-crafted
Beautiful	Dominant	Impressive	**Precise**	Well-crafted
Bulky	Dominant	**Innovative**	**Pretty**	Well-structured
Carefree	Dominant	**Interesting**	Proud	**Wild**
Careless	Dynamic	Interesting	Provocative	
Careless	Easygoing	Interesting	Pushy	
Casual	Easygoing	**Inviting**	**Relaxed**	
Chaotic	Easygoing	**Inviting**	**Selfish**	

During the exploration and development of the analysis method, first-order adjectives were visualized as a word cloud (using the www.wordle.net service), so as to quickly identify those adjectives with highest frequency of mention (Figure 4.21). In the word cloud, larger fonts are used to represent higher frequencies of mention. For the product NEST, the first-order adjectives '*cool*', *'attractive'* and '*modern*' can be seen to have the highest frequency of mention. To investigate the effect of second-order adjectives on users' collective impressions, an alternative word cloud was generated (Figure 4.22), which combines both first- and second-order adjectives. What becomes clear is an increased emphasis on '*attractive*' as the main descriptor of impression, but also the introduction of the new distinctive high frequency adjectives: '*showy*', '*dominant*', '*inviting*', and '*energetic*'.

Although word clouds offer a good at-a-glance visualization of mentioned adjectives, and are easy to create, there remains a doubt as to whether they lead to a good

summary characterization of users' actual impressions. The connections between first-order and second-order adjectives are disregarded when using word clouds. Furthermore, since individually each user may (and did) use common adjectives to describe their product impressions but in different ways (i.e. in different senses of the words), the semantic evaluation footprint tied to each participant is also lost. Accordingly, it was decided necessary to develop a more sophisticated analysis and visualization technique that retained the relationship between first-order and second-order adjectives.

Figure 4.21 Word cloud of users' impressions based on first-order adjectives only (for NEST)

Figure 4.22 Word cloud of users' impressions based on combined first-order and second-order adjectives (for NEST))

After some trialing of adjective clustering and visualization techniques, a stepped procedure for creating a 'Semantic Cluster Map' (Figure 4.23), retaining links between first- and second-order adjectives, was developed and documented. The following explanation for creating a draft Map by hand – which would then be prepared tidily as computer graphics – should be read in conjunction with Figure 4.23.

- Step 1. First-order adjectives from Table 4.5 were ranked based on highest frequency of mention. Each first-order adjective was written in an area of space on an A2 blank sheet of paper. Circles (or concentric circles) were marked around the adjectives, where the number of circles represented the frequency of mention amongst users. Thus, five concentric circles would show that a first-order adjective was mentioned by five users.
- Step 2. Second-order adjectives were written close to their associated first-order adjective (or adjectives). Connection lines were then drawn between first-order and second-order adjectives. An arrow tip was added to the connection line to show the direction of the relationship. Considering all first-order and second-order adjectives, a network of relationships was created that visualized the diverse but interrelated semantic appraisals of each product. For example, product NEST was considered by one user as '*energetic*' (i.e. first-order adjective shown with one circle), for the reasons that he found the product '*exuberant*' and '*dynamic*' (second-order adjectives, no circles used, arrows pointing out of '*energetic*'). Moreover, '*energetic*' was mentioned three times as an explanation (i.e. an example of a first-order adjective also performing as a second-order adjective) for the other first-order adjectives '*aloud*', '*lively*', and '*wild*' (arrows pointing into '*energetic'*).
- Step 3. Semantic clusters were identified amongst the network, which would be used to reach conclusions on users' collective initial product impressions. The clusters are shown in Figure 4.23 as coloured regions. It was necessary to devise a set of rules to decide on the origins of separate clusters and the boundary of adjectives that could be reasonably considered as members of a cluster. Firstly and most importantly, there was a requirement for a joining line (connection) to be present amongst all adjectives of a cluster; in other words, isolated adjectives without a direct connection could not be considered part of

a cluster. Secondly, the centre (or starting) point for defining clusters should be the highest frequency first-order adjectives. Thirdly, the semantic relationship implied by connections through the network should be scrutinized: adjacent adjectives should be *semantically related* and not *semantically distant* from the centre point (originating first-order adjective) of the cluster. For example, the first-order adjective '*attractive*' was considered as a strong cluster origin, having a middling frequency of mention (3) from Table 4.5. Referring to the original user impressions lists, NEST was found '*attractive*' (first-order adjective) in the sense of being *beautiful, nice, inviting,* and *interesting* (second-order adjectives). These adjectives were therefore included in the cluster by default. The adjective *pretty* was included in the cluster as semantically it is very close to the adjective *beautiful*, through which a direct connection is made to the origin adjective *attractive*. However, the adjective *playful* (having a potential indirect connection via the second-order adjective *inviting*) was excluded from this particular cluster, since it had no strong semantic connection with the adjectives that had been assembled. This acceptance/rejection rationale for cluster creation continued until the cluster boundary was discovered, at which point construction of the next cluster started and followed through the same developmental procedure. For the example mentioned, the final cluster membership encompassed the first- and second-order adjectives *attractive, beautiful, pretty, nice, inviting,* and *interesting.* The drawing of a bubble around these adjectives marked the end of the clustering process. Importantly, the identification of clusters was carried out not as a solo effort but as a joint/team effort between the doctoral candidate and research supervisor, so as to engage in the discussions and consensus necessary to define boundaries of semantic relations and to avoid single researcher biases.

Accordingly for the NEST chair, six clusters were created, which when taken together characterize users' collective impression of the visual properties of the product. This represents the critical result from the Semantic Cluster Map – which achieves a rationalization of a diverse pool of semantic appraisals into a discrete and concise summary. The user impression list for the NEST chair (below) is organized in rank

order, starting with clusters containing the most frequently mentioned first-order adjectives. The cluster headings (written in bold) are the most frequently mentioned first-order adjectives within the cluster.

1. **Cool (4)**, Modern, Impressive, Charming, Relaxed, Friendly, Unique, Innovative
2. **Attractive (3)**, Inviting, Nice, Beautiful, Pretty, Interesting
3. **Careless (2)**, Dominant, Selfish, Disrespectful, Dangerous, Powerful
4. **Aggressive (2)**, Wild, Energetic, Aloud, Lively, Provocative, Chaotic
5. **Showy (2)**, Gimmick, Eccentric, Striking, Dancing, Diva
6. **Precise (2)**, Accurate, Well-Crafted, Well-Structured

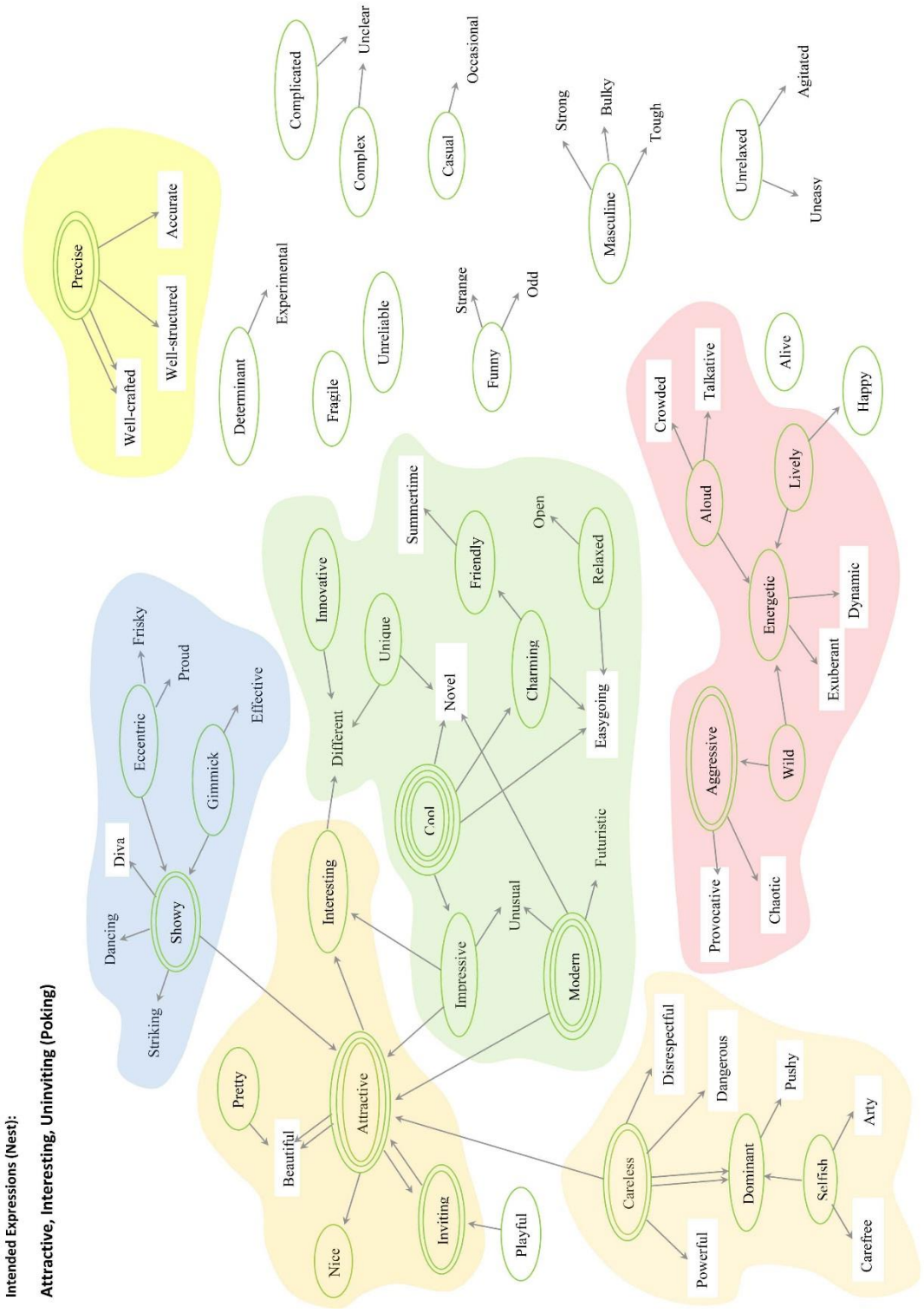

Figure 4.23 Semantic Cluster Map of users' initial impressions (NEST chair)

To dig deeper into the origins of users' impressions, it was necessary to identify which product features/qualities prompted those impressions. The original appraisal transcripts were analyzed for mention of specific visual product or component features/qualities tied to the first-order adjectives of the clusters (see Table 4.6). For the NEST chair, it seems that overall the different and striking construction of the chair created through connected wooden sticks had an effective influence on users' overall impressions. The inviting yet uninviting characteristics and behavior of the connected sticks resulted in a 'two-faced' (contradictory) product expression. This questionable characteristic of NEST may have strongly influenced users' interpretations – for example, users (collectively, as a group) considered the product to be both attractive/cool and aggressive/showy at the same time.

Table 4.6 Product or component features/qualities that influenced users' overall impression of the NEST chair

Impression	**Visual Features/Qualities/Associations**
Cool	Natural organic pattern of its construction, simple and harmonic elements of general shape, good sense of material using, wooden construction, sympathetic material, general oval shape of construction
Attractive	Same pattern, simple elements, organic shape, high-aesthetic construction, open and welcoming shape
Careless	The sticks are thrown around without caring the surroundings, open-shape sticks taking a lot of space
Aggressive	Position and direction of sticks, the perceived behavior of sticks
Showy	Bold sticks, powerful shape and construction, circulation and movements in the shape
Precise	The way the sticks connected, ordered consistent pattern in the overall shape

Referring to the original designer's intended expressions, the results of users' collective impressions can be qualitatively compared. The results reveal that there is *much* semantic overlap between what designers independently intended and how users were independently impressed. The original intent of *attractive* and *interesting* were

both directly and associatively mentioned by users. An expression of *cool* was also intended by the designer, although as a qualification for the expression of *attractive.* For the designer these expressions *attractive (cool)* and *interesting* were intended to be highly descriptive for the chair. Users' collective impressions reveal that the designer was highly successful in communicating these expressions. The intended expression *uninviting*, in the sense that the product pokes whoever comes into visual contact with it, was also to some extent perceived by users. The adjectives *aggressive, showy* and *careless* (mentioned by users) have a close semantic association with the intended expression *uninviting.* Therefore, it can be said that overall the designer's intended product expressions were highly perceived by target users.

4.2.1.2 Impressions of CIRRATA Lamp

Table 4.7 collates all instances of adjective use by users evaluating the CIRRATA lamp. Figure 4.24 shows the Semantic Cluster Map.

Table 4.7 Adjectives attributed to the CIRRATA lamp (n=12 participants): first-order adjectives are highlighted

Abnormal	**Cold**	**Feminine**	**Modern**	Shocking
Adaptive	Commanding	**Feminine**	**Modern**	Showy
Adaptive	Contemporary	**Flexible**	**Modern**	Silent
Adjustable	Controversial	Flexible	**Natural**	Silly
Alien	**Cool**	Flying	Nice	**Spiritual**
Arty	**Cool**	**Frivolous**	Novel	**Spiritual**
Attractive	**Corny**	**Funny**	Novel	**Strict**
Attractive	**Creepy**	**Funny**	Novel	Striking
Attractive	**Cute**	Funny	**Odd**	Superficial
Beautiful	Cute	**Futuristic**	**Playful**	Toy-like
Busy	Delicate	**Happy**	Pleasant	Transformative
Calm	Different	Happy	Pleasant	Transparent
Calm	Different	Happy	**Provocative**	Unaggressive
Calm	**Eccentric**	**Honest**	**Provocative**	Uncommon
Captivating	Eccentric	**Impressive**	Provocative	Uncozy
Casual	**Elegant**	**Informal**	Questionable	Understandable
Casual	**Elegant**	**Interesting**	**Relaxed**	**Unique**
Challenging	**Energetic**	**Interesting**	**Relaxed**	Unique
Cheap	Energetic	Interesting	Relaxed	Unusual
Childish	Exciting	**Lively**	Romantic	Well-defined
Childish	Exhibitable	Lively	**Sensitive**	Well-designed
Childlike	**Feminine**	Lively	Serene	**Wild**
Clear	**Feminine**	Lively	Sexy	Young

Figure 4.24 Semantic Cluster Map of users' initial impressions (CIRRATA lamp)

Nine clusters were established for the CIRRATA lamp, which when taken together characterize users' collective impression of the visual properties of the product. The user impression list for the CIRRATA lamp (below) is organized in rank order, starting with clusters containing the most frequently mentioned first-order adjectives. The cluster headings (written in bold) are the most frequently mentioned first-order adjectives within the cluster.

