



Journal of Indian Business Research

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Article information:

To cite this document:

Abhishek Mishra , (2016), "An exploratory conceptualization of consumer design perception for digital devices", Journal of Indian Business Research, Vol. 8 Iss 2 pp. 143 - 163

Permanent link to this document:

<http://dx.doi.org/10.1108/JIBR-03-2015-0037>

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An exploratory conceptualization of consumer design perception for digital devices

Consumer design perception

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Received 20 March 2015
Revised 17 October 2015
Accepted 16 January 2016

Abstract

Purpose – Despite the volume of work on the subject, product design and its conceptualization has remained relatively abstract. There is hardly any discussion about the holistic meaning of design, especially with regards to its meaning for a user. This paper aims to explore consumer design perception to provide it a multidimensional definition and measure that is more relevant to industrial designers.

Design/methodology/approach – The study was done in two qualitative phases: the first to generate and confirm the design dimensions pre-conceived from literature, corroborated with consumer voices; and the second to include gamified depth interviews triangulated with conventional depth interviews and word association-based correspondence analysis to generate items that can measure each of those dimensions.

Findings – The first study confirms five dimensions of consumer design perception: visual, functional, kinesthetic, interface and information. Following the second phase, the study proposes five items for visual design, seven for functional design, three for kinesthetic design, four for interface design and five for information design.

Research limitations/implications – Though through multiple qualitative studies, combined with literary evidence, this work provides reasonable qualitative validity to the findings, a semiotic analysis-based methodologies that can further concretize, if not refute, the findings. Rooted in the theory of design value, the study explores transformation of design values, from the designer's domain to that of a consumer. While each of the design constructs has gone through a thorough investigation in literature, this work is the first to provide a unified theory of consumer design perception.

Practical implications – Designers have long struggled to know what consumers want. There is a clear divide in designers and consumers' meanings of design. This study attempts to bridge this divide. Items measuring each construct should enable them in tweaking their offerings to a consumer's liking.

Originality/value – Design is an abstract term and can be applied by a designer or a consumer. Dimensionalization of this complex term for better understanding using innovative qualitative tools serves as an original contribution to field of design research.

Keywords Information, Interface, Functional, Design perception, Kinesthetic, Visual

Paper type Research paper

Introduction

Product design is a well-researched domain, with consumer researchers focusing on it as a primary source of user experience (Desmet *et al.*, 2007), consumption value



Journal of Indian Business Research

Vol. 8 No. 2, 2016

pp. 143-163

© Emerald Group Publishing Limited

1755-4195

DOI 10.1108/JIBR-03-2015-0037

The author would like to thank the PGP students of IIM Lucknow who helped in organizing some of the activities in this study as well as providing valuable assistance in the logistics involved. I would also like to thank the Index Core Committee at IIM Lucknow for funding the research.

(Holbrook, 1999) and brand identity (Karjalainen and Snelders, 2010). It is an equally powerful tool for marketers, as more and more organizations are now differentiating their products through design superiority and novelty to gain market shares and long-term competitive advantage. In theory, design remains an abstract concept, with contemporary research highlights ranging from outer appearance to internal functional capabilities. In a quest for clarity, product design has attracted ample but relatively unrelated streams of research. Most research efforts have been led by new product development and usability researchers. However, these studies still lack the depth to fully understand the consumer appeal and response to design (Noble and Kumar, 2010). Additionally, these efforts are more designer-oriented and thus not readily interpretable in a consumer context (Razzaghi and Ramirez, 2005). The cognition of a product's design prudence by the consumer often goes beyond the surface and can involve deeper meaning about the other product aspects (Krippendorff, 1989), as they subconsciously form cognitive models of product design and learn to use it (Norman, 1988). A deeper investigation into this subconscious processing is clearly required to develop an integrative framework of design as such a framework can provide a reasoning for the designer to create more powerful product designs. By bringing in preconceived design dimensions from design theories and finding their evidence in consumer voices, as a form of qualitative research based on logical positivism (Mick, 1986), this work attempts to make the framework more designer-relevant. This objective is achieved through an interesting mix of exploratory studies, which also includes a gamified version of in-depth interviews to increase user engagement with the process and provides richer and deeper information (Odobasić *et al.*, 2013). We discuss the prominent works in related areas in the next section. Following this, the research methodology section contains a discussion on the research paradigms to justify the suitability of the methods used, lending validity to the findings of the study. The findings of the studies are then deliberated followed by discussion, contributions of this work, its limitations and a conclusion.

