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Kansei Engineering and cultural differences in mobile phone design

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KANSEI ENGINEERING AND CULTURAL DIFFERENCES IN MOBILE PHONE DESIGN

By

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Abstract

Kansei Engineering, a Japanese design method used to translate feelings into product parameters, was used to look at the mobile phone design features of the Motorola Charm, Samsung t249, and HTC HD7 in the United States. Preferences of four design features (shape, material, LCD screen size, and navigation tools) were explored in a sample population of twenty-five university students in a private Northeastern university. Six kanseis/feelings elicited by phones were determined to be important to this group: (1) Attractive, (2) Cool, (3) Durable, (4) Ergonomic, (5) Modern, and (6) User-friendly. A (generic) phone with a rectangular shape, comprised mostly of metal-like and glass material, with a large LCD screen and navigation via a touchpad was determined to be the most ideal and strongly perceived to elicit many of these kanseis. After exploring the cultural sub-groups of this sample, it was determined that there are significant cultural group differences between Chinese participants and both American and Indian participants, mainly when considering the durability ($p=.008$) and coolness ($p=.034$) of the phone feature set.

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Introduction

User analysis is an integral and critical part of the product development lifecycle. The product development lifecycle refers to the process that a concept goes through to get developed into a tangible product and introduced to a particular market. There are numerous design models which specify a sequence of steps for analysis, design, and production of a product. Product design models are all relatively similar in that they include stages reflecting: (1) front-end analysis activities (characterizing functions of interest and the level of interactivity required by users, determining the value-add of the functions and drivers of the value-add, and examine the drivers to determine if functions are appropriately positioned for the intended users), (2) design of the product, (3) production, and (4) user testing and evaluation (Rouse, 1991). During this process it is important to have an early focus on the user and tasks, obtain feedback through empirical measurement, go through iterative designs using prototypes, and involve users in the design process (Rouse, 1991).

One such model is the Usability Engineering Lifecycle which is a unique and highly effective structured methodology for achieving good usability during the development of products across a variety of platforms (e.g., software applications, websites, hardware, etc.). There are three phases in development that are reflected in the Usability Engineering Lifecycle (Mayhew, 1999): (1) Requirements Analysis, (2) Design/Testing/Development, and (3) Installation. In phase one, there are five areas that need to be defined in order to move forward in the lifecycle: (1) user profile, (2) contextual task analysis, (3) usability goal setting, (4) platform capabilities/constraints, and (5) usability goals. Phase two is split into three levels. Level one deals with high-level design issues, level two deals with setting standards, and the third level speaks to the detailed user interface design (including iterative design evaluation). Phase three points to gathering user feedback after the product has been produced and made available to users. Feedback at this stage is used to enhance the product's existing design or later releases and aid in the design of new, related products.

The main goal in product development is to successfully implement a user-centered design which enhances human abilities, overcomes their limitations, and builds user acceptance by taking into account the variations found in target users. In order to achieve such a design, the user's needs, wants/preferences, and biases all need to be considered at each stage in the design process.

Design Criterion: Affect

Many researchers have supported the argument that affect is an important design criterion, after functionality and usability have been satisfied. Koehler & Harvey (2004) made a case for affect in decision-making processes; their idea was that emotional processing occurs very quickly when interacting with products. Products that are meaningful, interesting, or important to the decision-maker aid in more efficient and thorough processing when choosing a product. Consumers are able to better able to make better product-choice decisions and are less confused by complexity, if the conditions are conducive of positive affect. Lee's (2007) argument that affect plays a critical role in cognition and in human interaction with technology stems from the idea that basic emotions occur in all cultures and there are many different emotions which contribute to behavior. These emotional reactions serve as reflective cues that are related to some past experience and can, in-turn, affect how one views a product.

Jordan (2000) pointedly argued that, similar to Maslow's hierarchy of needs, there is a pyramid of consumer needs (in a product), which consists of three levels. Functionality, at the base of the pyramid, is of top priority. It refers to the behavioral capabilities of the product; the desire is that the product fulfills its purpose and performs at the desired level. Without functionality, the other design criteria do not matter. Usability, the second level, refers to the ease-of-use and learnability of the product. Once consumers have acquired the appropriate functionality in a product, they then want products that allow for simple and intuitive interaction. The peak of the pyramid, pleasure, is defined as the consciousness or sensation induced by the enjoyment or anticipation of what is felt or viewed as good or desirable (Jordan, 2000). Here, consumers want something extra; not only the functional benefits of a product, but also emotional ones. As soon as they are able to achieve the needs at the base of the hierarchy, the desire to fulfill those higher up becomes of interest as obtaining all three needs give off a sense of fulfillment and satisfaction with the product.

Norman (1990) noted that a well-designed product is one with a good conceptual model. A good conceptual model allows us to better understand objects and predict the effects of our actions. He stated that in order for users to form a good conceptual model about a device, it must have: (1) good visibility, (2) object affordances, (3) constraints that help to guide appropriate actions, (4) proper mapping, and (5) feedback for actions completed. All of these speak to the functionality and usability of the product. Norman has also argued that designers now need to consider the emotional appeal of objects through design as functionality, the most important feature, is no longer the only requirement for products (Norman, 2004). In the early days of a product's introduction to society, when users may experience some difficulty learning and getting adjusted to the product, then functionality is a key component. However, once a product has long been established, consumers tend to take functionality for granted (as it is expected to function appropriately) and instead turn to emotional appeal when selecting between similar products or considering whether to purchase a new product or keep an old one (Norman, 2004).