1. **Feminine (4)**, Cute, Sexy, Romantic, Beautiful, Nice, Arty
2. **Modern (3)**, Contemporary
3. **Cool (2)**, Funny, Happy, Exciting, Pleasant, Childlike
4. **Interesting (2)**, Attractive, Odd, Unique, Impressive, Eccentric
5. **Provocative (2)**, Energetic, Wild, Creepy, Lively
6. **Relaxed (2)**, Calm, Silent, Serene, Unaggressive
7. **Elegant (2)**, Well-Designed
8. **Spiritual (2)**, Flying
9. **Sensitive (1)**, Adaptive, Flexible, Delicate, Adjustable, Transformative

To dig deeper into the origins of users' impressions, it was necessary to identify which product features/qualities prompted those impressions. The original appraisal transcripts were analyzed for mention of specific visual features/qualities tied to the first-order adjectives of the clusters (see Table 4.8). For the CIRRATA lamp, having analyzed the original appraisal transcripts, it is evident that the product's overall organic form, resembling an octopus/jellyfish, the movement in the shape and legs, the material quality, and the hidden light, each had an effective influence on users' overall impressions. The perceived qualities of the lamp's lower part, especially the twisted legs, contributed to different interpretations. For example, users (collectively, as a group) considered the lamp to be both provocative and spiritual at the same time. The perceived smooth movements in the shape had a strong influence on users' impressions, considering the lamp as feminine, cool, relaxed, elegant, spiritual, and sensitive. A different approach to the definition of form, a hidden light, and the material qualities were found important to read the lamp as modern, interesting and elegant.

Table 4.8 Product or component features/qualities that influenced users' overall impression of the CIRRATA lamp

Impression	**Visual Features/Qualities/Associations**
Feminine	Curvy smooth lines, rounded shape, tiny longlegs, clean white color, resembling a ballet dancer/ a woman's body, the way the legs touch the ground
Modern	White color, innovative shape, reflective hidden light, plastic material
Cool	Twisted shape, resembling Octopus/ Jellyfish/Alien, movement of the legs/it is like flying
Interesting	Different/novel form and function, soft shape, sharp cuts in the form
Provocative	Peculiar shape, twisted and unstable legs
Relaxed	Calm/soft hidden light, color of the material used, dome-like shape,
Elegant	Balanced proportion, thoughtful definition of form, the movement
Spiritual	Color of light/object, hidden light, the movement in the shape
Sensitive	The feeling perceived from form, transformable shape

Comparing these results to the original designer's intended expressions reveals *slight* semantic overlap between what designers independently intended and how users were independently impressed. None of the original designer's intended visual product expressions was directly mentioned by target users. However, from the users' impressions it can be identified that the intended product expressions *dancing, charming*, and *precise* were associatively mentioned by users (i.e. through the use of different words). For example, there exists a close association between *precise* (intended) and *elegant* (perceived), since both were used in the sense of how the lamp had been thoroughly defined. The intended *charming* expression also clearly occurred in the semantic cluster entitled *cool*. Although the intended *dancing* expression was not directly perceived by users, its associated product features (twisted leg shape, sense of movement) were nevertheless mentioned by users as influencing features in the attribution of *feminine* and *spiritual* impressions. Therefore, it can be said that the designer's intended product expressions were somewhat semantically perceived by users, but the originating product features were certainly noticed and influential on attribution of meanings.

4.2.1.3 Impressions of ARC Chair

Table 4.9 collates all instances of adjective use by users evaluating the ARC chair. Figure 4.25 shows the Semantic Cluster Map.

Table 4.9 Adjectives attributed to the ARC chair (n=12 participants): first-order adjectives are highlighted

Attractive	Easygoing	Mature	**Reliable**	Straightforward
Balanced	**Elegant**	Minimal	Reliable	**Strict**
Boring	**Elegant**	Minimal	Robust	**Strict**
Casual	**Elegant**	**Modest**	**Sensitive**	Strict
Clean	**Energetic**	**Modest**	Sensitive	Sufficient
Clear	Energetic	**Modest**	**Serious**	Unchaotic
Cold	**Flexible**	**Modest**	**Serious**	Uncomfortable
Common	Flexible	Modest	**Serious**	Unexciting
Common	Flexible	Modest	Serious	Unexuberant
Complex	**Honest**	Ordered	Serious	Uninteresting
Delicate	**Honest**	**Organized**	Serious	Uninviting
Designerly	Indistinct	**Popular**	**Showy**	**Unisex**
Designerly	**Informal**	Practical	**Shy**	Unplayful
Discreet	**Introverted**	**Precise**	Simple	Usual
Distant	Introverted	Precise	Simple	**Young**
Distinct	Inviting	Pretentious	Simple	Unshowy
Dualistic	Laid-back	Quiet	**Smart**	
Dualistic	**Masculine**	Readable	**Sportive**	
Dynamic	**Masculine**	Readable	**Stable**	

Figure 4.25 Semantic Cluster Map of users' initial impressions (ARC chair)

Five clusters were established for the ARC chair, which when taken together characterize users' collective impression of the visual properties of the product. The user impression list for the ARC chair (below) is organized in rank order, starting with clusters containing the most frequently mentioned first-order adjectives. The cluster headings (written in bold) are the most frequently mentioned first-order adjectives within the cluster.

1. **Modest (4)**, Discreet, Shy, Introverted, Unshowy, Quiet, Simple, Laid-Back
2. **Serious (3)**, Strict, Cold, Mature, Unplayful, Uncomfortable, Straightforward, Distant
3. **Elegant (3)**, Smart, Clean, Simple, Minimal, Sufficient
4. **Honest (2)**, Readable, Clear
5. **Masculine (2)**

To dig deeper into the origins of users' impressions, it was necessary to identify which product features/qualities prompted those impressions (see Table 4.10). For the ARC chair, having analyzed the original appraisal transcripts, it is evident that the product's overall common shape, simple black color, graphical X-shaped legs, and perceived usability each had an effective influence on users' overall impressions. Attention to perceived usability of the product was understandable, since users were able to perceive the product's function, lightness, and material qualities. This helped users to find the product honest. A minimal way of using material, and its plain form together with simple black color, contributed to different interpretations as modest, serious, elegant and masculine.

Table 4.10 Product or component features/qualities that influenced users' overall impression of the ARC chair

Impression	**Visual Features/Qualities/Associations**
Modest	Simple geometrical shape, simple color, without ornament
Serious	Black color, practical elements, graphical direct legs/surfaces
Elegant	Minimal, color, crossing thin legs, being light, material quality
Honest	Function (perceived as being a foldable chair), material choices
Masculine	Black color, robust, hard surface, thick backrest and seat

Comparing these results to the original designer's intended expressions reveals *considerable* semantic overlap between what designers independently intended and how users were independently impressed. Among the three intended visual product expressions, *simple* and *honest* were directly mentioned by target users. The intended character *simple* occurred in the semantic cluster of *modest*. The intended expression *honest* is the heading of one of the clusters. However, from the users' interpretations, it can be inferred that the intended product expression *distinct* was also semantically mentioned by users but using different words. For example, there might be a close association between *distinct* (intended) and *elegant* (perceived), since both were used in the sense of how the chair had been thoroughly defined. Therefore, it can be said that the designer's intended product expressions were indeed semantically perceived by the users.

4.2.1.4 Impressions of PARASOL Lamp

Table 4.11 collates all instances of adjective use by users evaluating the PARASOL lamp. Figure 4.26 shows the Semantic Cluster Map.

Table 4.11 Adjectives attributed to the PARASOL lamp (n=12 participants): first-order adjectives are highlighted

Accurate	**Distinct**	**Industrial**	Novel	Simple
Arty	**Dominant**	Ingenious	**Odd**	Smart
Calm	**Easygoing**	**Intelligent**	**Odd**	Sober
Calm	**Eccentric**	**Interesting**	**Peaceful**	Sophisticated
Charming	**Elegant**	Interesting	Peaceful	Straight
Classy	Exact	**Masculine**	**Playful**	Straightforward
Clear	Extraordinary	**Mature**	**Precise**	Straightforward
Cold	Fashionable	**Mature**	**Precise**	Strange
Comfortable	**Feminine**	Minimal	Proud	Strange
Considered	**Friendly**	Minimalist	**Provocative**	**Strict**
Conspicuous	**Friendly**	**Modern**	Relaxed	**Stylish**
Cool	Friendly	**Modern**	Rigid	**Subtle**
Curious	Friendly	**Modest**	**Self-confident**	**Unattractive**
Cute	**Funny**	Noticeable	Showy	Unisex
Cute	Funny	Noticeable	**Simple**	Weird
Different	**Gender-complexity**	Novel	**Simple**	**Well-groomed**
Direct	Happy	Novel	Simple	
Distant	**Honest**	Novel	Simple	

Figure 4.26 Semantic Cluster Map of users' initial impressions (PARASOL lamp)

Six clusters were established for the PARASOL lamp, which when taken together characterize users' collective impression of the visual properties of the product. The user impression list for the PARASOL lamp (below) is organized in rank order, starting with clusters containing the most frequently mentioned first-order adjectives. The cluster headings (written in bold) are the most frequently mentioned first-order adjectives within the cluster.

1. **Modern (2)**, Simple, Minimal, Novel
2. **Friendly (2)**, Calm, Peaceful, Easygoing, Relaxed, Cool, Comfortable
3. **Odd (2)**, Eccentric, Conspicuous, Provocative, Noticeable, Strange, Weird, Arty, Novel, Different, Showy, Extraordinary
4. **Precise (2)**, Considered
5. **Mature (2)**, Sober
6. **Playful (1)**, Cute, Funny, Happy, Charming

To dig deeper into the origins of users' impressions, it was necessary to identify which product features/qualities prompted those impressions (see Table 4.12). For the PARASOL lamp, having analyzed the original appraisal transcripts, it is evident that the product's basic geometrical shapes, construction from metal, white color, reflective light, and the characteristics of the screen on the top of the product, each had an effective influence on users' overall impressions. The minimalistic approaches to design that were adopted resulted in different qualities, communicating such expressions as modern and precise. Users found the lamp to be friendly because of its color and the reflective light. The different characteristics of the lamp's screen that controls the direction of light has a strong influence on reading the product as odd and playful. The lamp was perceived as mature because of the simple balanced shape and white color.

Table 4.12 Product or component features/qualities that influenced users' overall impression of the PARASOL lamp

Impression	**Visual Features/Qualities/Associations**
Modern	Minimalistic, simple clean shape, white color, material selection
Friendly	The color of both object and light, movement of the screen on the top, circular shape of the reflective light on the table,
Odd	Different definition of lamp, reflective light, shadow
Precise	Shapes are thoughtfully defined, Material selection, passive light
Mature	Basic shapes, balanced proportion, color
Playful	Head of the lamp: drum inspiration,

Comparing these results to the original designer's intended expressions reveals a *low level* of semantic overlap between what designers independently intended and how users were independently impressed. Among the three intended visual product expressions only *calm* was directly mentioned by target users, being related to the semantic cluster of *friendly.* The intended expressions *honest* and *sensitive* were not directly perceived by target users. In contrast to the intended expression *sensitive,* users interpreted the product as *mature*. It seems that users and the designer had different opinions about the 'sensitivity' of the product. There is no association between the intended expression *honest* and the six semantic clusters. However, this does not imply that the product is dishonest. Therefore, it can be said that the designer's intended product expressions did not match well with users' actual impressions.

4.2.1.5 Impressions of 5Y Chair

Table 4.13 collates all instances of adjective use by users evaluating the 5Y chair. Figure 4.27 shows the Semantic Cluster Map.

Table 4.13 Adjectives attributed to the 5Y chair (n=12 participants): first-order adjectives are highlighted

Abstract	Complicated	**Feminine**	**Open**	Surprising
Active	Complicated	**Feminine**	**Open-minded**	Sweet
Aggressive	Complicated	Friendly	**Original**	Symbolic
Approachable	Contemporary	Friendly	Outgoing	Trendy
Arty	Cool	**Funny**	**Playful**	Unclear
Arty	Cozy	Funny	**Playful**	Uncommon
Attentive	Cute	Funny	**Playful**	Unconventional
Attractive	Distinct	Funny	Playful	Unconventional
Attractive	Eccentric	**Happy**	Questionable	**Unique**
Attractive	Edgy	**Happy**	Questionable	Unique
Attractive	Elaborate	Happy	**Romantic**	Unique
Attractive	**Elegant**	**Immature**	**Sexy**	Unique
Blended	Elegant	**In fashion**	Sexy	**Unpredictable**
Chaotic	**Energetic**	**Interesting**	Sexy	Unusual
Charming	Enthusiastic	Inviting	Shady	**Welcoming**
Cheerful	Enthusiastic	Inviting	**Showy**	**Young**
Cheerful	**Excited**	**Lively**	Showy	Young
Childish	Excited	Lively	Special	Young
Colorful	Exuberant	Lively	Striking	Young
Colorful	**Feminine**	**Modern**	Striking	Confusing
Colorful	**Feminine**	**Natural**	**Strange**	