Literature review

Design, as a concept, is still being examined in an attempt for a concrete definition and has been widely studied using different perspectives and contexts, from being a strategic tool (Kotler and Rath, 1986; Roy and Bruce, 1988) to being a source of affect (Seva *et al.*, 2007; Khalid, 2006; Seva and Helander, 2009) and user experience (Pullman and Gross, 2004). The design-as-value body of literature refers to it as an inherent product quality that generates utilitarian and hedonic benefits for the user (Batra and Ahtola, 1991; Chitturi *et al.*, 2008; Gutman, 1982; Petruzzellis, 2010; Huang and Truong, 2008; Page and Herr, 2002; Sheng and Teo, 2012; Dhar and Klaus, 2000; Mano and Oliver, 1993; Voss *et al.*, 2003). Researchers treating design as an aggregate of attributes have primarily been studying it at an atomistic level of small components (Karjalainen *et al.*, 2005; Han and Hong, 2003; Yun *et al.*, 2003; Sonderegger and Sauer, 2010), but recently there have been attempts to understand a concept of design made up of sub-dimensions, as opposed to an overarching construct (Seva *et al.*, 2007; Salmi and Sharafutdinova, 2008; Chitturi *et al.*, 2008; Ziefle, 2002; Hazzenzahl, 2004, Cyr *et al.*, 2006). Our work extends the arguments presented in these efforts to arrive at an exhaustive design definition.

As a foundation, this study borrows from the theory of product semantics that highlight the deeper meanings users attach to products beyond its outer beauty (Krippendorff, 1989). But rather than relying solely on the users to provide symbolic meanings to product design, a form of research performed extensively in consumer research according to design-as-value; this work aims to structure overall design into sub-design constructs, drawn primarily from the design literature and then explores the meanings and implications of each for the consumer. In an effort to identify viable and measurable dimensions for design, this work delved into streams of works that provide different identities of design as possible dimensions of consumer design understanding. It was found that, in the case of both pre-purchase and usage scenarios, general product design has been explained in various ways – aesthetics (Huang and Truong, 2008; Page and Herr, 2002; Sheng and Teo, 2012; Creusen and Schoormans, 2005; Cyr, 2008; Bloch *et al.*, 2003; Veryzer and Hutchinson, 1998; Coates, 2003; Tractinsky, 1997), product functionality (Chitturi *et al.*, 2008; Huang and Truong, 2008; Seva and Helander, 2009) and ergonomics (Noble and Kumar, 2008; Yanamoto and Lambert, 1994). In their theory of design value, Nobel and Kumar (2008) also exhibit these three design aspects as critical for consumer satisfaction, making them judicious choices for sub-dimensions of overall design. However, more recently, two new facets of design, interface and information design have also been investigated in detail (for a comprehensive review, see Sonderegger and Sauer, 2010). These two additional dimensions of design have a special relevance for the newly emerging category of digital devices. Digital devices (such as smartphones, computers and in-car infotainment systems) present unique challenges to designers about certain parameters of information design, including readability on small screens, legibility of information presented and the quality of interactions with the information system (Dillon *et al.*, 1990; Duchnicky and Kolers, 1983). Similarly, graphics user interface has gained a prominent role in device design with dedicated user-experience teams focusing on design cells and aiming to create a positive user experience, through an intuitive and easy-to-use interface. In a review, Sonderegger and Sauer (2010) highlight how interface and information quality is critical for the usability of such a category of devices. Interface design and information design thus needs to be investigated and integrated deeper for an exhaustive consumer design meaning.

To represent such an evolving category of digital devices, the smartphone was chosen as the context for this work, as it is well-embedded in everyday use. In addition to being a functional communication medium, smartphones have today become a conduit of self-expression for owners delivering, not only utilitarian benefits but also the ability to generate pleasure and enjoyment (Dess *et al.*, 2006; Sheth and Solomon, 2014; Clayton *et al.*, 2015; Cyr *et al.*, 2006; Jordan, 1998, 2000). Thus, within this context, consumers are expected to evoke all facets of design, giving a comprehensive framework generalizable to the entire category.

Research methodology

Ascribing to Popper's paradigm of realism that proposes objects are present independently of a researcher and a single way of measurement may not be enough to study it fully, for this study, we conducted four different qualitative studies in two different stages to understand the consumer perception thoroughly (Magee, 1985; Guba and Lincoln, 1994). To ensure higher generalizability of the findings, we conducted these

qualitative processes with respondent numbers greater than is generally adopted. In addition, the reliability and validity of the findings within the realism paradigm are maintained by two criteria – auditability and triangulation (Healy and Perry, 2000). Auditability has been maintained by reproducing original quotes, in form of thematic mentions, of the respondents, while triangulation has been meticulously followed by the conduction of three qualitative processes simultaneously for better results (Campbell and Fiske, 1959). We present a brief description of the stages below.