Norman (2004) proposed that three design methods, (1) visceral, (2) behavioral, and (3) reflective must collaborate to ensure an overall good design. Visceral design, used to forge a link between the consumer and the product, relates to the appearance of the product and it influences the consumer's initial reaction. Behavioral design deals with performance and effectiveness of use. There are four components to good behavioral design: (1) function ("What purpose does this product serve?"), (2) understandability ("How does the product work?"), (3) usability ("Can I use this product effectively?"), and (4) physical feel ("How does this product impact my sensory system?") (Norman, 2004). Reflective design is concerned with the meaning of the product, memories, self-image, and personal satisfaction. This type of design is often a part of people's long-term relationship with a product and can be enhanced by cultural conditioning.

Norman (2004) also suggested that attractive things work better because aesthetics influence emotions, which influence the way human mind solves problems. In the decision-making process, positive emotions broaden thought processes and are critical to learning, curiosity, and creativity while negative emotions cause anxiousness and narrow thought processes. When people experience negative emotions, they tend to concentrate on things directly related to the problem and focus on the details by going deeper into the issue until it is resolved. While this tactic may prove to be helpful in situations where survival is related to the issue or when one needs to transform ideas into tangible deliverables through concentration and focus, it tends to frustrate users in other situations when interacting with products in a casual environment. When users experience positive emotions, they tend to focus on the "big picture" (as opposed to the details) and the brain is more receptive to distractions that can facilitate new ideas or approaches. Also, someone who is happy is more likely to overlook or cope with minor problems encountered while interacting with a product.

For optimal success in product development, functional and emotional considerations should collaborate to ensure an overall good design (Jordan, 2000; Norman, 2004). This requires the implementation of a suitable tool, which can identify subjective feelings about a product and translate them into concrete design parameters, within a company's product development process. An existing method, Kansei Engineering, has been used in this manner to evaluate the emotional appeal of products during the development stage.

Kansei Engineering

Kansei Engineering (KE) was originated at Hiroshima University by Mitsuo Nagamachi in the 1970's. Nagamachi (1995) defined this concept as a Japanese word that means customer's feeling and includes the customer's feeling about the product design, size, color, and other distinguishing attributes. As a follow up, KE was defined as an efficient method for rendering the customer feelings into the product design elements (Matsubara & Nagamachi, 1997). As a sub-design method in Affective Engineering, by which the developer translates feeling and emotions into product dimensions, it provides a way to give measurable values to features of different products. Also, it takes the focus away from the developer's intentions of the product, and gives suggestions from the potential user's psychological feelings which help to develop a good user experience. The development of this design method came from a need to appeal to the emotional influences that a customer might experience when selecting an already functional product; that is, finding out which design elements arouse particular feelings in the user, and then, incorporating those features into the product to achieve a specific response.

There are three styles of KE: (1) Type I, Category Classification, (2) Type II, KE Computer System, and (3) Type III, KE Modeling. Category Classification is a method in which a kansei category of a product is broken down in the tree structure to get the design (Nagamachi, 1995). In Category Classification, a zero-level concept (which is the propositional value of the product) is defined. To determine the design specification details, this higher-level concept is broken down into meaningful, related sub-concepts. Physical traits of the product and kansei words are developed and translated into tangible designs. KE Type II is a computer-assisted system. Kansei Engineering System (KES) is a computerized system with the expert system to transfer the consumer's feeling and image to the design details. The KES architecture has four databases: (1) kansei database contains all of the words related to consumer feelings which are representative of the product, (2) image database contains the contributory items in the design details to a specific kansei word, (3) knowledge-base contains the rules needed to decide the highly correlated items of the design details with the kansei words, and (4) design and color database contains the design details with color separated (Nagamachi, 1995). These four databases are populated with information that comes from the kansei process, which is described below. With KE Modeling, a mathematical model is constructed, without the concern of the rules that were established to determine relatedness of the kansei word and design element, to obtain the ergonomic outcome (Nagamachi, 1995).

KE Type II Engineering Process

The first step in the process is to define the Product Domain, which is the assembly of products to be researched. This includes defining the target group/population of interest, and the product in question. Nagamachi (2002) utilized “young drivers” in a study on the Mazda Miata sports car and “ladies aged in the 20’s and 30’s at hair salons” for a study on Milbon hair-care products because these particular populations are the ones who use the product currently or will use the product in the future.

In order to determine the semantic space, the next step in the KE process, the adjectives used to describe the product are collected through research on the product. This can be done by getting feedback from the target group by asking them to use words to describe specific elements associated with the product. During this process, related words are eliminated so that the number of words used is controlled. Similar adjectives are clustered into higher level groups using either a manual or statistical method and kansei words are then formed. These higher level groups are used to form word pairs with opposite words. Words like “sporty vs. non-sporty”, “clean-looking vs. cluttered” and “luxurious vs. non-luxurious” may be determined as kansei words for a car speedometer (Jindo & Hirasago, 1997).