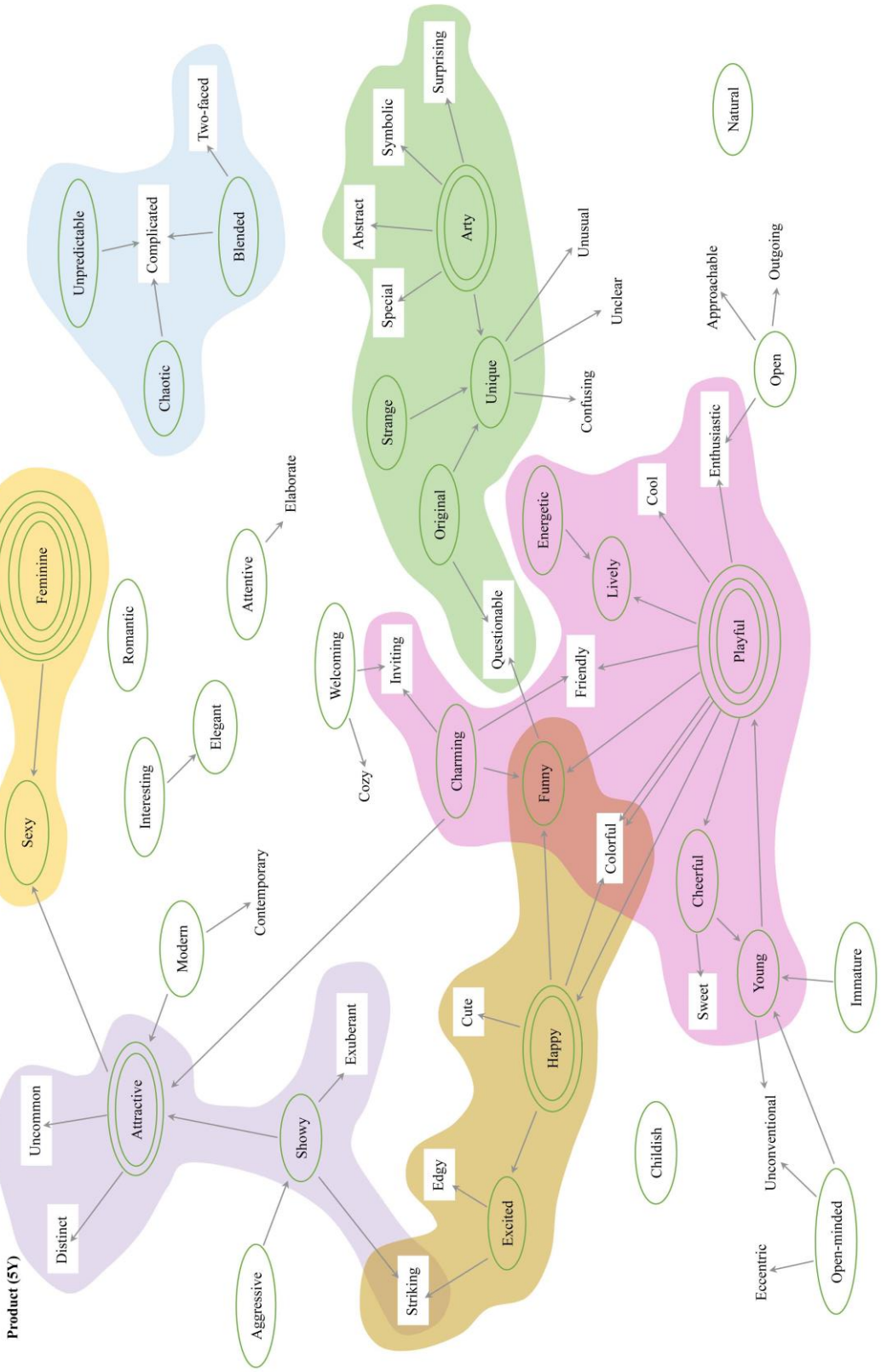

Figure 4.27 Semantic Cluster Map of users' initial impressions (5Y chair)

Six clusters were established for the 5Y chair, which when taken together characterize users' collective impression of the visual properties of the product. The user impression list for the 5Y chair (below) is organized in rank order, starting with clusters containing the most frequently mentioned first-order adjectives. The cluster headings (written in bold) are the most frequently mentioned first-order adjectives within the cluster.

1. **Feminine (4)**, Sexy
2. **Playful (3)**, Cheerful, Young, Sweet, Colorful, Funny, Charming, Inviting, Friendly, Lively, Energetic, Cool, Enthusiastic
3. **Happy (2)**, Excited, Striking, Edgy, Cute, Funny, Colorful
4. **Arty (2)**, Abstract, Symbolic, Surprising, Special, Unique, Original, Questionable
5. **Attractive (2)**, Uncommon, Distinct, Showy, Striking, Exuberant
6. ***Complicated***, Unpredictable, Chaotic, Blended, Two-faced

To dig deeper into the origins of users' impressions, it was necessary to identify which product features/qualities prompted those impressions (see Table 4.14). For the 5Y chair, having analyzed the original appraisal transcripts, it is evident that the product's pink color, the pattern on the backrest, and the differences between form languages of the backrest and lower parts, each had an effective influence on users' overall impressions. The upper half of the wooden backrest is not colored in pink. This characteristic of the chair invited users to look for the intention behind that. Thus, it was considered to be the main reason to perceive the product as playful, arty and complicated. Users found the chair to be feminine, attractive and happy – mainly because of the pink color of the product.

Table 4.14 Product or component features/qualities that influenced users' overall impression of the 5Y chair

Impression	**Visual Features/Qualities/Associations**
Feminine	Pink color, pattern of the backrest, proportion (resembling a woman's body),
Playful	Unfinished Color, woven pattern, combination of different shapes: backrest and seat
Happy	Effective shiny color
Arty	Wooden body colored in Pink, unfinished color, specific pattern
Attractive	Color, overall shape
Complicated	Unfinished color

Comparing these results to the original designer's intended expressions reveals a *considerable level* of semantic overlap between what designers independently intended and how users were independently impressed. Among the three intended visual product expressions, *feminine* and *attractive* were directly mentioned by target users. The intended expression *honest* was not directly perceived by target users. In contrast to the designer's intentions, users read the chair as complicated. The designer argued that the product's honesty is related to its perceived usability and construction. On the other hand, users found it complicated because for them the reason behind the unfinished color was neither clear nor understandable. Therefore, it can be said that although much design intent could be communicated successfully, the designer could not communicate a sense of 'honesty'.

4.2.1.6 Impressions of WOODSTOCK Lamp

Table 4.15 collates all instances of adjective use by users evaluating the WOODSTOCK lamp. Figure 4.28 shows the Semantic Cluster Map.

Table 4.15 Adjectives attributed to the WOODSTOCK chair (n=12 participants): first-order adjectives are highlighted

Annoying	Cozy	Inviting	**Relaxed**	Stable
Arty	Cozy	**Lazy**	**Relaxed**	**Strange**
Arty	Curious	**Masculine**	Relaxed	Strange
Bold	**Cute**	**Modest**	**Reliable**	Strange
Calm	Designerly	**Modest**	Retro	**Strict**
Calm	Different	Modest	**Sensible**	Stylish
Calm	**Eccentric**	**Mysterious**	**Sensitive**	Subtle
Calm	**Fresh**	Natural	Serene	Sufficient
Calm	**Friendly**	Natural	Serious	**Sweet**
Calm	**Friendly**	Novel	Sharp	Toy-like
Calm	**Friendly**	Obese	**Simple**	Unaggressive
Caring	**Funny**	**Odd**	**Simple**	Unattractive
Casual	**Funny**	**Old-fashioned**	**Simple**	Uncommon
Childlike	Funny	**Old-fashioned**	Simple	Unexaggerated
Childlike	**Gentle**	**Original**	Simple	Unexpected
Classic	Heavy	Original	Simple	**Unique**
Clear	Honest	Passive	Simple	Unique
Closed	Immature	Peculiar	Soft	Unobtrusive
Cold	Inflexible	Playful	Soft	Unprovocative
Complicated	Interesting	Playful	Stable	Unshowy
Confident	**Interesting**	**Relaxed**	Stable	Warm
Cool	Interesting	**Relaxed**	Stable	**Young**

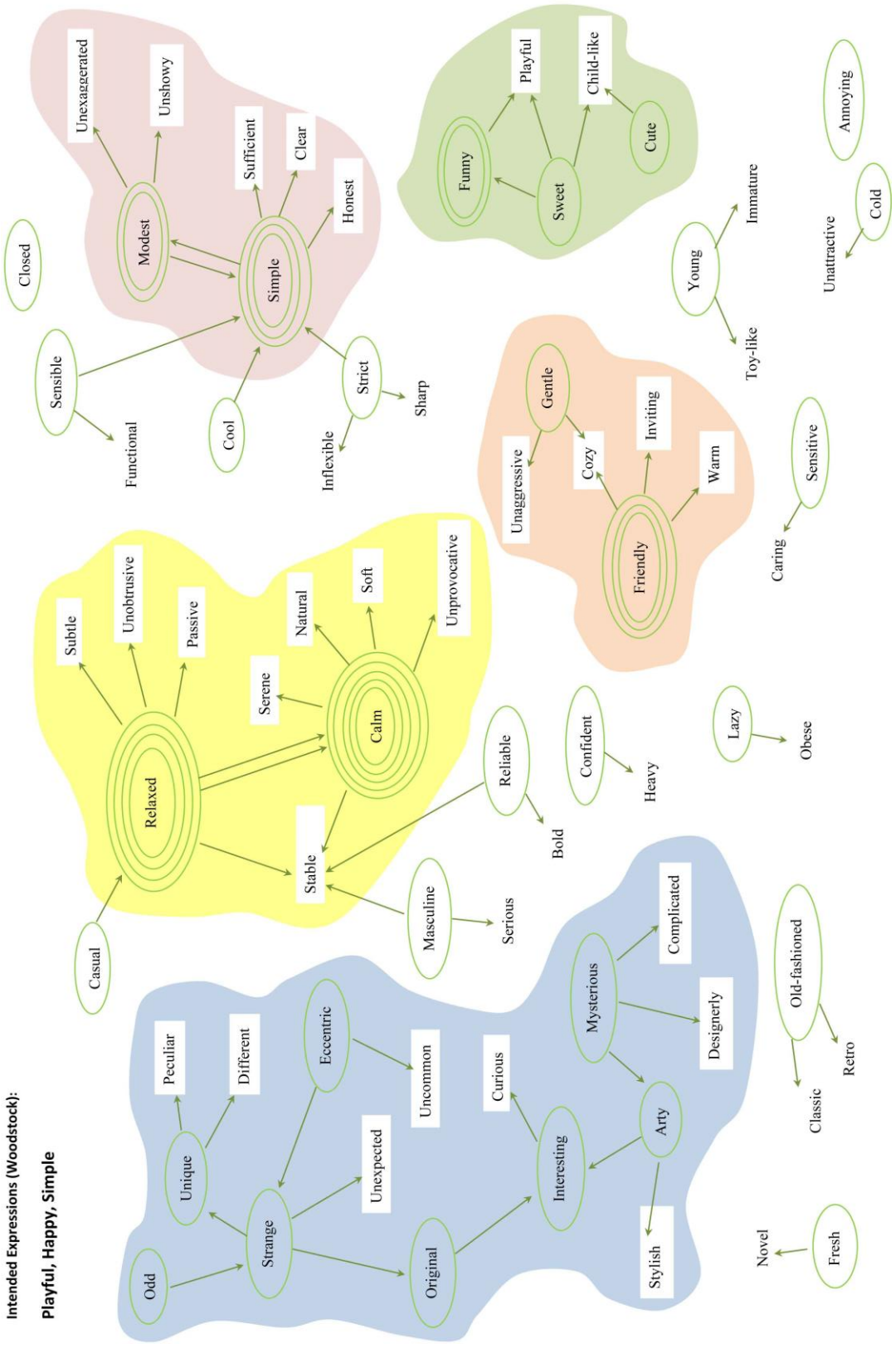

Figure 4.28 Semantic Cluster Map of users' initial impressions (WOODSTOCK lamp)

Five clusters were established for the WOODSTOCK lamp, which when taken together characterize users' collective impression of the visual properties of the product. The user impression list for the WOODSTOCK lamp (below) is organized in rank order, starting with clusters containing the most frequently mentioned first-order adjectives. The cluster headings (written in bold) are the most frequently mentioned first-order adjectives within the cluster.

1. **Calm (5)**, Relaxed, Serene, Natural, Soft, Unprovocative, Stable, Subtle, Unobtrusive, Passive
2. **Simple (3)**, Modest, Sufficient, Clear, Honest, Unexaggerated, Unshowy
3. **Friendly (3)**, Gentle, Cozy, Inviting, Warm, Unaggressive
4. **Funny (2)**, Sweet, Cute, Playful, Child-Like
5. **Strange (1)**, Unique, Original, Eccentric, Odd, Interesting, Arty, Mysterious

To dig deeper into the origins of users' impressions, it was necessary to identify which product features/qualities prompted those impressions (see Table 4.16). For the WOODSTOCK lamp, having analyzed the original appraisal transcripts, it is evident that having simple elements, using the big wing bolt, and reflective light each had an effective influence on users' overall impressions. Most of the representative users found the product calm and relaxed because of the stable wooden base and soft color of the lamp and lighting direction. The characteristic of the wing bolt was the basic reason to see the lamp as funny and friendly. For users the overall shape and characteristics of the lamp were new and different compared with more common lamps. Thus, it was considered to be the main reason to perceive the product as strange.

Comparing these results to the original designer's intended expressions reveals a *considerable level* of semantic overlap between what designers independently intended and how users were independently impressed. Among the three intended visual product expressions, *simple* and *playful* were directly mentioned by target users. However, the intended expression *happy* was neither directly nor associatively perceived by target users. Users found the product to be *calm* rather than *happy*. It seems that users and the designer had different opinions about the product's 'happiness'. Therefore, it can be said that despite having overlaps with two intended expressions, the designer could not communicate a sense of 'happiness.

Table 4.16 Product or component features/qualities that influenced users' overall impression of the WOODSTOCK lamp

Impression	**Visual Features/Qualities/Associations**
Calm	Hidden reflective light, wooden stable body, soft color
Simple	General shape, construction, simple visual elements
Friendly	Reflective light, pattern of the wood, the wing bolt, color
Funny	The wing bolt, the screen, different elements in different proportion, resembling mushroom
Strange	New construction, combination, reflective light

4.2.2 Stage 4 – Designers' Evaluations of Users' Realized Visual Impressions

As a reminder, at this stage, the original designers of the studied products were exposed to the Semantic Cluster Maps, to see if users' realized visual impressions of their products fell within or outside the scope of designers' intended product expressions. The following paragraphs discuss the designers' reactions to users' impressions, on a product-by-product basis.

4.2.2.1 Evaluation of Impressions of NEST Chair

Six semantic clusters with the headings COOL, ATTRACTIVE, CARELESS, AGGRESSIVE, SHOWY, and PRECISE were evaluated by the designer. As expected, Markus Johansson was happy with the users' interpretations. He stated that "the user impressions were exactly how I thought them to be. It feels good that I was able to carry out my expressions through the design. Cool, Modern and Attractive were just the foremost expressions I was aiming for." The designer confirmed that beside the clusters with headings COOL and ATTRACTIVE, the cluster SHOWY also was in some way within the 'scope' of his intentions. However, the clusters CARELESS, AGGRESSIVE, and PRECISE were not considered to be in the scope of his original thinking, but equally were not dismissed as well. The result indicates that although the designer was successful in evoking impressions that stemmed from intended product expression, the product still aroused some (negative) impressions that were not intended. Comparing the results from Stage 1 of the analysis, it can be

said the designer's intentional character of UNINVITING (used in a positive sense to arouse a good interaction) in fact resulted in a negative experience summarized as AGGRESSIVE.