Stage 1

In the first stage, there were 13 focus group discussions (FGD) that were conducted with the support of post-graduate students at a prominent business school in India. All respondents were smartphone owners recruited randomly from the schools’ admissions list. A brainstorming session was conducted to generate different design elements critical to users. The participants were asked to explore suggested discussion themes by discussing *what they understood by design and what does a good or bad design mean to them*. Figure 1 below represents the *modus operandi* of this stage.

The aim of this stage was to explore and reinforce the broad design dimensions conceived from the literature review above.

Stage 2

The second stage of the research involved generating meanings consumers attach to each proposed design dimension that can be used to develop possible items to measure each. The second phase was set in the annual market research fair organized by the business school and where there was an influx of real consumers. The target group for this leg were those who owned smartphones in the price range of US\$100 to US\$300 and were manufactured by leading players including Samsung, Nokia, Blackberry and LG. The choice of this price range and brands, indicating a segment with heavy market uptake, was used to operationalize the otherwise loosely defined category of smartphone. At the time of data collection, phones below the US\$100 price range were difficult to be classified as smartphones, while those above US\$300 were considered luxury products, and not necessarily because of their objective features. The qualitative methods used in this stage were three-pronged to serve the purpose of triangulation.



Figure 1.
FGD process

The first sub-stage composed of conducting gamified in-depth interviews with 70 respondents at the fair venue and sequential random sampling followed. Of all, the smartphone owners that turned up at the fair, every fifth one was sent to the stall to take part in this research. Gamifying the interaction was preferred to mitigate the social desirability bias consumers depict during the course of a normal depth interview, as well as concurrently increase respondent engagement (Odobasić *et al.*, 2013). Conventional processes such as in-depth interviews, with a lack of a fun element, put a great cognitive load on the respondents, referred to in the literature as respondent burden, which results in exponential decay in engagement with time (Cannell and Kahn, 1968; Bradburn, 1977). On the other hand, gamified studies tend to over-relax the respondents leading to sub-optimal information (Delaney *et al.*, 2008). To cover for the drawbacks of gamified and conventional research processes, we used a combination of gamified and non-gamified methodologies. At the gamified research stage, the respondents were taken through three different games which were set up in an attempt to simulate three popular reality shows. The details of the games are given in Table I.

The three games were meant to inquire into the respondents feelings about the meaning of design in general and the smartphone in particular, including design aspects they liked or disliked in a displayed product and an in-depth probe about each of the

Games	Procedure
Game 1: Big Boss 	The respondent is asked to arrive in the confession room and made to sit in front of a two-way mirror. The interviewer, makes her feel like a celebrity and then asks the respondent, to give her views on design and what does a good or a bad design mean to her
Game 2: Smartphone Shop 	In this game, the same respondent then goes to a smartphone shop and is asked by the vendor to scratch a card. He gets to choose among six smartphone phones as a lucky prize. When he makes the choice, the vendor asks him about the reason for making the choice especially from design angle
Game 3: Koffee with Karan 	The respondent, then proceeds to the next game where he is made to sit on a couch in front of an interviewer behaving like Karan Johar (a popular Indian Filmmaker). In line with the original show's theme of confessions and controversies, the interviewer dummies the different design dimensions as features of human beings (like visual design becomes beauty) and asks for relevant characteristics. The respondent is then asked to transcribe those qualities into a smartphone

Table I.
Game details

design dimensions generated from the first stage of the study (focus groups and literature review).

To ensure that the findings of the gamified in-depth interviews were not inferior because of gamification, the second sub-stage involved conducting six parallel conventional in-depth interviews with a discussion guide developed to further explore the five design dimensions. A third sub-stage was conducted to achieve a concrete design understanding by enabling respondents to associate diverse design meanings to specific design buckets that involved the creation of a long list of design-derived meanings from the literature. Each of the items was framed as a statement in an attribute-benefit format. The depiction of items as a set of attributes and benefits has its roots in the means end theory which implies that subconsciously each individual perceives a product as a hierarchy of attributes topped by abstract benefits (Gutman, 1982; Geistfeld *et al.*, 1977). Respondents who participated in the gamified in-depth interviews were asked to link each of these statements to specific unnamed design buckets. Only 45 of the 70 respondents agreed to do this exercise, as they waited for their turn to enter the gamified in-depth interviews, represented in Plate 1.

A correspondence analysis was run as part of the data to get perceptual maps and understand the proximity of each statement to each dimension. The three sub-stages of stage two were then integrated to come up with final possible items as a measure for each design dimension. The overall process flow is represented in Figure 2.

Results

The findings of each stage of the qualitative study were in sync with the conceptualization derived from the exhaustive literature review. The findings of the study have been presented at each stage.