Properties that are most important to the users are defined in the product elements space. Products that are represented in the particular domain are collected and key components are identified. To select which components of the product are important, a Pareto-diagram is used to highlight these features, as expressed by the users. For a car speedometer, these key components can be the meter layout, meter types (speedometer, tachometer, fuel level gauge, water level gauge, etc.), panel color and material (plastic, wood, leather), meter shape (round, semicircular, quarter, oval), inside vs. outside scale, needle starting point, scale type, number orientation (horizontal, centrifugal), lettering and indicator shape (Jindo & Hirasago, 1997).

In the synthesis stage, a semantic differential (SD) scale is used to determine the level of relatedness between a particular adjective (semantic space) and product component (product elements space). The relationship between the semantic and the product elements spaces is established by using statistical tool(s). Jindo & Hirasago (1997) found that when considering the “sportiness” of a speedometer, consumers indicated that 5 meters (number of clusters), round (meter shape), 3-points (scale type), and yellow (indicator color) scored the highest in their relevant categories.

Based on the results of this research, a model is then proposed and tested for validation. If successful, then the kansei model can be applied to the product domain. For a particular kansei word, the model should be able to identify the properties that are important and the design element parameters associated with that word. If the model is found to be unsuccessful, the semantic and product elements spaces should be updated until the model is able to yield reliable results (Figure 1).

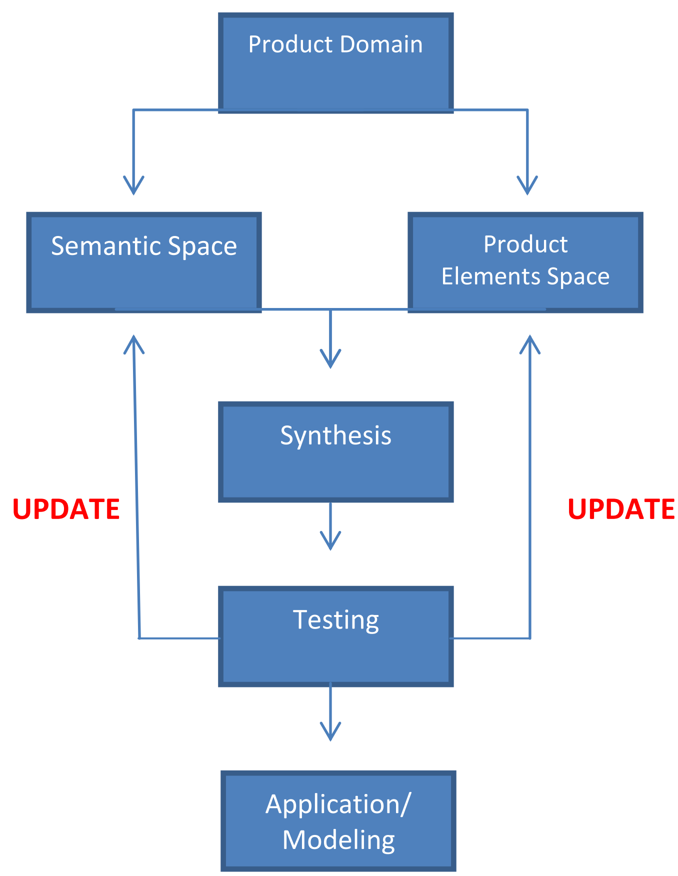

Figure 1. A framework for the Kansei Engineering process (Ying & Yan, 2006)

There are two applications of the KES: (1) consumer-supporting KES, and (2) designer-supporting KES. Both function similarly in that each application provides the user with design feature results. With the consumer-supporting KES, it is a personal-use product with which consumers can directly interact. Kansei words are entered into the system by the user, which are indicative of the feeling the consumer wants from a product. The system is designed to understand what the user wants in a product and outputs the final designs which match these desires. With the designer-supporting KES, the system behaves similarly and it is typically used to aid a designer when creating a new product. The difference, here, is that outputs can be changed in shape design and color if the displayed images are different from the designer's image.

So far, KE has been introduced to multiple industries including automotive, construction machinery, electric home appliance, office machinery, house construction, costume, and cosmetic (Nagamachi, 2002). Application to mobile and entertainment devices have also been more recently explored (Lai, Lin, Yeh, & Wei, 2006; Chen, Chiu, & Lin, 2007; Roy, Goatman, & Khangura, 2009). These studies sought to find the emotional elements that are important to consumers. Moreover, they were able to determine which factors influence consumer's impressions and which emotional tags were associated with each design elements.

Cultural Differences

Culture is often underestimated when it comes to interface design. KE has been studied extensively in Japan and used in the design of products for the Japanese market. While the method has been demonstrated successfully within the very homogenous Japanese culture, there are cultural issues that arise when the method is applied in other countries, for example, in the United States. Designers are not always successful at understanding how cultural differences affect the user's product-purchase decisions and also, in an effort to reduce costs, some companies will opt to use a standard design (with minor design adjustments) to be used in all markets in different countries. This issue highlights the need for gaining a deeper understanding of target cultures and defining different methods which can be used to promote culturally-oriented product innovation.