4.2.2.2 Evaluation of Impressions of CIRRATA Lamp

Nine semantic clusters with the headings FEMININE, MODERN, COOL, INTERESTING, PROVOCATIVE, RELAXED, ELEGANT, SPIRITUAL, and SENSITIVE were evaluated by the designer. The designer Markus Johansson seemed to be accepting, but not enthusiastic, about the users' interpretations. He stated that "It opened my eyes for new expressions. My initial thought was to express movement in form and the rotational use of repetition. The users' impressions are not exactly as I expected but it helped me to understand more about the form language and the subconscious impressions from the user group. The characteristics are not matching my expectations exactly but they are not too far from it either." Accordingly, among the nine semantic adjective groups, the designer confirmed that the clusters with headings MODERN, COOL, RELAXED, and ELEGANT were within the 'scope' of his intentions. The result reveals that although the designer was quite successful in evoking impressions that stemmed from intended product expression, the product still aroused some (negative) impressions that were not expected.

4.2.2.3 Evaluation of Impressions of ARC Chair

Five semantic clusters with the headings MODEST, SERIOUS, ELEGANT, HONEST, and MASCULINE were evaluated by the designer. The designer Jonas Forsman seemed to be satisfied with the users' interpretations. He stated that "I am happy with the impressions. When I read them they seem very well fitting to the product. I have not thought of it as a *SERIOUS* product but when I look at it I see that it is. When I think of the chair I also add some off its functionality and movement into the impression I get, which the user cannot do since they look at a static product." He maintained that "I think all my three adjectives are represented in the user impressions. The user impressions that are not contained in my words would be SERIOUS and MASCULINE." Accordingly, among the five semantic clusters, the designer confirmed that those with headings MODEST, ELEGANT, and HONEST were within the 'scope' of his intentions. The result reveals that although the designer was quite

successful in evoking impressions that stemmed from intended product expression, the product still aroused some impressions that were not expected.

4.2.2.4 Evaluation of Impressions of PARASOL Lamp

Six semantic clusters with the headings MODERN, FRIENDLY, ODD, PRECISE, MATURE, and PLAYFUL were evaluated by the designer. The designer Jonas Forsman was not really satisfied with the users' interpretations. He stated that "When looking at the map, I see that the impressions are very varied and spread out. That is also seen in the 6 clusters that are quite mixed. I guess that people do not see it as dull and uninteresting and that is important for me, but then they all interpret it in different ways, which I do not mind." The designer confirmed that the clusters with headings MODERN, FRIENDLY, and PRECISE were within the 'scope' of his intentions. He maintained that "ODD and PLAYFUL are not part of my intentions but when comparing the product to other lamps I can understand that it is perceived that way." The designer confirmed that the cluster MATURE was not within the 'scope' of his original intentions. The result reveals that the designer was not quite successful in evoking impressions that stemmed from intended product expression.

4.2.2.5 Evaluation of Impressions of 5Y Chair

Six semantic clusters with the headings FEMININE, PLAYFUL, ARTY, HAPPY, ATTRACTIVE, and COMPLICATED were evaluated by the designer. The designer Sami Kallio was satisfied with users' interpretations. He stated that "I think the users' impressions fit pretty well with my intentions. Overall I´m happy with the users' impressions, but not so happy about the COMPLICATED impression. I personally think that Y5 is not complicated, unpredictable and chaotic, in fact just the opposite." It indicates that except for the COMPLICATED impression, all the semantic clusters matched with the designer's expectations and intentions. The result reveals that although the designer was successful in evoking impressions that stemmed from intended product expression, the product still aroused some negative impressions that were not expected.

4.2.2.6 Evaluation of Impressions of WOODSTOCK Lamp

Six semantic clusters with the headings CALM, SIMPLE, FRIENDLY, FUNNY, and

STRANGE were evaluated by the designer. The designer Sami Kallio was satisfied with users' interpretations. He stated that "I´m a little bit surprised about the impressions CALM and STRANGE, but overall I'm happy about the users' impressions." Then, the designer confirmed that the semantic clusters matched with his original thinking and expectations.

4.2.2.7 General Observations

The results of the stage 4 analysis reveals that although the original designers aimed to be successful in evoking positive impressions that stemmed from their intended product expressions, products still aroused some negative or positive impressions that were not expected or were beyond the designer's control. From the results of Stage 4, it can be proposed that designers were able to communicate intentional product expressions on many occasions, through only the medium of product visual form, but users' interpretations of that form would inevitably lead to some diversions from expressive intent.

CHAPTER 5

DISCUSSION ON THE DEVELOPED METHODOLOGY

Communication of meaning through a designed object was the general subject of this study. The starting argumentation of this thesis was that there can exist a level of discontinuity between the meaning intended to be expressed (by the designer of a product) and the meaning as actually construed (by target users of that product). The study adopted the 'semiotic school' within design communication studies, seeing the differences between intended semantic expressions and actual semantic impressions as acceptable diversity rather than communication failure.

The aim of the thesis has been to conceive and develop an evaluative design research tool/method that could help to identify where, and to what extent, the aforementioned semantic discontinuities are present in product design. It was proposed that the developed 'Semantic Expression/Impression Comparison' method (SEIC method) could be applied by design researchers, practicing designers and design educators as a systematic approach to the appraisal of product semantics, highlighting stronger and weaker areas of semantic communication.

It was argued that designers are able to influence, but not dictate, users' product experience. It was assumed that user experience could be changed through different types of user-product relationships, becoming more complex over time and more varied according to context, commencing with a surface level of experience and progressively deepening. In this respect, the study of user experience within the thesis has focused on relationships between sensorial information of a designed product and users' initial semantic impression (from a 'pre-use' appraisal).

For developing the SEIC method, the relationship between designers and users was

explored within the communication model proposed in Figure 5.1. According to this model, both designers and users are considered as *interpreters* of a designed product. Designers on one side of the communication interpret their intended semantic expressions that are realized in a final materialized product. Users, on the other side, interpret their initial semantic impressions of that product based on its sensorial information. Investigating multi-sensorial appraisals of a physical product, the study discussed that visual properties/qualities of a product are dominant in the verbalization of connotative expressions and impressions. Therefore, the methodology developed in this study was based solely on the visual appraisal of a physical product, investigating the level of discontinuities between intended *visual expressions* and initial *visual impressions*. However, it is assumed that the method can be applied in investigating the subject of discontinuity for different types of product appraisal, represented in Figure 2.16.

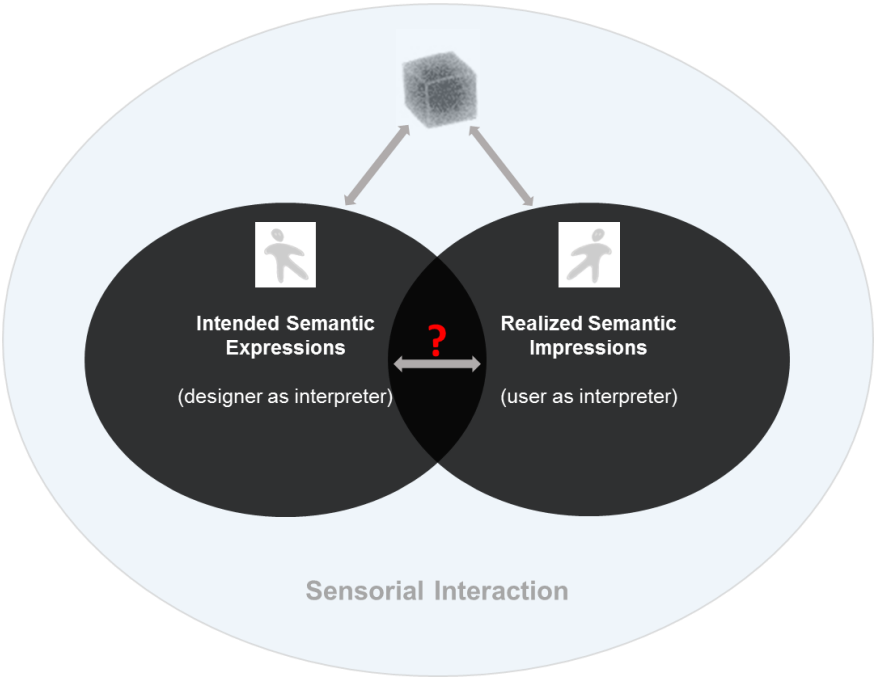

Figure 5.1 Communication model: intended semantic expressions vs. initial semantic impressions within the context of multisensorial product interaction

5.1 Semantic Expression/Impression Comparison Method (SEIC Method)

Table 5.1 provides a visual summary of the four main stages of the SEIC method.

Methodologically, SEIC focuses on product visual form as a communicator of meaning, studying the relationship between an individual designer, who decides on the sensorial qualities of a product, and a group of target users, who interact and interpret the sensorial qualities of the designed product. A designed product is considered as a mediator that carries its designer's intentions while affecting end users' impressions and experience.

Table 5.1 Visual representation of the four main stages of the SEIC method

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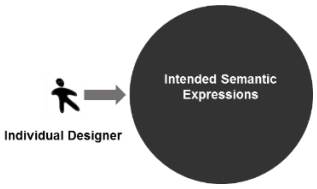
Investigation of designer's intended expressions</td><td> 
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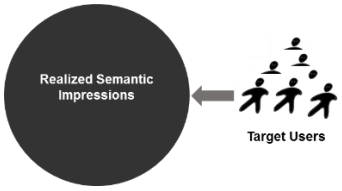
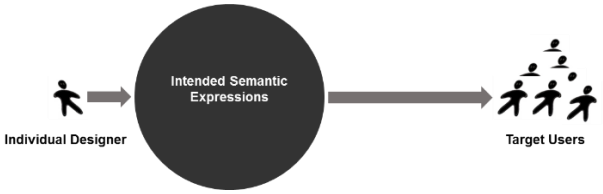
<tr><td>Stage 2
Investigation of users' actual impressions</td><td> 
</td></tr>
<tr><td>Stage 3
Users' evaluation of designer's intended expressions</td><td> 
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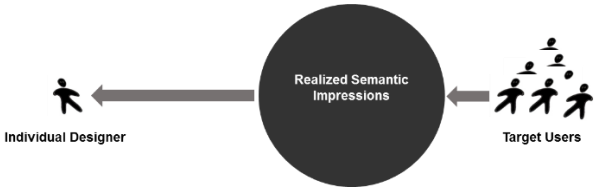
<tr><td>Stage 4
Designer's evaluation of users' actual impressions</td><td> 
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To investigate the relationship and the level of semantic discontinuity between a designer's intended expressions and users' impressions, independent and dependent empirical studies were considered. During Stages 1 and 2 of the SEIC method, both the individual designer and target users evaluate product semantic expression / impression independent from the other side's evaluation. At Stage 3, target users evaluate their impression on the basis of the original designer's intentions (NB first dependent comparative study). At Stage 4, the designer evaluates users' overall impressions (NB second dependent comparative study). The following sections discuss the critical steps to be followed in using the SEIC method in design research studies, and offer guidance on application of the method.

5.1.1 Preparation for the SEIC Method

Before conducting a substantial SEIC study, it is necessary to construct a set of evaluation documentation to obtain evaluation adjectives and representative products (Table 5.2). The thesis research has discussed that there exist different types of meanings that can be attributed to a product's sensorial qualities: 1) connotative meanings, 2) sensorial meanings, 3) meanings of interaction, and 4) affective meanings. For the present study (visual appraisal of product expression/impression), the *connotative level* of meanings was considered, ignoring other levels as being diverse and complicated to study. However, for future studies, other types of meanings can be separately investigated by employing the same SEIC methodology. It is assumed that a single study looking at combinations of all levels of meaning might be prohibitively complicated to implement.

Through the study, it was observed that providing designers and target users with a cue card of descriptive adjectives could help them to verbalize their expressions/impressions, overcoming linguistic constraints. This study used the collection of descriptive adjectives provided by Mugge et al. (2009). The collection was found to be helpful in describing and probing product connotative meanings. However, for studies looking for a wide or purpose-selected set of adjectives to describe a product from a specific product sector and/or within a specific context of evaluation, an adjective collecting technique can be applied. Through such a technique, a group of designers – since designers are more sensitive about product

meanings compared with users (Hsu et al., 2000) – can be approached to attribute meanings to some representative products. Later, through keyword analysis, a group of applied adjectives can identified to be used in a major study such as presented in this thesis.

Table 5.2 Implementation of SEIC method: Preparation

Preparation	**Constructing the evaluation format** a. Deciding on the intended type of product appraisal (based on stage of product acquaintance) b. Classifying different types of product semantic attributes c. Providing a pool of descriptive adjectives - using previous studies on product attributes, or - conducting a pre-study to define attributes/adjectives d. Developing Likert scale single dimension semantic evaluation sheet e. Approaching original designers to participate f. Providing representative (physical) products

The study showed that there is a need for a semantic scale sheet to evaluate the clarity or perceptibility of intended/realized meanings/adjectives during product semantics appraisals. Participants should be asked to indicate their score using a 5-point Likert scale from 'non-descriptive' to 'fully descriptive' on the evaluation sheet. The use of a higher resolution (7-point) Likert scale can be considered, but the indication from this present research is that a 5-point scale gives sufficient resolution to identify semantic discontinuities and, probably, users and designers will find it difficult to discriminate between adjacent grades on the higher resolution scale.

An important issue in setting up a study using the SEIC method is the use of 'new-designed products', to increase the likelihood that users' impressions of products would also be their *first impressions.* Furthermore, it is thought that the selection of remarkable, unusual, exotic or somehow surprising products is a good trigger to motivate participants to reveal their initial impressions of those products.

Although the study reported in this thesis investigated visual appraisals of products at

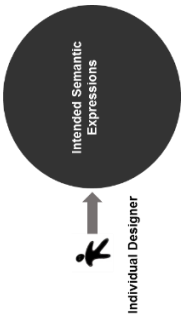
a ‘pre-use’ stage, there is expectation that the SEIC method can be applied at different stages of product acquaintance, from ‘pre-product’ to ‘use’. It should also be adaptable to different types of meaning, for example semantics based on user-product interaction rather than static visual properties.