Plate 1.
Word association
exercise

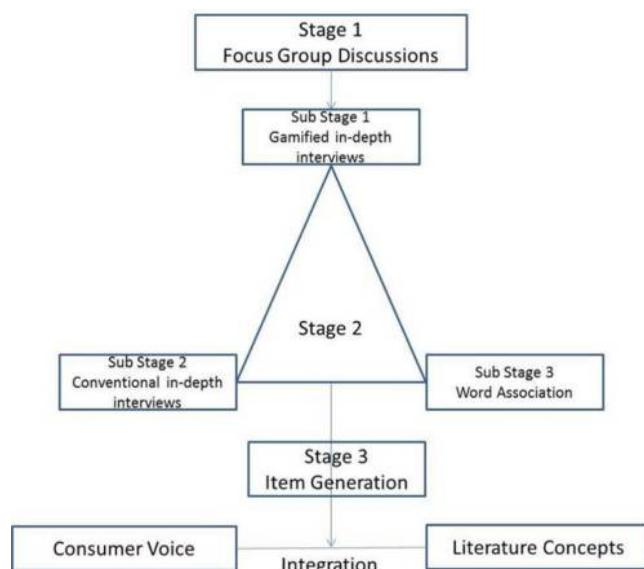


Figure 2.
Process flow

Stage 1

Appendix 1 summarizes the core themes that emerged in each of the focus groups. Across all the groups in the first phase, the most common element mentioned was **visual design**, representing the outer appearance of the product, in the form of various terms including *appearance, aesthetics, looks, external appeal* and *first impression*. The second most elicited design dimension in the group discussions was **functional design** in the form of elicitations such as *features, usability, functionality, utility, technology features* and *specifications*. This is again, as per expectations, the functionality of a product as decided by whether it meets or exceeds the expectation of a user. Quite a few groups also discussed **kinesthetic design** and mentioned such phrases as *easy to handle, fits in pocket, small size, ergonomics* and *easy to use*. This provides the supporting evidence that human factors are also an important factor when it comes to evaluating the overall design. Interface of products in the digital devices category have substantial importance, and thus **interface design** was expected to figure in these discussions. And it did, with the groups discussing aspects involving *user-interface, touch screen, navigation design* and *menu structure*. Finally, there were erratic views about the clarity of information written on the screen or body with words such as *simplicity* and *clarity* being mentioned. Respondents' responses about this aspect of design provides the evidence of the existence of the **information design** dimension in the consumer design perception.

Stage 2

This stage was aimed at generating possible items to measure each of these dimensions comprehensively. As this stage was composed of three parallel sub-stages, we present the results of each separately.

Sub-stage 1. Gamified qualitative processes were conducted at this sub-stage. When asked about their understanding of design in the first game, respondents came up with adjectives such as *shape, attractiveness, appearance, looks, color, pattern, style* and *material used, artistic* and *funky* pointing towards visual design as conceptualized in Stage 1. Further, they elicited words including *functionality, features, connectivity, durability* and *latest technology* that confirmed the dimension of functional design. Similarly, descriptions such as *convenience, easy to carry in pocket, easy to handle, portable, sleek, weight, size, manageable* point towards the kinesthetic design, while *screen size, smooth touch, user interface* and *simple uncomplicated interface* point towards the interface design. Finally, elicitations related to *clarity, simplicity* and *simple language* point towards information design. Thus, the design understanding provided by the respondents in the first game is pretty much in sync with those mentioned in the focus groups. The next two games of the sub-stage involved a deeper probing into each design dimension. Questions were asked in a surrogate manner to enhance engagement through gamification. While the second game involved invoking each design dimension as the reason for choosing a particular phone, the third game was a more direct simulated depth interview about each design aspect in a gamified environment. **Figure 3** represents most elicited items corresponding to each design element in these two games.

Sub-stage 2. The second sub-stage comprised of six conventional in-depth interviews conducted to support the findings of the gamified in-depth interviews where respondents were randomly chosen and those who had participated in the earlier game exercises were eliminated. The questions asked in this sub-stage were similar to the ones asked in the previous sub-stage, except that the questions were put directly. Prominent consumer voices for each design dimension are highlighted below:

- *Visual design:* When asked about visual design, RP (research participant) 1 mentioned *color should stand out, the visual effects should represent the brand and*