Hofstede (1980) described culture as multi-defined construct whose definition relies explicitly on the context in which it is being held. He considered the national differences of employees in the organizational setting in the different parts of the world, in an attempt to find aspects of culture that might influence business behavior. Culture was also described as a collectable programming of the mind which distinguishes the members of one human group from another (Hofstede, 1980). For the purposes of this study, we will define culture as that which encompasses the collective characteristics found in groups and which distinguishes one set of people from other sets when making product-selection decisions. The concern of this study is not to finalize a definition for culture, but to ensure that it was understood that there are differences that can be determined in how different groups make decisions.

Hofstede (1980) accounted culture to a combination of five bi-polar dimensions: (1) power distance, (2) individualism-collectivism, (3) masculinity-femininity, (4) uncertainty avoidance, and (5) long-term-short-term orientation. Power distance (PD) describes the degree to which a culture believes how institutional and organizational power should be distributed (whether equally or unequally) and how those decisions should be viewed (whether accepted or challenged). People in high distance cultures are more comfortable with a larger status differential than those who belong to a low distance culture. Individualism vs. collectivism (IDV) indicates the degree to which a culture relies on and has allegiance to the self or the group.

However, it is important to note that individualism and collectivism are not “give-and-take” constructs. A culture can be high in both or low in both. Also, a strong negative correlation was found between a culture’s scores on power distance and individualism-collectivism. High power distance cultures tend to be more collectivistic, while low power distance cultures tend to be more individualistic. Masculinity-femininity (MAS) refers to the degree which a culture values such behaviors as assertiveness, achievement, acquisition of wealth (masculine) or caring for others, social supports and the quality of life (feminine).Uncertainty avoidance (UA) relates to the extent which a culture feels threatened by ambiguous, uncertain situations and tries to avoid them by establishing more structure. Cultures with low uncertainty avoidance believe in accepting dissenting views among cultural members and taking risks and trying new things unlike their high uncertainty avoidance counterparts. Lastly, long-term orientation (LTO) relates to adopting virtues that are focused on future rewards, while short-term orientation is concerned with the virtues related to the past and present. These elements are thought to be universal constructs that make up the framework that aids in understanding how cultural values will influence decision-making.

Hofstede’s model has been used to explain variations in the concepts of self, outlook and how people identity themselves—all of which explain the differences seen in consumer behavior. The model shows that China (IDV= 20), India (IDV = 48), and Korea (IDV=18) are low on individualism, while the United States ranks high (IDV= 91). With power distance (PDI), China, India, Korea and the United States are rated 80, 77, 60, and 40, relatively. China (MAS= 66), India (MAS= 56), and the United States (MAS= 62) fall in the middle of the masculinity scale, while Koreans tend to be on the lower end (MAS=39). On the uncertainty avoidance (UAI), China scored 30, India scored 40, and the United States scored 46; Korea scored highly with 85.

With long-term orientation (LTO), China scored 118, India scored 61, Korea scored 75 and the United States scored 29. China is strongest in long-term orientation, India in power distance, Korea in uncertainty avoidance, and individualism for the U.S. These scores indicate that there are differences in the four aforementioned countries' cultural values (Table 1).

Table 1

Country Scores on Hofstede's Cultural Dimensions Model

Country	Power Distance	Individualism	Masculinity	Uncertainty Avoidance	Long-term Orientation
China	80	20	66	30	118
India	77	48	56	40	61
South Korea	60	18	39	85	75
United States	40	91	62	46	29

Lodge (2007) highlighted how these five dimensions are relatable to user interface and web design. Power distance can be represented in how users access information, user mental models, and value given to authoritative/official symbols. The individualism dimension can be influenced by interfaces that reflect personal achievement, sense of morality, and change. Masculinity can be represented in design elements that speak to gender, family or age traditional values, as well as a user navigation which emphasizes exploration and control. In masculine societies, performance and achievement are important and achievement must be demonstrated, so status brands or expensive products are important to show one's success (De Mooij & Hofstede, 2010). More feminine cultures tend to mask this distinction from the product interface. Clear metaphors and components, use of color and typography to emphasize information all speak to uncertainty avoidance. Also, some design components will use relationships (LTO) and design features that focus on truthful content and rules (short-term orientation) as a basis for information and to establish credibility and practical value (Lodge, 2007).

Desmet & Hekkert (2007) showed that in earlier studies, security, challenge, personal life values and emotional responses elicited by automotive designs were found to be related. They argued that there is an existing relationship between the user's product experience and their values in the context of cultural studies, because implicit and explicit values are often seen as key determinants of culture (Desmet & Hekkert, 2007). "Culturability" was used by Barber & Badre (1998) to define the importance of the relationship between culture and usability. They noted that sound, architecture, geography, flags, mode of dress, signs, customs, language, and currency contribute to the one's awareness of being in an unfamiliar place. Similarly, colors, spatial organization, fonts, shapes, icons and metaphors, geography, language, sounds, and motion contribute to the design and content of a web page, which directly affects the way that a user interacts with the site. Misunderstanding of these components can lead to frustration when users need to accomplish tasks easily and efficiently.