Any study employing the SEIC method requires the original designer (or designers) of a product to be willing and interested participants.

5.1.2 Stage 1 of SEIC Method

Designers are the source of product meanings. Within the main study, original individual designers were approached to participate. The interview session with designers and the analysis procedure of designers’ intended expressions are summarized in Table 5.3. The methodology to explore intended meanings (expressions) of product visual qualities was found very fruitful. Healthy discussions were managed to be held with designers regarding their intended product expressions. In the end, it was somewhat surprising that individual designers identified only few (three) intended visual expressions, and did not use the full (five) that the SEIC method allowed. The first assumption is that designers were asked to focus only on connotative levels of product meaning, hence restricting their answers. It is also believed that intended connotative levels of product meaning are not limited to just visual appraisal. So, the focus on the visual modality may also have led to restricted answers. These concerns should be duly considered in future studies using the SEIC method, especially in cases where the intention is to elicit large numbers of intended expressions (as separately offered adjectives).

Table 5.3 Implementation of SEIC method: Stage 1

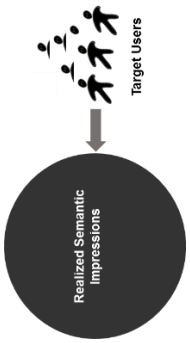
Stage 1 	**Interview session with individual designers** a. Informing the designer about the type of meanings that the study focused on (e.g. connotative meanings) b. Discussions on intended (visual) attributes realized in the final product (warm-up session) c. Asking the designer to verbalize his/her intended expressions through carefully chosen adjectives (if needed, providing the designer with a cue card of possible adjectives) d. Asking the designer to explain in which sense the adjectives were used e. Asking the designer to identify product features/qualities conveying each intended adjective f. Asking the designer to evaluate the perceptibility level of each intended adjective on a 5-point Likert scale **Analysis of the data** a. Identifying the intended adjectives b. Transcribing the designer's further explanation on each intended adjective c. Transcribing the designer's statements on the key product features/qualities conveying each adjective d. Processing and reporting the designer's evaluation of intended adjectives on the Likert scale

5.1.2 Stage 2 of SEIC Method

Target users are considered as the destination of the product meanings in a design communication model. Within the main study, a sample of target users was approached to participate in product appraisals. The interview session with target users and the analysis procedure of users' product impressions are summarized in Table 5.4. Through this approach, users actual impressions (independent from original designers' intentions), were explored. As expected, it was not especially easy for users to voluntarily offer connotative meanings – since such discussions and 'labelling' of product attributes is not a daily or familiar activity. It emphasized the important role of having a cue card of example adjectives to hand, to assist users with their appraisals. Furthermore, Stage 2 (step d) essentially asked users to try to view the products not holistically but atomistically, in the sense of trying to isolate certain features

(elements) of visual form that led to their impressions. It was assumed that users would be comfortable – and able – to perform such an activity, but it must be acknowledged that, unlike a designer, some people may perceive a product only as 'a whole' and not be capable of perceiving a product as a collection of elements organized into a composition. Fundamental studies in psychology may be able to offer deeper advice about the reasonableness of asking such an activity of users.

Table 5.4 Implementation of SEIC method: Stage 2

Stage 2 	**Interview session with target users** a. Informing users about the type of meanings that the study focused on (e.g. connotative meanings) b. Discussions on users' initial (visual) impressions of product (warm-up session) Asking users to verbalize their semantic impressions through adjectives ('first-order adjectives') – assisted by providing users with a cue card of example adjectives c. Asking users to explain in which sense the adjectives were used, by providing supportive or synonym adjectives ('second-order adjectives') d. Asking users to identify product features/qualities conveying each first-order adjective **Analysis of the data** a. Identifying the first-order adjectives b. Transcribing users' further explanations on each first-order adjective ('second-order adjectives') c. Transcribing users' statements on the key product features/qualities conveying each first-order adjective **Developing a Semantic Cluster Map** a. Investigating the relationship between first-order and second-order adjectives b. Creating a network relationship visualizing the diverse but connected semantic appraisal of the product c. Identifying clusters of adjectives amongst the network that are semantically related to each other d. Rank ordering of the 'prominence' of semantic clusters, based on first-order adjectives with highest frequency of mention – thereby representing target users' overall impressions of intended product

The study focused on connotative meanings that users attributed to the visual qualities of a physical product. It's believed that exploring product meaning through multi-sensorial appraisal would be more *realistic*, but (at least for connotative meanings) the pilot study conducted for the doctoral research revealed that visual appraisals provided full enough results, negating the need for multi-sensorial appraisals. However, as a direct way of investigating the realization of designer's intent within users' impressions, the focus can be shifted on the investigation of users' *inferences of original designers' intended meanings*. With this approach, users could be asked to discuss about the product connotative meanings that they think the original designer *tried to convey* through visual or multi-sensorial qualities of his/her product.

The systematic evaluation of users' impressions involved visualization of a semantic network and a clustering technique to create Semantic Cluster Maps. These maps are an important methodological contribution of the doctoral research. They can be applied to different studies investigating users' interpretations/responses to a product. It is a new visually oriented approach to generalize users' overall appraisals of a product, classifying semantically distributed adjectives into coherent clusters based on shared meaning. It is assumed that Semantic Cluster Maps become increasingly powerful as a research tool in line with the increase in user participants.

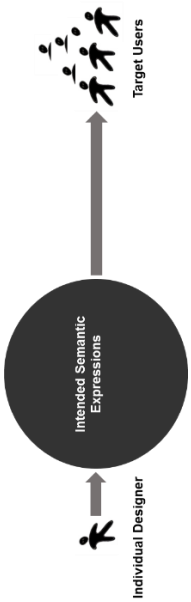
5.1.3 Stage 3 of SEIC Method

Following Stage 2, the same target users were approached to directly evaluate the original designer's intended expressions. The session with target users and the analysis procedure of users' evaluations are summarized in Table 5.5. Through this approach, users' impressions (within the boundaries of the original designer's intentions) were explored. However, to increase the robustness of the method at Stage 3, users were exposed not only to the collection of intended (true) adjectives but also a pool of not-intended (false) adjectives. This provided a hidden control group within the experimental design, since participants were not aware of which were true or false adjectives. The intention here was to check if semantic discontinuities were (as might be predicted) more intense for false adjectives than for adjectives that defined true design intent. In the end, the results of the incidental true/false adjective analysis were inconclusive and raised questions about the effectiveness of making blind 'true/false'

appraisals. An alternative approach to a control can be considered, asking users to detect the intended (true) adjectives from non-intended (false) adjectives. From this perspective, it would be possible to quantitatively examine users' inference of the original designer's intended meanings.

The macro analysis at Stage 3 helped to identify the *level* of semantic discontinuity between intended expressions and realized impressions for each product. The per-product results can be cross-compared, to achieve a value on the percentage of semantic discontinuities within or across product sectors. The follow-up micro analysis attempted to identify whereabouts the communication of intended meanings through product visual form broke down (i.e. the *origin* of semantic discontinuity). It enabled intended expressions (as individual adjectives) with a high level of semantic discontinuity to be identified, along with associated attributes / components of product form through which those expressions were intended to be communicated. The pinpointing of this semantic discontinuity information can be used by designers to improve the clarity of intended meanings by adjusting or altering their designs, thereby decreasing levels of semantic discontinuity for subsequent versions of the product. Or, more appropriately, the semantic discontinuity results can be integrated into an interactive product development process, to help improve the design of a yet-to-be manufactured product.

Table 5.5 Implementation of SEIC method: Stage 3

Stage 3  	**Users' evaluation of individual designer's intended expressions** a. Asking users to evaluate the applicability and then the perceptibility level of predefined true/false adjectives on a 5-point Likert scale b. Asking users to identify product features/qualities conveying each evaluated adjective **Macro-Analysis: investigating the <u>level</u> of semantic discontinuities** a. Defining different levels (bands) of semantic discontinuity, considering the distance between designers' and users' gradings on the 5-point Likert scale b. Calculating the discontinuity level in the evaluation of each intended adjective on the 5-point Likert scale, considering data from the original designer and each individual user c. Providing distribution data for discontinuity bands across all users' evaluations for all intended adjectives d. Calculating the proportion of evaluations falling within each discontinuity band e. Calculating the overall level of discontinuity for each product (focusing on distribution of low and higher-order semantic discontinuities) **Micro-Analysis: investigating the <u>origin</u> of semantic discontinuities** a. Determining the 'median' value of all users' grading of each intended (true) adjective together with each non-intended (false) adjective b. Calculating to what extent users were able to detect true adjectives from false adjectives c. For each true adjective, comparing the median grade of users with the intended value of the designer d. Calculating discontinuity values for each adjective and creating a symbolic matrix to visualize results e. Identifying adjectives with significant semantic discontinuities f. Indicating those product features/qualities associated with significantly discontinued expressions, to reveal whereabouts product design intent breaks down

5.1.4 Stage 4 of SEIC Method

The original designers of the products studied for the research were exposed to the target users' impressions of those products, via the Semantic Cluster Maps created at Stage 2. The details of the online questionnaire with individual designers and the analysis procedure of designers' opinions of users' impressions are summarized in Table 5.6. Stage 4 provides a concise feedback on designers' successes in communicating intended meanings. The results can be very useful in redefining product qualities and intentions, as well as generally educating designers about how users interpret their products and how (unintended) meanings can arise.

Table 5.6 Implementation of SEIC method: Stage 4

Stage 4 	**Designer's evaluation of users' overall impressions** a. Constructing an evaluation format: Designing an online questionnaire including: - Semantic Cluster Map - Rank-ordering of clusters, characterizing users' overall impression through related adjectives b. Asking the designer to express his/her interpretation of the Semantic Cluster Map and rank-ordered clusters c. Asking the designer to discuss if users' general impressions were within or outside the scope of his/her intended product expressions **Content Analysis** a. Extracting main themes from the designer's written opinions of the Semantic Cluster Map results b. Identifying clusters outside the scope of designer intention

5.2 Application of SEIC Method in Different Contexts

This doctoral study has shown by way of example that the SEIC method has potential application in a variety of different design contexts, offering a systematic approach to the appraisal of product semantics directly from stakeholders' (original designers,

intended users) perspectives. The SEIC method leads to precise identification of stronger and weaker areas of semantic communication.

5.2.1 Application in a Design Research Context

The SEIC method is primarily proposed as a useful approach and set of tools for design researchers concerned with investigating the theory and practical implication of communication through the medium of product design. This method provides *empirical* knowledge and insights in the area of 'designer-product-user' relationships, and has so far been shown to be effective in the area of 'semantic discontinuities'. Conducting such empirical studies implementing the SEIC method in a specific product sector helps to identify to what extent target users' impressions match or mismatch with original design intent. The unique feature of the SEIC method is that it can pinpoint both the *level* and the *origin* of semantic discontinuities, offering a powerful data set for design studies.

5.2.2 Application in a Design Practice Context

The SEIC method is proposed to be a useful analytical tool if applied within a product design and development process. It should be especially effective in evaluating aesthetic and meaning experiences of products. In a design practice context, instead of using a physical product (e.g. materialized/manufactured artifact), the SEIC method would more appropriately be used on lower fidelity product representations (e.g. images, concept sketches, mock-ups, prototypes), to obtain reliable and actionable insights on how user impressions of products may align or misalign with design intentions. In this respect, designers could identify where and why an intended expression is lost, and make iterative or conceptual changes to a design as deemed appropriate. The preparation of Semantic Cluster Maps of users impressions, as well as inclusion of 'true' and 'false' adjectives, are suggested as key steps in a professional design application of the SEIC method.

5.2.3 Application in a Design Education Context

In the context of design education, the SEIC method can be followed by undergraduate or graduate design students as a vehicle for learning about (i) the importance of

product semantics as an aspect of design communication, and (ii) the challenges in trying to communicate a product *expression* that will align with targer users' *impressions*. Accordingly, the SEIC method can be integrated into studio-based design projects, which would normally allow sufficient time for an empirical evidence-based product design and development process to be followed. An example student project would be framed under 'designing for intended meanings'. The project brief might be such that the *intended users* fits the profile of the student designers, allowing peer evaluations. This was usefully circumnavigate the practical problem of securing external participants for the user studies.

It would certainly be interesting, if the method is applied in a design education context, to examine the level of semantic discontinuities arising from student projects. Intuitively, one would expect the proportion of higher-level discontinuities to be higher than exhibited by professional designers, because of students' less experience in embedding meaning into product form.

CHAPTER 6

CONCLUSIONS

Having argued the theory of the 'communicative function of product design' and especially 'the relationship between designer intention and user initial experience', a new methodology has been developed through this thesis to explore designers' intended product expressions and users' actual impressions embodied in product visual properties. This concluding chapter begins by discussing the importance of the developed methodology for detecting levels of semantic discontinuity in product design. It then presents implications of the empirical study based on development and application of the 'Semantic Expression/Impression Comparison' Method (SEIC Method) for detecting semantic discontinuities. Answers to the research questions posed in Chapter 1 are provided. Limitations of the study are then stated, followed by suggestions and directions for follow-up research.

6.1 Methodology for Detecting Semantic Discontinuities

Research question 1 stated: "How can a designer's success in communicating intended product expressions be measured?" The literature in the area of design communication and product experience provides a great knowledge on the complicity of the relation between designers (who decide on a product's physical qualities) and end users (who perceive and experience the designed product at different levels of acquaintance). Although it is understood that designers cannot *directly* 'design experiences', since user experience is generated and changed within different contexts and at different stages of product use, the literature argues that designers have an ability to *influence* users' initial impressions and experiences of product qualities. Accordingly, within the context of design communication, a linear relationship between designers' intentions and users' experiences is not relevant to be considered. Moreover, a product should

not be viewed as a transmitter of designers' intentions, but rather as a mediator that is positioned in between designers and users, affecting both party's interpretations. According to this perspective, there should be differences – perhaps even large differences - between designers' *expressions through products* and users' *impressions of products*.

Although there exist a few studies evaluating the differences between designers and users in interpreting product qualities, none of them provides concrete knowledge on the relationship between the 'original designer's' intended experience and target users' actual impressions. However, the literature reveals that designers are more sensitive about product attributes compared with users' interpretations of product attributes.