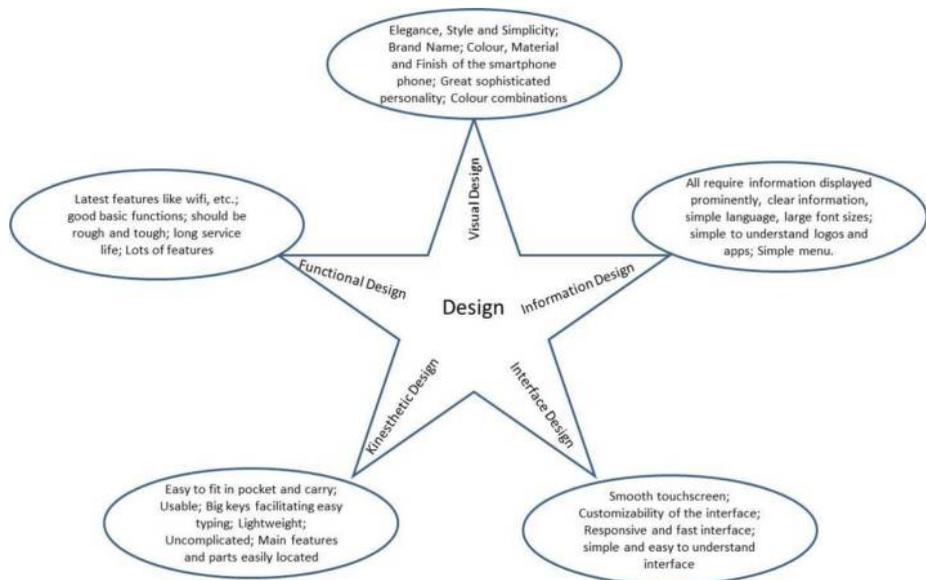


Figure 3.
Broad design
elements and major
consumer voices
(FGDs)

should be able to make a good first impression. RP2 described visual design as *sleekness, smooth edges, should be proportional in looks, texture, color and looks should be categorical to the brand*. RP3 and RP4 considered an effective visual design as *great finish and phone should look premium*. RP5 had an understanding of visual design as *rounded curves, attractive, simplicity and elegance and eye catching shine*. RP6 mentioned exclusively the concept of *quality of workmanship* as an important visual aspect.

- *Functional design*: Respondents also vividly described different elements of functional design. RP1 talked about *usability* and *durability*, while RP2 had impression of functional design as *multitude of features, fast response, reliability* and *durability*.
- *Kinesthetic design*: The interpretation of this design aspect was not much different from those in the first sub-stage of gamification. While kinesthetic design implied *fit in hand, small size, fit in pocket* and *easy to type* for RP1, it meant *shortcuts that make usability high* for RP2. An exclusive emphasis for this design element was stated by RP5 as *my phone should be intuitive and easy to learn*.
- *Interface design*: This design aspect also found, according to RP1, that interface in the form of *easy to find, most used apps, customizability* and *simplicity of interface*. RP2 described a good interface design as one which has *simplicity in navigation* and *one-touch access*, while RP3 and RP4 considered it as the ability of the interface to allow *multitasking* apart being from *simple* and *customizable*. RP5 wanted the interface to be *lively* and *capable in performance* and RP6 desired an effective interface to be one where *applications and features are easy to find*.
- *Information design*: This design element, though respondents struggled to explain it, did get described as *concise information, simple logos for apps* and *display of prominent information* by RP1, *the display area should be less cluttered and basic information always there* by RP2, *clarity of information both in device and on keypad* and *less but relevant information* by RP5, while RP6 described it as *easy* and *simple language avoiding tough English*.

Sub-stage 3. This stage, as mentioned earlier, was a bottom-up approach to zoom in on relevant items from a long list generated from the existing literature, as well as the previous two sub-stages. This exercise was done a day after the previous two, as it enabled the integration of items from consumer voices to those generated from the literature. The full list of items is depicted in [Appendix 2](#). Correspondence analysis was used to analyze the proximity of items to design dimensions through a perceptual map. The output of the exercise in the form of correspondence analysis is given in [Figure 4](#).

Based on the output of the correspondence analysis seen above, we shortlisted the items that were close to their correct dimensions, depending on visual proximity. Other items found to be close to the wrong dimensions were considered to be misclassification and removed from the list. We did, however, find there were some cross-associations and items that were closer to inappropriate dimensions. The possible reason lies in the lack of clarity of respondents about tenets and details of

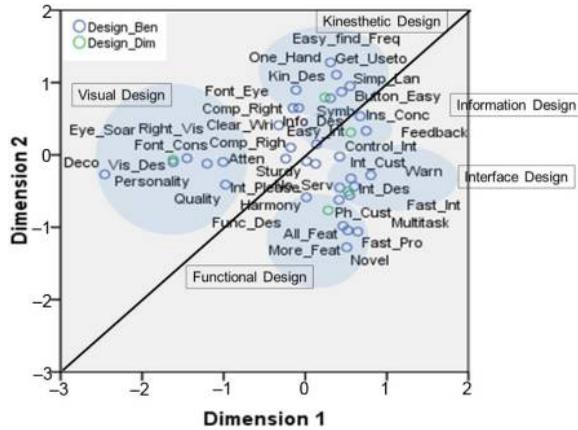


Figure 4.
Correspondence
output

different dimensions, especially interface design and information design. Hence, the findings of the correspondence analysis, though robust, were taken only as indicative to item generation rather than as a rule of sanctity.