Mobile Devices

The mobile computing and communication industry is a domain that is experiencing explosive growth that will continue into the near future. Mobile device technology has evolved drastically in the last decade. Among the world population of about seven billion people, there are likely to be five billion mobile device subscriptions in 2010 (Cnet, 2010). The features found in mobile devices are being rapidly developed and refined to meet the ever-increasing demands of users. From video cameras to full web browsing capabilities, slim and convenient designs to different interaction methods, these features are coming to better suit the needs and preferences of different users.

A recent survey reported that 43% of Indian consumers consider the brand when making a decision to purchase a mobile phone (iPhoneMagazine, 2010). These consumers consider brand as the main influential factor. For the Chinese consumer, the 2010 Chinese Consumer Report noted that personal style and fashion are important. More and more Chinese consumers are placing emphasis on keeping up with the trends and about 50% of them consider a product's style to be more important than its function. According to the study, more than a quarter of consumers across all cities purchase new phones simply because they feel that their current phone is no longer in style (Roland Berger Strategy Consultants, 2010).

A Nokia report (Ketala & Röykkee, n.d.), related that the technical components that make up the mobile device can be divided into two categories: the user interface and external interface. The external interface is the interface that helps to use the device but is not physically part of it. It is formed from user support elements, accessories, PC connectivity and add-on software. The user interface category includes input/output devices and techniques, industrial and mechanical design and application factors (Ketala & Röykkee, n.d.). This study focused on the external user interface. The input tool is usually a keypad/keyboard (hard or touchscreen), and sometimes, camera and voice recognition. Also, navigation tools such as the back, home, and end call buttons are also used for input. Output tools include speakers and visual display screen. The ergonomics involve the touch and feeling, size, and interaction method.

Purpose of the Research and Thesis

The goals of this study were to (1) implement the KE process and examine how it influences mobile phone designs, and (2) explore the role that cultural differences play in the perception of the relationship between mobile phone design mobile phone design features and the desired kansei.

The premises for this research may be summarized as follows:

(P1) User analysis is an integral and critical part of the product development lifecycle (Rouse, 1991; Mayhew, 1999).

(P2) Affect is an important design criterion, after functionality and usability have been satisfied (Jordan, 2000; Koehler & Harvey, 2004; Norman, 2004; Lee, 2007).

(P3) KE is a formal method/technique used to capture affect and translate emotions and impressions into product parameters (Nagamachi, 1995; Jindo & Hirasago, 1997; Matsubara & Nagamachi, 1997; Nagamachi, 2002).

(P4) KE has predominantly been used in culturally homogenous environments (e.g., Japan).

(P5) There are large cultural differences in affect and emotions towards and in impressions of products (Hofstede, 1980; Barber & Badre, 1998; Desmet & Hekkert, 2007; Lodge, 2007; De Mooij & Hofstede, 2010).

(P6) Mobile computing and communication devices (e.g., so-called smart phones) is a domain that will experience explosive growth in the near future (Cnet, 2010).

Therefore, it is important to investigate how sensitive the KE method is to cultural differences, particularly in the domain of mobile phones, and whether the results of the KE process generalize across cultural boundaries.

Hypothesis. The primary hypothesis tested may be stated as follows:

(H0) There will be no differences between cultural groups when evaluating mobile phone design features with kansei words.

(H1) There will be significant differences between cultural groups when evaluating mobile phone design features with kansei words.

Method

Participants

Research participants included a convenience sample of 25 college students (10 males, 15 females), who interacted with mobile devices regularly and attended Rochester Institute of Technology in Rochester, New York. Participant ages ranged from 18 to 30. As the cultural backgrounds of RIT students are diverse, American, Chinese, Indian and Korean students were recruited from various student organizations related to ethnic-identification (i.e., Asian Culture Club, Baha'i Student Association, Chinese Student Scholar Association, Organization for the Alliance of Students from the Indian Subcontinent, etc.). However, the majority of participants were recruited via a school-wide distribution email list. The range of years in the U.S. for American, Chinese, Indian, and Koreans participants were 18 to 26, 0.5 to 18, 0.5 to 8, and 1.5 to 11, respectively.

Materials

Two survey instruments were used in this study. The first survey was used to capture data on demographics (demographic and background questionnaire), cultural identity (Individual Cultural Value Scale), descriptive words for mobile phones, and mobile phone feature prioritization (semantic space and product element space questionnaire). The second survey was used to capture data on extended demographics (demographic questionnaire #2**)** and kansei level for various phone features (semantic differential scale questionnaire). These surveys allowed for the collection of information used to go through the KE process.

Demographic and background questionnaire. The first part of the first instrument asked questions related to the participant's personal experiences with purchasing mobile devices, such as "When deciding to purchase a phone, what do you consider?" and contained demographic questions concerning the gender, age, and self-identified cultural-affiliation of the participant (Appendix B).

Individual Cultural Value Scale (CVSCALE). Hofstede's metric has been used to study behavior in a variety of fields. Since then, it has been scrutinized for trying to assess culture on a micro-, or individual level when Hofstede (1980) intended the dimensions to relate to a macro-, or nationalistic level (Bakir, Blodgett, Vitell, & Rose, 2000; Yoo, Donthu, & Lenartowicz, 2010). Since culture is defined at this higher level, individual-cultural consistency needs to be taken into consideration. As such, researchers have strived to design different scales that were used to explore cultural value at the individual level- consumer perception on antismoking websites, ethical norms, market segmentation, negotiation behavior, personality and transformational leadership, consumer moral ideologies, package design, and consumer ethnocentrism (Yoo, Donthu, & Lenartowicz, 2010).