This present work has investigated design communication from the perspective of the 'semiotic school', seeing differences between intended and realized experiences as acceptable diversity rather than communication failure. In this respect, the research reported in this thesis has focused on the need for investigating the level of discontinuity that can plausibly exist between meanings intended to be expressed (by the designer of a product) and meanings as actually construed (by target users of that product). Therefore, the primary purpose of this study has been to develop and implement a practical methodology to investigate the *level* and *origin* of semantic discontinuities between individual designers' intended product expressions and target users' initial impressions. A communication model to study semantic discontinuity was taken into consideration (Figure 6.1). Through this approach, a designer's success in communicating intended product expressions was proposed to be established.

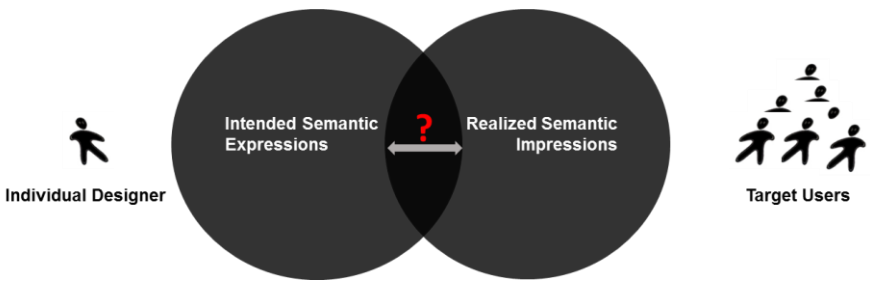


Figure 6.1 Communication model showing plausible semantic discontinuities

The experimental 'Semantic Expression/Impression Comparison' method (SEIC method) developed in the thesis consisted of four main stages considering independent and dependent evaluations: *Stage 1: Investigation of designer's intended expressions (independent); Stage 2: Investigation of users' actual impressions (independent); Stage 3: Users' evaluation of designer's intended expressions (dependent on Stage 1); and Stage 4: Designer's evaluation of users' actual impressions (dependent on Stage 3).* The detailed steps of implementing the SEIC method, as well as notes for its practical application, were discussed in Chapter 5.

The SEIC method has been developed for, and applied to, the visual appraisal of products. However, the method has sufficient adaptability to be a candidate for investigating the subject of discontinuity for different types of sensory modality appraisals, across different product types. In the thesis, the method was evaluated for the investigation of product connotative meanings. Again, the origin and degree of discontinuity in the communication of other types of product meaning (e.g. affective meaning, interactive meaning) can be amenable to investigation with the SEIC method. The methodology can also be considered for the empirical study of users' inference of original designers' intentions.

As a whole, the SEIC method is proposed as useful to design researchers who seek to investigate the theory of 'communicative functions of product design' and especially 'the relationship between designer intention and user initial experience'. It provides a way of directly accessing and processing original product design intent to be specifically compared with target users' realized product experiences. The research outcomes, adopted methodology of the fieldwork, and the data analysis methods can also be beneficial for designers, design industries and design students aiming to create a strong connection with target users through visual attributes of products.

6.2 Empirical Study: Intended Product Expressions versus Realized Product Impressions

Research question 2 stated: "To what extent do people's experiences of meaning, derived from the visual qualities of a product, align with what was intended by the originating designer of that product?" The principal challenge of the doctoral research was to conduct an empirical study to identify where, and to what extent,

aforementioned semantic discontinuities are (or might be) present in product design. Three pairs of products (one lamp, one chair) from three individual Swedish freelance designers were studied using the SEIC method. The following sections discuss the outcomes of the empirical study, which purposefully collected qualitative and quantitative data. Accordingly, quantitative and qualitative data analysis methods were deployed across the four stages of the SEIC method: quantitative analysis (Stages 1 and 3) where *discontinuity values* were sought; and qualitative analysis (Stages 1, 2 and 4) where *semantic representation* and discussion were paramount.

6.2.1 Qualitative Approach to Studying Semantic Discontinuities

The underlying concept within the main fieldwork was to see if the original designers of a product were able to trigger intended expressions (realized within target users as intended impressions) through the definition of a product's visual qualities. The literature review had established that the combination of visual elements of a product, such as shape, color, texture, shade and light, pattern, and ornament, together with material qualities, are decided upon by a designer (assuming the role of a 'construer of meaning'). Designers decide on the visual qualities of a product, such that the visual qualities express or induce certain characteristics, with the aim of influencing users' initial experiences and impressions in a positive way.

The comparison of qualitative data across three stages was carried out to examine to what extent original designers' intended expressions overlapped with target users' actual impressions. Evaluations based on a qualitative approach were included at Stage 1 (designer's intended expressions), Stage 2 (users' actual impressions) and Stage 4 (designer's evaluations of users' actual impressions). The generated user data at Stage 2 were processed using a newly created semantic network visualization and Semantic Cluster Map technique. These are described in detail in Chapters 4 and 5. Intended expressions and actual impressions were then compared, to determine if there existed any semantic overlap between what designers independently intended and how users were independently impressed.

The Semantic Cluster Maps provide a means to resolve the problem of reducing into manageable sets the widely distributed connotative meanings attributed by

representative target users. The maps maintain and made explicit relationships between linked terms and keep the integrity of meaning attribution in tact. Their value is proposed in being able to visually articulate users' verbalized impressions, to the extent that groups of semantically connected adjectives (meanings) can be identified and those adjectives (meanings) with high frequency of mention can be flagged as being especially impressionable. In this way, the analysis provides a route for characterizing an overall group impression of a product, from the diverse impressions of all group members.

The analysis of the Semantic Cluster Maps reveals that in the process of describing product impressions, individual users attribute semantically common adjectives to products, but in different ways (i.e. in different 'senses'). It was critical that the analysis retained sensitivity to the use of these different 'senses' (e.g. 'modern in the sense of A' or 'modern in the sense of B'). With the collective group impression characterized by the semantic clusters, it was then possible to make comparisons against designers' intended product expressions. The results of the six product evaluations revealed that designers were able to influence users' product perceptions, being considerably successful in eliciting their intended product expressions. However, users' overall impressions were not limited to only positive experience (as preferably intended by designers), but also included negative and indifferent experiences, which are usually outside of designers' intentions.

In continuing the investigation, at Stage 4 of the SEIC method, original designers were asked to interpret target users' overall visual impressions of their products, especially to see if semantic characteristics mentioned by target users were within or outside the general scope of designers' intended product expressions. The designers' reactions to users' evaluations revealed that users' impressions were mostly not too far from original designers' expectations. Most designers were happy about the influences of product visual qualities and the diverse semantic impressions that were generated in response to their products. The SEIC method provided valuable insights for the original designers, revealing a story of how some unexpected or unintended meanings became attributed to their products. It also helped designers to gain an understanding into users' contemporary semantic evaluations.

As a result, users' evaluations – comprising both positive and negative impressions of product visual qualities – enabled designers to identify points of semantic weakness or strength. It can be argued that if designers provide honest and understandable product expressions, users may more readily interpret what the designer intended to be conveyed through product visual qualities. From the outcomes of this comparison, it can be concluded that designers were able to communicate intentional product expressions, but they could not fix users interpretations.

6.2.2 Quantitative Approach to Studying Semantic Discontinuities

The research has been concerned not only with identifying *origins* of semantic discontinuity but also *levels* of discontinuity. To achieve this, it was necessary to adopt a quantitative approach within the main study. Numerical (Likert scale) data collected through Stage 1 (designers' intended expressions) and Stage 2 (users' evaluations of designers' intended expressions) of the SEIC method formed the basis of quantitatively exploring differences in the attribution of meanings to visual product qualities from designers' and users' perspectives. Throughout the empirical work, designers were regarded as a *constructor* of product expressions and target users were regarded as *interpreters*. Therefore, the results within this area of the research were based conceptually around discontinuity of meaning communication from a 'source' (designer) to a 'destination' (target user) within a general 'semiotic school of thought' for design communication.

As mentioned in earlier chapters, the doctoral work focused only on the 'pre-use' phase of a user-product relationship, investigating connotative meanings expressed through a product's visual qualities. Individual designer's intended product expressions and target users' impressions of products were quantified on a 5- point Likert scale featuring 3 intended expressions/adjectives for each product (3 chairs and 3 lamps). The communication process between the designer and target users through each product type was investigated separately, with the outcomes then cross-compared over the 2 product types (lamps, chairs).

The results for the three lamps revealed the existence of discontinuities between semantic intent and realization. Therefore the SEIC method was effective in

uncovering levels of difference between product expression and impression. If gradings on the Likert scale for designers (d) and users (u) are compared, the following headline results are obtained: 30% of semantic intent is successfully communicated (u=d); 42% of semantic intent is reasonably realized within close tolerances (u=d±1); and the remaining 28% of semantic intent is not satisfactorily communicated (u=d≥±2). If the results are more liberally divided into two groups – 'zero' discontinuity (u=d) combined with 'low-order' discontinuity (u=d±1), and 'high-order' discontinuity (u=d≥±2) – we see a 72:28 ratio between 'successful' and 'unsuccessful' semantic communication.

For the three chairs, the results also confirmed the existence of discontinuities between semantic intent and realization. Again considering the Likert scale gradings, the following headline results are obtained: 31% of semantic intent is successfully communicated (u=d); 50% of semantic intent is reasonably realized within close tolerances (u=d±1); and the remaining 19% of semantic intent is not satisfactorily communicated (u=d≥±2). As for the lamps, if the results are more liberally divided into two groups – 'zero' discontinuity (u=d) combined with 'low-order' discontinuity (u=d±1), and 'high-order' discontinuity (u=d≥±2) – we see a 81:19 ratio between 'successful' and 'unsuccessful' semantic communication.

Cross comparing the results across the two type of products reveals that the intended semantic expressions of the chairs were communicated more successfully than intended expressions of lamps. It is assumed that the primary reason is based on the perceived function of the product and the level of surprise involved. Although the three lamps were switched on during the experiment, for some participants, the visual form properties were not 'representative' of a common table lamp and therefore challenged conventional thinking. Users found the lamps as surprising products, which may have different use functions than normal. On the other hand, the three chairs afforded the basic and obvious function of sitting. Calculating the mean value of different levels of semantic discontinuity for the two product types *combined* (lamps and chairs) reveals that approximately 30% of semantic intent was successfully communicated (u=d), 46% of semantic intent was reasonably realized within close tolerances (u=d±1), and the remaining 24% of semantic intent was not satisfactorily

communicated (u=d≥±2). This result shows that the studied designers were generally successful in maintaining semantic intent within close tolerances (76 %), but were unable to successfully communicate semantic intent in one-in-four instances (24%).

The 24% level of semantic discontinuity is especially interesting to note, since it repeats the result from a previous but methodologically very different study, involving predefined expressions/impressions, product images (not physical products) and semantic differential evaluation, in the context high-end seating in a Turkish marketplace (Khalaj & Pedgley, 2014). Although precautionary, there is now evidence that an approximate 75:25 split in successful/problematic semantic communication is a fundamental finding that can be expected to be present independent of product type or cultural setting. If this is so, then still there would be some circumstances in which slightly improved or slightly worsened ratios would occur. For example, Swedish designers of chairs were slightly more successful than the proposed general rate, where empirical findings revealed 75-80% of semantic intent being successfully communicated within tight (u=d±1) tolerances.

Research question 3 stated: "What can designers do to lessen any gaps between intended product expression and initial product impression?" This question required the SEIC method to be able to determine the *origin* of discontinuities (that is, whereabouts semantic intent was lost when comparing intended expression and realized impression). For this reason, the SEIC method included a micro-level semantic discontinuity analysis and visualization technique. This micro-analysis was developed specifically to probe those intended expressions (i.e. individual adjectives) that fell outside the (u>d±1) threshold of semantic communication. The approach uncovered precisely how users' impressions differed from designers' intended expressions, with accompanying explanation of the *product features* and *qualities* that influenced users' evaluations. The outcome of this individual 'defective' adjective analysis can be valuable for designers, who on the basis of the information can reconsider the communication dimension of product visual expression in a targeted manner, by revising product visual properties and materialization to more clearly communicate their design visions. In this respect, designers' are expected to use their design expertise to sensitively redesign their products – guided by the micro-analysis

results that pinpoints problematic adjectives - to lessen gaps between intended product expression and realized product impression. However, this implies that the SEIC method is applied more in the context of design practice (i.e. a designer uses the method as part of a product development process) than design research (i.e. a researcher uses the method as an evaluative tool on a manufactured product).

6.3 Statement of Contributions to Design Research

Three headline contributions to knowledge in the field of design research have been made though the thesis. First, the thesis develops and tests new and useful methods for studying message construction, embodiment, communication and reconstruction in the context of user and designer product appraisals (SEIC method). The method opens new ways to carry out design research based around issues of design communication through artefacts, interfaces, environments etc. Second, the thesis uniquely characterizes the origins and levels of discontinuity between designers' intended expressions and users' actual impressions of products, within certain product sectors, as a means to (i) show the effectiveness of the SEIC method, and (ii) generate insightful data on how product semantics succeed or fail to 'connect' designers and target users. And third, as a complete body of work, the thesis uniquely provides a complementary empirical investigation of many of the much-cited theoretical points on product communication raised by the respected University of Cambridge researcher *Nathan Crilly*.

6.4 Possible Limitations of the Study

In reviewing the completed work, it is inevitable that some aspects are open to discussion. One of the most debated issues in design communication studies is whether or not participants (in this case, designers of the studied products) should be provided with fixed expressive words against which they are asked to rate their own products. Although fixed terms can dramatically help during data analysis and cross-comparison, especially in cases of a large number of participants, the counter-argument is that it is not possible for designers' true intentions and ideas for their products to surface. Considering this, the product evaluation session with designers was decided to be carried out closer to a *discussion* rather than a *questionnaire completion exercise*, so as to extract expressive words from the designer's perspective.

However, the success of collecting expressive words through a discussion on intended product expression is directly related to a designer's personality and articulation of language. Although the studied Swedish designers had good English, it was still not their mother tongue. Accordingly, providing designers with a stimulus (an English adjective cue card) as a probe in instances when discussions were not free-flowing was considered a suitable response to overcome linguistic constraints. Still, the cue card in itself was not exhaustive, and in itself may have limited or guided designers to offer adjectives that still did not 'perfectly' reflect design intent.