Discussion

The first aim of the second stage was to confirm the findings of the focus groups about the existence of the five design dimensions conceived from the literature. We found that the gamified in-depth interviews reiterated the views echoed by the participants of the FGD and confirmed that, for measuring design adequately for a digital device, visual, functional, kinesthetic, interface and information designs need to be measured together. The next aim of the second stage was to generate possible items to measure each of these design dimensions. The most critical stage involved triangulation of the findings and integrating them with the concepts of literature to come up with possible items in the attribute-benefit format (Geistfeld *et al.*, 1977). We demonstrate the integration process in Table II. All the possible items can be measured on a five or seven-point agree-disagree scale. Discussion of the anchor is beyond the purview of this study.

As is evident from the table, the five design dimensions have diverse interpretations. Visual design refers to the elegance of the product which implies that people prefer simplicity when it comes to the outer appearance, compared to over-designed products. Yet, people prefer some outside elements to be included in the product, whether it is the brand, logo or any part of design language, to make the product look special. Texture, color and finish also emerge as strong indicators of a good visual design, something that designers need to be conscious of. Another interesting manifestation of visual design is a good color contrast in the product, implying a good mix of colors, with simplicity maintained being preferable. Finally, consumers associate their own personality with that of their product and want it to reflect their personal characteristics. When it comes to a product's functional design, in addition to the basic features that define the product in its category, consumers also want it to be laden with the latest features technology has to offer, more than any other competing product. An important representative of this design aspect is product performance, reflected in the multitasking ability of the product

Concept	Source	Mentions	Possible item
<i>Visual design</i>			
Simplicity/elegance	Linghammer (2007), Mullet and Sano (1995)	Smartphone should have right decoration/Smartphone design should be simple and sober	My phone styling looks elegant
Refinement	Linghammer (2007), Mullet and Sano (1995)	The phone should be of right size/shape should be attractive/eye catching/brand name prominent/soft edges	Standout elements of my phone (such as brand name, logo, size, shape and edges) are eye catching
Unity	Verzyer and Hutchinson (1998)	Phone looks good overall/everything looks good together/the whole package looks excellent/good overall impression	The appearance (like finish, texture, color, sleekness and pattern) of my phone go well together
Contrast	Verzyer (1993)	Color combination should be right/It should be easy on eyes	My phone has proper contrast in form of right color combinations
Personality	Linghammer (2007)	Phone should have the right personality/personality matching with mine	My phone matches my personality
<i>Functional design</i>			
Features	Jordan (1998)	Latest features/features like Wi-fi, NFC, etc./latest technology	The phone offers a lot of latest features like NFC, Wi-Fi, 3G, 3-D, OS, etc.
Features	Jordan (1998)	Should have good features/basic functionality served well/voice clarity/battery backup	The phone has just the right amount of basic features that I need like battery life, clear voice, etc.
Features	Jordan (1998)	Loaded with features/more features than competition/best in the class in terms of features	My phone has the maximum amount of features in its own category
Performance	Bloch (1995), Hollins and Pugh (1990), Kotler and Rath (1986)	Fast processor/smartphone performance should be good/No lag in performance/latest processor/large memory	The processor and memory of the phone enables seamless performance
Performance	Bloch (1995), Hollins and Pugh (1990), Kotler and Rath (1986)	Can open more than two applications/phone should allow multitasking/can work on 3-4 applications simultaneously	The phone specifications allow for opening two or more applications
Reliability	Bloch (1995), Hollins and Pugh (1990), Kotler and Rath (1986)	Long service life/should not break down frequently/need not go to service center/reliable	The phone is reliable and yet to be sent to service center for repairs
Durability	Bloch (1995), Hollins and Pugh (1990), Kotler and Rath (1986)	Smartphone should be tough and tough/should be able to take abuse/should be sturdy/should not break easily	The phone is very sturdy and can take a lot of abuse like accidental fall, sharp objects

(continued)

Table II.
Proposed items for each design dimension

Table II.