The Individual Cultural Values Scale (CVSCALE) (Yoo et al., 2010) was designed to measure Hofstede's (1980) five dimensions of culture (Power Distance, Individualism, Masculinity, Uncertainty Avoidance, and Long-Term Orientation) at the individual level. Modified items were chosen from HERMES (Hofstede's original survey), the Values Survey Module 1994 (an improved and shortened version of the HERMES questions), additional work from Hofstede, the Chinese Culture Connection, and non-Hofstede efforts (Yoo et al., 2010). On the scale, there are twenty-six items in which the participant must rate how closely related their attitudes are to the choices given for particular questions on a 5-point Likert scale. Selecting "1" represents attitudes that are not likely of the person and selecting a choice from the higher end of the rating scale represents attitudes that are very likely of the person. Higher scores indicate a higher level of adherence to the particular cultural value. The sub-scales that measure the collectivism, uncertainty avoidance, masculinity, power distance, and long-term orientation values, yield Cronbach alpha reliabilities of 83, .88, .86, .86, and .82, respectively (Yoo et al., 2010).

Those possessing cultural values of the Chinese culture are expected to obtain high scores on the Power Distance and Long-term Orientation scales, and lower scores on the Individualism and Uncertainty Avoidance scales. Participants who self-identify as Indians are expected to achieve high scores on Power Distance and low scores on Uncertainty Avoidance. American self-identifiers are expected to achieve high scores on the Individualism scale and low scores on Power Distance and Long-term Orientation. Lastly, Koreans are expected to achieve high scores on Uncertainty Avoidance and Long-term Orientation, and low scores on Individualism and Masculinity (Appendix C).

Semantic space and product element space questionnaire. The last section of the first instrument asked participants to list three descriptive words that can be used to describe the ideal industrial design/physical hardware of the mobile devices, as well as to rank the three most important features from a pre-determined list of components. Participants whose native language is that other than English are also asked to include the translation of the three selected descriptive words in their respective native tongue (Appendix D).

Demographic questionnaire #2. The first section of the second instrument asked participants to self-identify with an extended list of cultural options which took into account any partial American affiliation. Participants were also asked to note their age, and the amount of years that they have lived in the Unites States (Appendix E).

Semantic differential (SD) scale questionnaire. This section contained a list of six Kansei words and their respective antonyms on a 6-point SD scale. Also included was an additional 'likeability' question also using a 6-point Likert scale. Participants were asked to rate four design features of three phones, going through one phone at a time. This instrument contained basic information on the design features for each phone (similar to information that would be found on packaging in a store when a consumer is making a purchasing decision), as well as a basic definition of the design feature. For example, the design feature 'LCD Screen Size' was accompanied by the definition "the diagonal length of the LCD screen primarily used to view the user interface" and the descriptive text for one particular phone was 4.3" (Appendix E).

Phones. The phones that rated during the study where: (1) "Phone 1", Motorola CHARM, (2) "Phone 2", Samsung t249, and (3) "Phone 3", HTC HD7 (Figure 2). Tangible phone samples (i.e., real phones) were used as opposed to images to allow the participants to have tactile feedback when exploring the features of the phone and provide more accurate/realistic ratings.

Experimental Design

This study was a mixed factorial design. The kansei words (semantic space) and mobile phone design features of interest (product elements space) were developed from the first part of the study and were the within-subjects variables. Then, participants were divided into four groups depending on their responses to the CVSCALE so that the four groups were culturally-distinct and all participants participated in the KE process of ranking the pre-determined mobile phone design features on the SD scale. The cultural group was a between-subjects variable. The data were analyzed to determine if there was a significant difference in responses between the four culture groups, and to also determine how the kansei words were linked with the different design features.

Procedure

Over 17,000 students received an email distributed to all members of the student body at the Rochester Institute of Technology. The email noted that the study's purpose was to determine the role that cultural differences play in mobile phone design preferences, and as such, only American, Chinese, Indian, and Korean students were asked to participate. They were also informed that the study involved two separate parts and that completion of both parts was required in order to be entered to win one of two 50-dollar VISA gift cards (Appendix G).

The first part of the test was conducted using an online survey system developed at RIT, called "Clipboard", and took approximately 10 to 20 minutes to complete. Participants were instructed to answer the questions within all three sections of the instrument package. Once logged into Clipboard with their RIT Student ID and password, these students were given a three-part instrument, consisting of demographic and background mobile device questions, the CVSCALE, and the semantic space and product element space questionnaire**.**

A total of 401responses were received (296 Americans, 36 Chinese, 36 Indians, 16 Koreans, and 17 Other Responses). A total of 45 participants self-identified as a member of a particular culture, and had results on the CVSCALE that positively correlated with the cultural identification. These students were asked to participate in the second part of the study. An extended set of participants were later asked to participate to expand the data set which brought the total up to 98 participants who were asked to participate in the second round of data collection. Due to some level of uncertainty with the accuracy in the CVSCALE used, self-identification was ultimately used to assign participants to cultural groups. Data were ultimately collected from 25 participants in total (7 Americans, 6 Chinese, 10 Indians and 2 Koreans).