A further possible limitation of the study is that in the process of extracting design intent from designers, only a few adjectives (three) indicating (summarizing) intended product impression were uncovered for each product. This resulted in target users being subjected to evaluations of 18 (6 products × 3 intended adjectives) semantic intent adjectives for the complete product sample set. Accordingly, a total of 216 evaluations (12 users × 18 intended adjectives) was made. Referring to the results of the closest previous empirical study (Khalaj & Pedgley, 2014), in which individual designers evaluated their intended expressions against a much larger number of *pre-defined* adjectives, it is believed that the results of this present study are both valuable and complementary. However, it is expected that the resultant data and findings would be strengthened if the designers had been able to offer a greater number of adjectives to describe their semantic intentions.

With regard to product evaluations, designers evaluated their intended product expression based on a real physical product interaction, together with their professional experiences during product development, and possibly benefited from feedback from users during product development. In other words, designers already had considerable acquaintance with the product being appraised. On the other hand, users reached a product impression having only made a visual (physical product) evaluation across a very short duration of first-time acquaintance. This difference in the context of meaning attribution is acknowledged to have possibly influenced participants' evaluations and, thereby, have slightly affected the final results. In effect, users' evaluations might be 'more true' or at least 'more considered' if they had a chance to spend a longer period evaluating the products.

On a final matter, the doctoral candidate tried to reach *target users*, as intended by the designers of the studied products. However, the influence of product visual qualities differs between each user. Previous research supports that even within a defined cultural, social or economic setting (which typically are the criteria used to define target users), people vary in their tastes and preferences. So, although twelve users were involved in evaluating each of the six product examples, it is thought that the results would be more confidently generalized on a product-by-product basis if the empirical study had been conducted with a larger number of representative users. This matter was essentially a trade-off between the need to develop and document the new SEIC method and the need to generate insightful and useful research data through application of the method.

6.5 Recommendations for Follow-Up Research

Throughout the doctoral research, several side issues related to the main subject of study arose. These side issues can be considered as directions for follow-up and future research.

The present study investigated the relationship between intended product expressions and target users' initial visual impressions. Consequently, the origin and the level of discontinuities between expression and impression were explored through a specially staged empirical study and related data analysis and presentation techniques. Follow-up research could examine the relationships between designers' intentions and users' initial experiences in regard to *multi-sensorial appraisal* of physical products. This is suggested because the visual information emanating from a product can differ from information emanating from multi-sensorial interaction with that product. Therefore, with multi-sensorial evaluations stemming from physical products, the resultant data would be closer to real-life evaluations and would help level any remaining disparities between designer intent and user impression. It should be noted, however, that the kinds of meanings that are effective to research through multisensorial evaluations should be carefully identified. The pilot study for this present research showed that for connotative meanings, the headline results did not change between visual or multisensorial evaluation.

One further fruitful avenue to explore is the dimension of pre- and post-use impressions of products, as it is expected that after having used a product, users' semantic evaluations would differ from those they held when evaluating the same product solely on the basis of (initial) product visual properties. This point is important since the vast majority of our acquaintance and investment with a product is during ownership and use, and not during the pre-purchase phase. The SEIC method developed and demonstrated for this thesis can be readily applied to a temporal-based study of user-product interaction and experience, possibly taking a time sampling approach to examine how and why semantic impressions change in time.

Studies similar to that carried out in this thesis can be contemplated for just one physical product attribute, such as materials or a simple overall shape (colored or non-colored), in order to look in more depth at individual elements of product physical qualities.

Also for follow-up research, it would be helpful to examine work methods and approaches to understand *how* designers go about embedding meaning into their products (e.g. through a retrospective interview). The goal would be to try to establish 'critically successful steps', concentrating on the most matched adjectives, or to establish 'where things go wrong', concentrating on adjectives having the greatest discontinuity. Accordingly, it might be uncovered that intuition can only go so far in robustly building intended expressions into products and that visual semantic guidance based on typologies of product features might prove an effective tool to lessen the presence of semantic discontinuities.

Finally, it may be beneficial to undertake a comparative cross-cultural study, to ascertain localized differences that may arise from designers or users within different socio-cultural contexts of use. Through such a study, a conceptual framework that can be generalized across cultures would be contemplated.

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APPENDIX A

QUESTIONNAIRE: COLLECTING TURKISH DESCRIPTIVE ADJECTIVES

The aim of this questionnaire is to collect a group of Turkish descriptive adjectives that can be applicable to expressing a product's figurative meanings or characteristics (from the perspectives of Turkish designers and users). The questionnaire has THREE steps for each listed adjective. There are 74 adjectives in total.

Step 1: Please confirm (**by ticking the checkbox**) your agreement that the offered English-to-Turkish translation accurately conveys the meaning of the listed English adjective. (If you leave the checkbox blank, it indicates your disagreement)

Step 2: Please **strikethrough** ('~~like this~~') any adjectives that you believe are not applicable for use in the Turkish language to describe a product's figurative meaning or characteristic. (For example, it is possible you agree on the accuracy of a translation but not on its applicability).

Step 3: If you can think of a 'better' translation for the listed English adjective (i.e. more applicable to describing a product's figurative meaning or characteristic), please **write it** in the 'Better Suggestions' column.

Thank you in advance for taking the time to help me with this survey.

Javad KHALAJ

English Adjectives	**Turkish Translation 1**	**Turkish Translation 2**	**Turkish Translation 3**	**'Better Suggestions'?**
1. Aggressive	Agresif ☐	Saldırgan ☐	Kavgacı ☐	
2. Aloof	Soğuk ☐	Uzak ☐	İlgisiz ☐	
3. Attractive	Cazibeli ☐	Alımlı ☐	Çekici ☐	
4. Boring	Sıkıcı ☐			
5. Bourgeois	Burjuva ☐	Kentsoylu ☐		
6. Businesslike	Ciddi ☐	Sistemli ☐	Pratik ☐	
7. Calm	Sakin ☐	Huzurlu ☐		
8. Careless	Dikkatsız ☐	İlgisiz ☐		
9. Casual	Gündelik ☐	Geçici ☐		
10. Chaotic	Karmakarışık ☐	Düzensiz ☐		
11. Charming	Sevimli ☐	Hoş ☐		
12. Cheerful	Neşeli ☐	Keyifli ☐		
13. Cheerless	Neşesiz ☐	Hüzünlü ☐	Keyifsiz ☐	
14. Childish	Çocuksu ☐	Çocuk gibi ☐		
15. Consistent	Tutarlı ☐			
16. Conspicuous	Çarpıcı ☐	Dikkat çekici ☐		
17. Corny	Eski ☐	Modası geçmiş ☐		
18. Creepy	Ürepertici ☐	Korkutucu ☐		
19. Cute	Sevimli ☐	Şirin ☐		
20. Decent	İyi ☐	Terbiyeli ☐	Nazik ☐	
21. Dominant	Baskın ☐	Hakim ☐		
22. Easy-going	Uysal ☐	İyi niyetli ☐		
23. Eccentric	Garip ☐	Acayıp ☐	Tuhaf ☐	
24. Energetic	Enerjik ☐	Güçlü ☐		
25. Excessive	Aşırı ☐	Lüzumsuz ☐		
26. Exuberant	Coşkun ☐	Bereketli ☐		
27. Feminine	Kadınsı ☐	kadın gibi ☐		
28. Flexible	Esnek ☐	Uysal ☐		
29. Friendly	Samimi ☐	Dostça ☐	Sıcak ☐	
30. Funny	Komik ☐	Eğlenceli ☐		
31. Happy	Mutlu ☐	Sevinçli ☐		
32. Honest	Dürüst ☐	İçten ☐		
33. Idiosyncratic	Kendine özgü ☐			
34. Immature	Olgunlaşmamış ☐	Ham ☐		
35. Inconspicuous	Göze çarpmayan ☐	Farkedilmez ☐		
36. Informal	Gayrı resmi ☐			
37. Insular	Dar görüşlü ☐	Ayrılmış ☐		
38. Interesting	İlginç ☐	İlgi çekici ☐		
39. Lively	Canlı ☐	Neşeli ☐		
40. Masculine	Erkeksı ☐	Erkek gibi ☐		
41. Mature	Olgun ☐			
42. Modest	Mütevazi ☐	Alçakgönüllü ☐		
43. Nice	Güzel ☐	Hoş ☐	Sevimli ☐	
44. Obtrusive	Sıkıntı veren☒	Rahatsız edici ☐		
45. Odd	Garip ☐	Ecayip ☐	Sıradışı ☐	

46. Old-fashioned	Eski moda ☐	Modası geçmiş ☐		
47. Open	Açık ☐	Ferah ☐	Kısık olmayan ☐	
48. Pathetic	Acıklı ☐	Hazin ☐		
49. Pleasant	Keyifli ☐	Hoş ☐		
50. Precise	Dakik ☐	Belli ☐	Açık ☐	
51. Predictable	Tahmin edilebili ☐			
52. Provocative	Kışkırtıcı ☐	Tahrik edici ☐		
53. Reliable	Güvenilir ☐	Emniyetli ☐		
54. Reticent	Suskun ☐			
55. Sensible	Mantıklı ☐	Makul ☐		
56. Serious	Ciddi ☐			
57. Showy	Gösterişli ☐	Havalı ☐		
58. Silly	Aptal ☐	Aptalca ☐		
59. Strict	Sıkı ☐	Sert ☐	Hoşgürüsüz ☐	
60. Tough	Sert ☐			
61. Unattractive	İtici ☐	Çirkin ☐	Sevimsiz ☐	
62. Uninteresting	İlginç olmayan ☐			
63. Unreliable	Güvenilmez ☐			
64. Untidy	Düzensiz ☐			
65. Well-groomed	Bakımlı ☐			
66. Wild	Vahşi ☐	Çılgın ☐		
67. Popular	Popüler ☐			
68. Pretty	Güzel ☐	Zarif ☐		
69. Relaxed	Rahat ☐			
70. Romantic	Dugusal ☐	Romantik ☐		
71. Sensitive	Hassas ☐	Duyarlı ☐		
72. Sweet	Tatlı ☐	Şirin ☐		
73. Terrific	Müthiş ☐	Olağanüstü ☐		
74. Young	Genç ☐			

APPENDIX B

EVALUATION SHEET FOR INTENDED/REALIZED MEANINGS

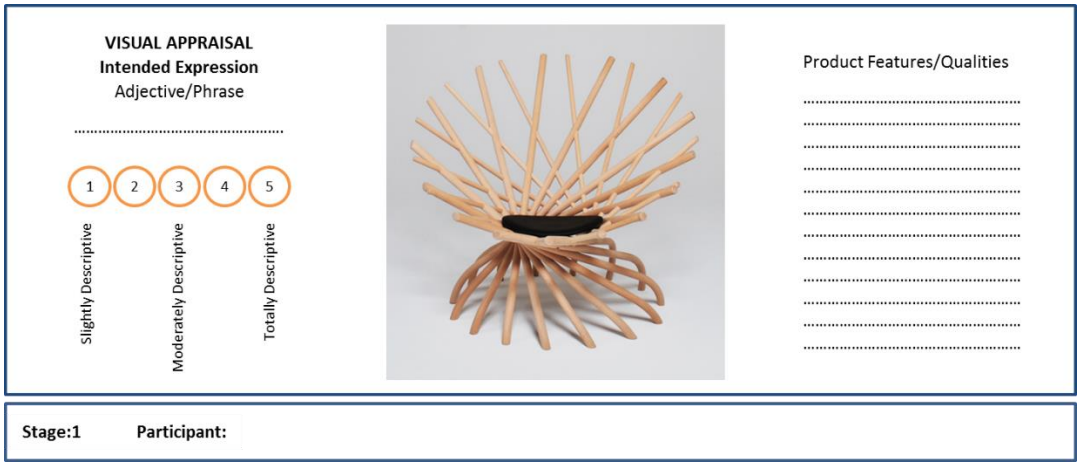


Figure A.1 Stage 1: Individual Designers' Intended Visual Expressions (e.g. Nest Chair)

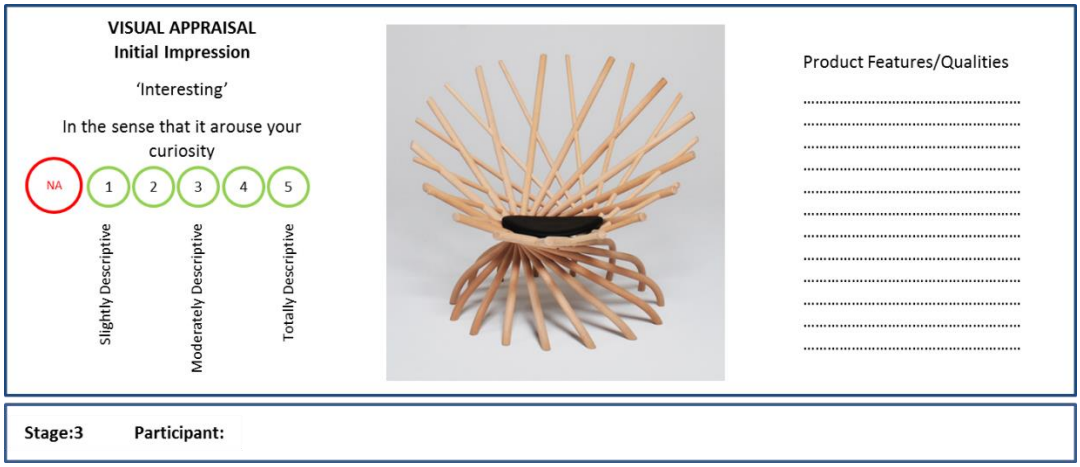


Figure A.2 Stage 3: Users' Evaluation of Intended Visual Expressions (e.g. Nest Chair)

APPENDIX C

QUESTIONNAIRE: DESIGNERS' EVALUATION OF USERS' IMPRESSIONS

Example of the questionnaire for Nest chair

The purpose of this questionnaire is to investigate original designers' interpretations of users' actual visual impressions, especially to see if semantic characters mentioned by target users are within or outside the scope of designers' intended product expressions.

Users' actual impressions are represented as a semantic cluster map. Please first study the logic behind the cluster analysis of users' impressions and answer the questions that follow.

Thank you in advance for taking the time to help me with this questionnaire, which marks the final stage of the field study.

Javad Khalaj

A product sample designed by
Markus Johansson

Product name: **NEST**

Intended Product Expressions: Attractive, Interesting, Uninviting (Poking)

Users' Actual Impressions:

As a reminder, target users of the product (12 participants) were asked to describe their visual impressions through adjectives/meanings. Later, in order to understand in which sense/meaning they had used the adjectives, they were requested to clarify their impressions by providing synonyms for each adjective. Accordingly, these two types of adjectives were defined as 'first order' and 'second order' adjectives.