Concept	Source	Mentions	Possible item
<i>Kinesthetic design</i>			
Convenience	Osborne (1987)	Should be easy to hold in one hand/can operate by one hand/one hand usability/small size/light weight	The phone shape and size is such that it makes it easy to hold
Convenience	Osborne (1987)	Fits in one pocket/can carry in jeans or trouser pocket	The phone's size makes it easy to fit in a pocket
Convenience	Osborne (1987)	Buttons should be large in size/easy to type/gaps between buttons should be large/qwerty keypad to make typing easy	The keyboard of the phone facilitates easy typing of messages and phone numbers
<i>Interface design</i>			
Task suitability	ISO/CEN(2) 9241	The interface should be responsive/there should be no lag/It should not hang	The interface of the phone is fast and there is no lag in performance
Self-descriptive	ISO/CEN(2) 9241	The interface should be easy to understand/interface should not confuse me/navigation should be simple and easy to understand	The interface is very helpful and guides me in case I need help
Customizability	ISO/CEN(2) 9241	Can change interface as per my need/should be customizable	The interface is highly customizable, and thus I can change it as per my need
Learnability	ISO/CEN(2) 9241	Interface should be easy to get used to/It should be intuitive/should be easy to learn	The interface is very easy to get used to and operate thus making it pleasant to use
<i>Information design</i>			
Clarity	ISO/CEN(2) 9241	Information on the phone should be clear/information should be easy to read/Number of buttons should be large	Information like numbers on buttons, instructions in the interface, etc., are very clear
Comprehensibility	ISO/CEN(2) 9241	The font size should be just right/the font should make it easy to read/	The font size used is just right size to make it easy to read
Legibility	ISO/CEN(2) 9241	Simple language used in the phone/should not use tough English/should have support for Hindi	The language used in the phone is simple and suits everyone
Discriminability	ISO/CEN(2) 9241	Logos for application should be easy to get/the symbols used in the phone should be right	The symbols used in the phone for apps, actions are right and easy to understand
Clarity	ISO/CEN(2) 9241	Phone should provide feedback/error messages should be there	The phone provides me error messages that helps me fix problems

and the ingredients that enable it. Finally, people want their products to be sturdy and resilient, but they also want them to be reliable with limited requirements of support services. From the human factor perspective of design, represented in our framework by kinesthetic design, the primary requirement for the users is the shape and size of the product that enables convenient usage. Additionally, for interactive devices, consumers require an input system (such as a keyboard) that facilitates easy interaction with the device. For digital devices having some sort of an interface that enables communication, users want it to be fast and lag-free for a better experience. They also want the interface to be intuitive and not taxing by a specific layout. And if the standard layout is found to be too difficult, users want the power to be able to customize it to their own requirements, a feature that is still yet to be seen in most modern devices. Possibly, part of a natural human resistance to change, people want interfaces of new products to be similar to those they are used to consuming to prevent a great amount of additional learning. Finally, in the information design component of overall design, consumers demand instructions in the device to be very clear and legible and include simplicity of font size and language depicted in the device for communication. Additionally, users frequently find the design of logos for applications too difficult to associate with the purpose of the application and thus require congruence. Finally, error messages that not only prompt the users about a wrong action but also guide them towards the correct action, is another feature demanded as part of the information design.

Contributions

As an academic contribution, this study attempts to develop a comprehensive design understanding by appropriate categorization of specific aspects into five dimensions. It provides a starting point of integrating and expanding the exhaustive, but fragmented, work on design perception in the literature. The framework should also serve to provide a platform for better design conceptualizations, applicable to different unrelated product categories. This work has extended the theory of product semantics by revealing deeper meanings that consumers associate with various design dimensions, achieved by using a variety of qualitative exercises (Krippendorff, 1989). Revelations about minute details of each design concept by respondents, which led to the development of scale items, confirm that consumers view their products as made of micro-features, which they aggregate into abstract benefits with unique mental models, thus ascribing different meanings to the overall product (Barsalou, 1999).

Interactions between a consumer with a product is a dyadic process, with consumers looking not only to provide input but also expecting an outcome and feedback. This study, additionally, highlights other design aspects for interactive products beyond the obvious general product facets including aesthetics, functionality and ergonomics. By building in interface and information design, we absorb the product input and feedback aspect into our framework for design perception, thus explaining factors that enhance the efficiency of product usage.

From a practitioner's perspective, we have a significant contribution for contemporary designers. We not only highlight the way design is constructed in a consumer's mind but also important elements of these constructs. Tweaking some of the elements can enhance the overall consumer perception about a broader design aspect, as well as the overall design of the product. Post-study qualitative interviews conducted with a design manager of a prominent smartphone manufacturer, to get feedback on the

design dimensions as well as scale items, got the following response: *It is interesting to see how consumers can go in details about certain features that they can see and some they cannot see. We know they look for good interfaces, but the concept of interface and information design as well as their microscopic understanding by this study has really given us good leads.* The findings highlight what are those elements that need to be focused upon, for designers to deliver products much more acceptable to the users.

Methodologically, another significant contribution of this study is the usage and demonstration of gamified inquiry designs and to assess their effectiveness in revealing consumer information, which normally can become restrained due to respondent fatigue. We successfully demonstrated the triangulation of three qualitative methodologies, two of them unique in gamified depth interviews and word association with correspondence analysis. The findings were fairly convergent and helped in using these methodologies as reinforcements, while covering up the drawbacks simultaneously.