A total of 103 words were acquired from the selected group of participants. These words were then grouped into six higher level categories of kansei words and antonyms of these words were established to develop the semantic space (Appendix I). The top three ranked phone design features were determined and the results were used to develop the product elements space (Appendix J). The top four design features were determined to be “Shape of Phone”, “Phone Material”, “Color”, and “LCD Screen Size”; however, “Color” was removed as there are many cultural associations with color that are beyond the scope of this study. Also, with the introduction of personalizable phone shells (commonly referred to as “skins”) in the mobile phone market, phone color can be changed at will by the consumer to fit their design preference. The next ranked design feature, “Navigation Tools”, was selected to replace “Color”.

Following this, a sample of current mobile phones known in the United States was determined. From this sample, three phones which provided variability in the design features were selected (Table 2).

Table 2

Design Features and Styles of Selected Phones

Design Feature	Phone	Style of Design Feature
Shape of Phone	Motorola CHARM Samsung t249 HTC HD7	Squared Egg Rectangular
Phone Material	Motorola CHARM Samsung t249 HTC HD7	Glass, Chrome-plated plastic Painted plastic, rubber Glass, Metal
LCD Screen Size	Motorola CHARM Samsung t249 HTC HD7	2.8”- medium 1.8”-small 4.3”- large
Navigation Tools	Motorola CHARM Samsung t249 HTC HD7	Hard Buttons 5-way controller Touch Pad

a. b. c.

Figure 2. Front and Back Images of the Phones, a. Motorola CHARM (Phone #1), b. Samsung t249 (Phone # 2), and c. HTC HD7 (Phone #3).

All three phones were de-branded with the use of masking tape. For the second part of the study, a two-part instrument was utilized to determine the level of relatedness between a particular adjective/kansei word and a particular design element. Those students who agreed to participate in the second part of the study were instructed to meet the researcher at the Wallace Library on RIT's campus. The researcher followed a guide to ensure that the same directions were given to all participants (Appendix F). Participants were given a consent form to sign, and at the completion of the study, participants were debriefed. After the data collection phase was completed, a random drawing of two participant names occurred and they were both given 50 dollars.

Analyses

The data from the first instrument were analyzed using descriptive statistics, manual cluster analysis to determine the Semantic Space, and manual ranking analysis to determine the Product Elements Space. Data from the second instrument were analyzed using descriptive statistics, and analysis of variance (ANOVA).

Results

Descriptive statistics were used to explore the results of the demographic and background questionnaire. Frequencies were determined for each questioned asked. The data revealed that, initially, 187 males and 212 females responded to the survey. Note that two responses are missing from this set. Participants were also asked about frequency and drivers of new phone purchase (Table 3). Most participants responded that they purchase a new mobile phone when it's worn/damaged/unusable and the main driver for purchasing a new phone is its capabilities.

Table 3

Percentage of User Responses on the Demographic and Mobile Device Questionnaire

Question	Choice	Percentage of Participants Who Selected Choice
How often do you purchase a new mobile phone?	When the phone is worn/damaged/unusable	38%
	When my mobile phone service company offers a discount/upgrade	37%
	When my service contract expires	22%
	As soon as a new trending design becomes available	3%
When deciding to purchase a new phone, which do you consider first?	Phone Capabilities	69%
	Price / Promotional Offer	24%
	Aesthetics	5%
	Popularity of phone	2%
	Brand Image	<1%

Note. *N=401

Twenty-four single factor ANOVAs were conducted to see if there were any significant differences in the kansei ratings of mobile phone design features between three phone styles. Of the 24, 15 pairs yielded significant differences: (1) Durable-Shape, (2) Attractive-Shape, (3) Attractive-Material, (4) Attractive-LCD Size, (5) Attractive-Navigation, (6) Modern-Shape, (7) Modern-Material, (8) Modern-LCD Size, (9) Modern-Navigation, (10) Cool-Shape, (11) Cool-Material, (12) Cool-LCD Size, (13) Cool-Navigation, (14) User-friendly-LCD Size and (15) Ergonomic-Shape. The details of this result are further explained in the Discussion section.

Table 4

ANOVA Results for Statistically Significant Kansei Words and Design Features

Kansei Word	Design Feature	F	P
Durable	Shape	7.56	0.001
Attractive	Shape	9.3971	< 0.001
Attractive	Material	5.02703	0.009
Attractive	LCD Size	12.3683	< 0.001
Attractive	Navigation	7.82872	< 0.001
Modern	Shape	12.734	< 0.001
Modern	Material	5.1249	0.008
Modern	LCD Size	28.5003	< 0.001
Modern	Navigation	21.8534	< 0.001
Cool	Shape	3.9025	0.025
Cool	Material	5.83526	0.004
Cool	LCD Size	18.7956	< 0.001
Cool	Navigation	9.23827	< 0.001
User-friendly	LCD Size	10.4043	< 0.001
Ergonomic	Shape	23.2476	< 0.001