To process and classify the adjective types, the relationship between first order and second order adjectives was investigated and then a semantic cluster map was developed. The starting point to draw the map was first order adjectives with highest frequencies of mention. The number of circles drawn around each first order adjective reveals the frequency of mention among users. The direction of arrows shows the relationship between first and second order adjectives. For example, product NEST was considered by one user as '*energetic*' (i.e. one circle is shown) since he found it '*exuberant*' and '*dynamic*'. Moreover, '*energetic*' is mentioned three times as an explanation for the adjective '*aloud*', '*lively*', and '*wild*'. Through this approach, connected/related adjectives can be defined, and their meaning (semantic) connections revealed. Accordingly, six groups of adjectives, which characterize users' overall impressions of the product 'NEST' were established.

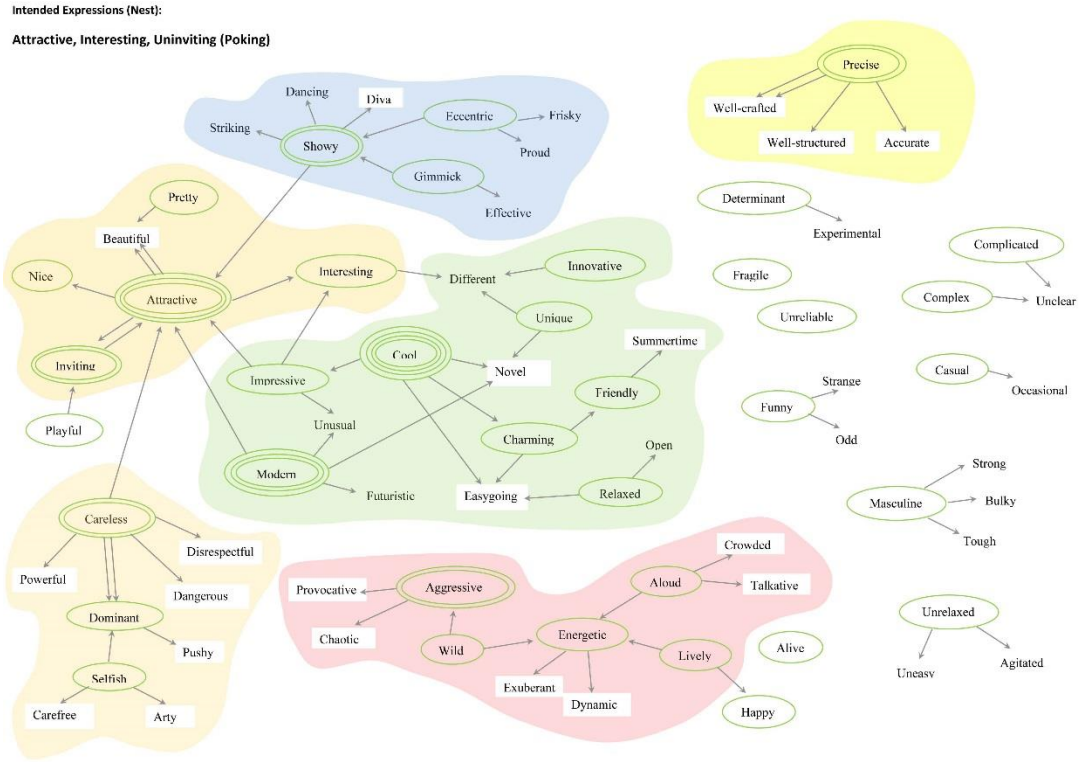
1. **Cool**, Modern, Impressive, Charming, Relaxed, Friendly, Unique, Innovative
2. **Attractive**, Inviting, Nice, Beautiful, Pretty, Interesting
3. **Careless**, Dominant, Selfish, Disrespectful, Dangerous, Powerful
4. **Aggressive**, Wild, Energetic, Aloud, Lively, Provocative, Chaotic
5. **Showy**, Gimmick, Eccentric, Striking, Dancing, Diva
6. **Precise**, Accurate, Well-Crafted, Well-Structured

Question 1:

May you please discuss your overall interpretations of users' impressions? Are you happy about users' impressions? Do the semantic characteristics listed above match with your expectations?

Question 2:

Within the context of your overall intended visual expressions, which types of adjectives/meanings do you think are within the 'scope' of your original thinking? Please confirm your evaluation by mentioning the first order adjective of the group.



APPENDIX D

DESIGNERS' AND USERS' EVALUATION OF PRODUCT EXPRESSIONS/IMPRESSIONS

Markus Johansson							Original Gradings								
	LAMP (Cirrata)	DESIGNER		USER 1	USER 2	USER 3	USER 4	USER 5	USER 6	USER 7	USER 8	USER 9	USER 10	USER 11	USER 12
	Dancing (Floating/Hovering)	5		4	4	5	4	5	5	5	5	5	2	4	5
	Charming	4		3	1	3	NA	3	5	3	3	2	5	4	4
	Precise	4		4	NA	3	3	2	4	5	4	5	4	4	4
	Honest	-		5	3	3	NA	2	5	4	2	4	5	5	5
	Calm	-		2	3	2	4	4	4	3	1	2	5	2	2
	Sensitive	-		NA	1	2	4	4	5	2	3	2	4	NA	4
	Playful	-		NA	3	4	4	5	3	3	4	4	4	4	4
	Happy	-		NA	3	3	NA	5	5	NA	2	3	4	4	2
	Simple	-		3	3	1	NA	4	NA	3	NA	3	4	3	2
	CHAIR (NEST)	DESIGNER		USER 1	USER 2	USER 3	USER 4	USER 5	USER 6	USER 7	USER 8	USER 9	USER 10	USER 11	USER 12
	Attractive	4		5	2	1	5	4	5	5	4	5	3	4	5
	Interesting	4		5	2	5	5	4	4	5	4	5	3	4	5
	Uninviting (Poking)	3		3	5	5	3	2	5	2	4	2	NA	2	3
	Simple	-		4	NA	NA	NA	2	NA	2	NA	3	1	NA	2
	Distinct	-		5	4	5	5	4	4	5	4	5	5	4	4
	Honest	-		5	3	4	5	1	5	3	3	4	4	5	4
	Feminine	-		NA	NA	NA	NA	2	NA	3	NA	4	NA	2	NA
	Attractive	-		5	2	1	5	4	5	5	4	5	3	4	5
	Honest	-		5	3	4	5	1	5	3	3	4	4	5	4

Figure A.3 Users' gradings: Evaluation on 'true' and 'false' adjectives (Cirrata and Nest)

Markus Johansson							Distance from designer's Gradings								
	LAMP (Cirrata)	DESIGNER		USER 1	USER 2	USER 3	USER 4	USER 5	USER 6	USER 7	USER 8	USER 9	USER 10	USER 11	USER 12
	Dancing (Floating/Hovering)	5		-1	-1	0	-1	0	0	0	0	0	-3	-1	0
	Charming	4		-1	-3	-1	-4	-1	1	-1	-1	-2	1	0	0
	Precise	4		0	-4	-1	-1	-2	0	1	0	1	0	0	0
	Honest														
	Calm														
	Sensitive														
	Playful														
	Happy														
	Simple														
	CHAIR (NEST)	DESIGNER		USER 1	USER 2	USER 3	USER 4	USER 5	USER 6	USER 7	USER 8	USER 9	USER 10	USER 11	USER 12
	Attractive	4		1	-2	-3	1	0	1	1	0	1	-1	0	1
	Interesting	4		1	-2	1	1	0	0	1	0	1	-1	0	1
	Uninviting (Poking)	3		0	2	2	0	-1	2	-1	1	-1	-3	-1	0
	Simple														
	Distinct														
	Honest														
	Feminine														
	Attractive														
	Honest														

Figure A.4 Users' gradings: Distance from designer's gradings on intended 'true' adjectives

Jonas Forsman							Original Gradings									
	LAMP (PARASOL)	DESIGNER		USER 13	USER 14	USER 15	USER 16	USER 17	USER 18	USER 19	USER 20	USER 21	USER 22	USER 23	USER 24
	Dancing (Floating/Hovering)	-		2	NA	NA	5	3	1	3	3	5	4	3	4
	Charming	-		NA	4	3	4	3	3	3	3	1	4	5	5
	Precise	-		4	5	5	3	4	4	2	4	5	5	4	4
	Honest	3		5	4	5	4	4	4	3	5	NA	2	4	4
	Calm	4		3	2	4	3	3	4	4	5	NA	4	5	4
	Sensitive	5		3	3	4	4	3	3	5	4	2	3	5	5
	Playful	-		3	4	2	5	3	3	5	2	2	4	2	4
	Happy	-		NA	2	2	4	2	3	NA	3	NA	4	5	3
	Simple	-		4	5	5	5	4	4	5	5	3	5	5	3
	CHAIR (ARC)	DESIGNER		USER 13	USER 14	USER 15	USER 16	USER 17	USER 18	USER 19	USER 20	USER 21	USER 22	USER 23	USER 24
	Attractive	-		4	2	4	3	2	3	4	4	NA	NA	3	3
	Interesting	-		2	1	4	4	3	3	3	4	NA	3	5	4
	Uninviting (Poking)	-		3	4	3	5	3	2	NA	NA	3	3	4	NA
	Simple	3		5	4	3	5	4	4	4	4	5	5	5	4
	Distinct	4		3	4	4	3	2	4	3	4	4	2	3	4
	Honest	4		5	3	4	2	4	3	4	3	3	5	5	5
	Feminine	-		NA	2	3	NA	NA	NA	NA	NA	3	3	NA	4
	Attractive	-		4	2	4	3	2	3	4	4	NA	NA	3	3
	Honest	-		5	3	4	2	4	3	4	3	3	5	5	5

Figure A.5 Users' gradings: Evaluation on 'true' and 'false' adjectives (Parasol and Arc)

Jonas Forsman							Distance from designer's Gradings									
	LAMP (PARASOL)	DESIGNER		USER 13	USER 14	USER 15	USER 16	USER 17	USER 18	USER 19	USER 20	USER 21	USER 22	USER 23	USER 24
	Dancing (Floating/Hovering)														
	Charming														
	Precise														
	Honest	3		2	1	2	1	1	1	0	2	-3	-1	1	1
	Calm	4		-1	-1	0	-1	-1	0	0	1	-4	0	1	0
	Sensitive	5		-2	-2	-1	-1	-2	-2	0	-1	-3	-2	0	0
	Playful														
	Happy														
	Simple														
	CHAIR (ARC)	DESIGNER		USER 13	USER 14	USER 15	USER 16	USER 17	USER 18	USER 19	USER 20	USER 21	USER 22	USER 23	USER 24
	Attractive														
	Interesting														
	Uninviting (Poking)														
	Simple	3		2	1	0	2	1	1	1	1	2	2	2	1
	Distinct	4		-1	0	0	-1	-2	0	-1	0	0	-2	-1	0
	Honest	4		1	-1	0	-2	0	-1	0	-1	-1	1	1	1
	Feminine														
	Attractive														
	Honest														

Figure A.6 Users' gradings: Distance from designer's gradings on intended 'true' adjectives

Sami Kallio							Original Gradings								
	LAMP (WOODSTOCK)	DESIGNER		USER 25	USER 26	USER 27	USER 28	USER 29	USER 30	USER 31	USER 32	USER 33	USER 34	USER 35	USER 36
															
	Dancing (Floating/Hovering)	-		3	NA	1	NA	NA	1	3	NA	NA	2	NA	4
	Charming	-		4	3	4	3	4	2	5	1	3	5	1	5
	Precise	-		3	2	4	4	3	2	NA	5	2	5	2	4
	Honest	-		5	4	4	4	3	2	3	5	5	5	3	3
	Calm	-		5	5	4	5	4	4	4	5	5	5	4	5
	Sensitive	-		NA	3	1	3	NA	2	NA	NA	1	NA	NA	NA
	Playful	3		3	2	4	3	4	4	5	4	4	5	1	3
	Happy	5		4	NA	3	3	3	3	5	2	1	4	NA	2
	Simple	4		5	4	4	5	3	2	4	5	5	5	3	4
	CHAIR (5Y)	DESIGNER		USER 25	USER 26	USER 27	USER 28	USER 29	USER 30	USER 31	USER 32	USER 33	USER 34	USER 35	USER 36
															
	Attractive	-		4	NA	4	4	5	3	5	4	5	2	5	5
	Interesting	-		5	2	5	5	4	4	4	4	4	4	4	4
	Uninviting (Poking)	-		3	3	NA	NA	NA	NA	2	1	NA	4	NA	2
	Simple	-		NA	2	3	3	2	3	3	4	5	3	3	5
	Distinct	-		5	5	4	4	4	3	5	3	4	4	3	5
	Honest	-		NA	NA	4	4	3	4	4	4	5	3	4	4
	Feminine	4		4	5	5	1	4	3	5	4	5	5	5	3
	Attractive	4		4	NA	4	4	5	3	5	4	5	2	5	5
	Honest	4		NA	NA	4	4	3	4	4	4	5	3	4	4

Figure A.7 Users' gradings: Evaluation on 'true' and 'false' adjectives (Woodstock and 5Y)

Sami Kallio							Distance from designer's Gradings								
	LAMP (WOODSTOCK)	DESIGNER		USER 25	USER 26	USER 27	USER 28	USER 29	USER 30	USER 31	USER 32	USER 33	USER 34	USER 35	USER 36
															
	Dancing (Floating/Hovering)														
	Charming														
	Precise														
	Honest														
	Calm														
	Sensitive														
	Playful	3		0	-1	1	0	1	1	2	1	1	2	-2	0
	Happy	5		-1	-5	-2	-2	-2	-2	0	-3	-4	-1	-5	-3
	Simple	4		1	0	0	1	-1	-2	0	1	1	1	-1	0
	CHAIR (5Y)	DESIGNER		USER 25	USER 26	USER 27	USER 28	USER 29	USER 30	USER 31	USER 32	USER 33	USER 34	USER 35	USER 36
															
	Attractive														
	Interesting														
	Uninviting (Poking)														
	Simple														
	Distinct														
	Honest														
	Feminine	4		0	1	1	-3	0	-1	1	0	1	1	1	-1
	Attractive	4		0	-4	0	0	1	-1	1	0	1	-2	1	1
	Honest	4		-4	-4	0	0	-1	0	0	0	1	-1	0	0

Figure A.8 Users' gradings: Distance from designer's gradings on intended 'true' adjectives

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