Limitations and future directions

The study itself is not without limitations. A possible drawback is that a positivist approach was adopted to define the five design dimensions, which were assumed to be present in consumer cognition. Though ample literature support was presented to establish the viability of each of the design dimension, a semiotic analysis to reveal consumer meanings to the concept of design would have led to a more consumer-relevant design perception scale. However, as previously mentioned, a primary aim of this work was to make the scale useful for practicing designers, and the preconceived literature derived concepts of design were adopted, and respondents were then made to ascribe meanings to each of them that designers would find much more relevant in tweaking their products to make them more appealing.

Another drawback is that the items generated for each design dimension is purely done using qualitative methods. Though triangulation, auditability as well as literature integration ensure exploratory validity, there needs to be an empirical validation of the findings of this study to really accept the generated items as a valid scale for measuring different design dimensions. A final limitation of this work is the applicability of the model to a general product domain. The current study generated scale items for each design dimension from a smartphone perspective. While most of the items would retain relevance in a broader category of digital devices, some might become redundant in other categories, especially the category of non-interactive devices. A concerted effort to tweak the scale followed by empirical validation represents the progress made by this work.

Conclusion

The digital world is seeing huge advancements in technology every year, resulting in a proliferation of new breeds of products including smartphones, tablets, laptops, wearable gadgets and smart televisions, and the market encompasses three categories of manufactures: those involved in new innovations in form and function for devices with capabilities of micro-computers; players who have controlled manufacturing costs of older technologies and now set competitive prices for new products; and lower priced brands that manufacture products resembling costlier counterparts, therefore satisfying the aspirational needs of their owners. Considering the dynamics of this

market, it is critical to understand the role of different components of product design, especially as understood by the consumer. A dimensional framework should help design firms compartmentalize the design process and thus develop designs that are not just acceptable but also lead to a positive consumer experience. Conducted with a variety of qualitative exercises, this study proposes five dimensions to measure the product design of a digital device, as well as items that can be used to measure each of these dimensions. It is expected that these dimensions can be generalized in other similar product categories (such as interactive devices) and even be chosen selectively, with modifications, depending on the category and, as a result, be extremely and equally useful to designers and marketers.

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Further reading

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Table A1.
Summary sheet,
Stage 1 focus group
discussions

Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Group 9	Group 10	Group 11	Group 12	Group 13
Appearance	Innovative	Looks	Appearance	Practicality	Abstract	Looks	Aesthetics	Functionality	Aesthetics	Features	Physical looks	Looks
Usability	New features	Uniqueness	Functions	External appeal	Aesthetics	Functionality	Technology	Simplicity	Look and feel	Aesthetics	Functional Structure	Looks
Features	Curves	Features	Creativity	Utility	Ergonomics	VFM	Ergonomics	User interface	Differentiation	Personality	Durability	Complexity
	Internal attribute	Technology	Durability	Usability	Functionality	Out of Box	Functionality	Creativity	User Friendliness	Specification	Complexity	
	User-friendliness	Custom looks		Affordability	Structure	Convenient	Uniqueness	Uniqueness	Technology	Brand	Brand	
	Shape			Quality	Usability		First impression	Size				

Appendix 2

Attributes	Category 1	Category 2	Category 3	Category 4	Category 5
The smartphone with right amount of decoration					
The phone always comes with right feedback					
The phone uses simple language					
The interface of this phone is fast and with no lag					
The phone is not eye-soaring.					
The phone allows me to customize it					
Interface is a pleasure to use over time					
Symbols used in the phone are easy to understand					
Due to the interface, the phone feels in control					
My phone has equal or more features than any other phone					
Different components of the phone are at right places					
The critical elements of the phone catch attention					
The font size used is right and not eye taxing					
The phone's shape and size makes it very easy to hold and use in one hand					
The interface gives me warnings/notifications					
Various instructions in the phone are concise and take less time to read					
The phone is yet to be sent to service center					
The processor and memory of the phone make the phone fast					
The writings on the phone body/screen are very clear and do not put a strain					
The visual elements look right for the phone					
The phone material quality is good					
The phone interface is easy to use					
My phone has almost all the features that I need					
The font size and style used is consistent across the phone					
The phone is very sturdy					
The phone components are just the right size					
The phone offers a series of novel features like NFC, Energy saving functions, etc.					
The camera, screen, keyboard and other components go very well together					
The interface is highly customizable					
I can multitask/open more than two applications simultaneously on my phone					
The phone personality matches with me					
The phone was easy to get used to					
Easy to find frequently used application/button					
Button and Icon placement are easy to understand					

Table AII.
Word association
sheet