Seven factorial ANOVAs were also conducted to determine if the model produced any significant effects when considering the number of participants, gender, design features, phones, and cultural groups. Note that Koreans were removed from this model as the group was too small with N = 2. For the "Durable" kansei word, the results indicated that cultural groups, F (2, 250) = 4.86, p =.008, phone styles, F (2, 250) = 6.68, p = .001, and the cultural group-phone interaction, F (4, 250) = 2.52, p =.042, had significant effects on the kansei ratings. For the "Attractive" kansei word, the phone, F (2, 248) = 18.29, p < .001, and phone-design feature interaction, F (6, 248) = 2.92, p =.009, were determined to have an effect on the ratings. For the "Modern" kansei word, the significant effect came from the phone main effect, F (2, 247) = 47.21, p < .001, and phone-design feature interaction, F (6, 247) = 3.29, p =.004. "Cool" kansei ratings were determined to be affected by cultural groups, F (2, 249) = 3.42, p=.034, phone, F (2, 249) = 22.38, p < .001 and phone-design feature interaction, F (6, 249) = 2.16, p =.048. For "User-friendly", the results indicated that gender, F (1, 250) = 5.44, p =.020, and phone-design feature interaction, F (6, 250) =2.81, p =.012, had significant effects on the kansei rating scores. Phone, F (2, 250) = 5.61, p =.004, and the phone-design feature interaction, F (6, 250) = 6.54, p < .001, were determined to have significant impact on the "Ergonomic"' kansei rating scores. Considering the likeability of the phone design features on the given kansei rating scales, phone, F (2, 250) = 5.55, p =.004, and phone-design feature interaction, F (6, 250) = 4.70, p < .001, both played a significant role in the scores obtained from participants. Tukey's Honestly Significant Difference (HSD) was used to run pair-wise comparisons on significant main effects and determine which groups differed from each other without the inflation of Type I error rate. These results can be found below under the respective kansei word results.

Attractive

The phone-design features interaction was found to be a significant effect (Table 5, in Appendix L). Considering all participants, Phone 3 received the highest ratings for all four design features. Phone 1's squared body was rated the lowest for shape but had higher, similar scores for Phones 2 (egg-shaped) and 3 (rectangular shape). For the material used, Phone 1's painted plastic and glass and Phone 2's painted plastic and rubber were rated similarly, but Phone 3's metal and glass combination received the highest ratings. For the LCD Screen size, Phone 2 (1.8") received the lowest ratings, while Phone 3 (4.3") had the highest ratings. Navigation was rated similarly for Phones 1 (hard buttons) and 2 (5-way controller), but very high for Phone 3 (touchpad) (Figure 3).

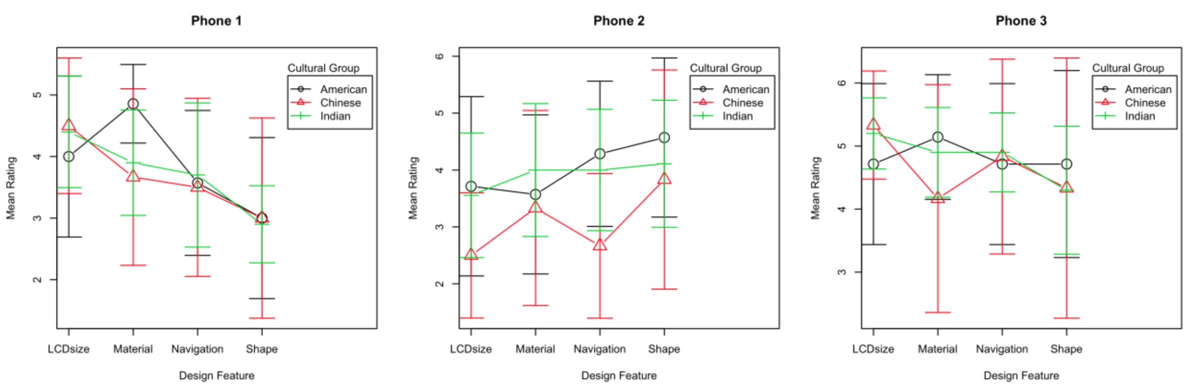

Figure 3. Ratings for the "Attractive" kansei word on the three experimental phones by design feature (on the x-axis) and cultural groups (separate lines).

Cool

The phone-design feature interaction effect was found to be a significant contributor, along with cultural groups (Table 6, in Appendix L). Again, Phone 3 yielded the highest scores across all four design features. Significant differences were determined for Phone 1 and Phone 3 shape results- Phone 3 was considered to be significantly cooler. Material for Phones 1 and 2 were similarly rated, and Phone 3 obtained the highest ratings of the group. Considering the LCD Screen, large differences were found between Phones 1 and 2 LCD screen sizes and Phone 3's and Phone 2's LCD screen sizes- a larger screen was deemed cooler. Phone 2's navigation was determined to be the "lamest" when comparing phones, while Phone 3's touchpad was favored. Tukey's HSD test revealed significant differences between the Indian and Chinese groups (p= .026) (Table 12, in Appendix L). Chinese participants tended to give the lowest ratings across design features. This difference can be seen with Phone 2 where the largest separation between mean scores of Chinese and Indian participants exists (Figure 4).

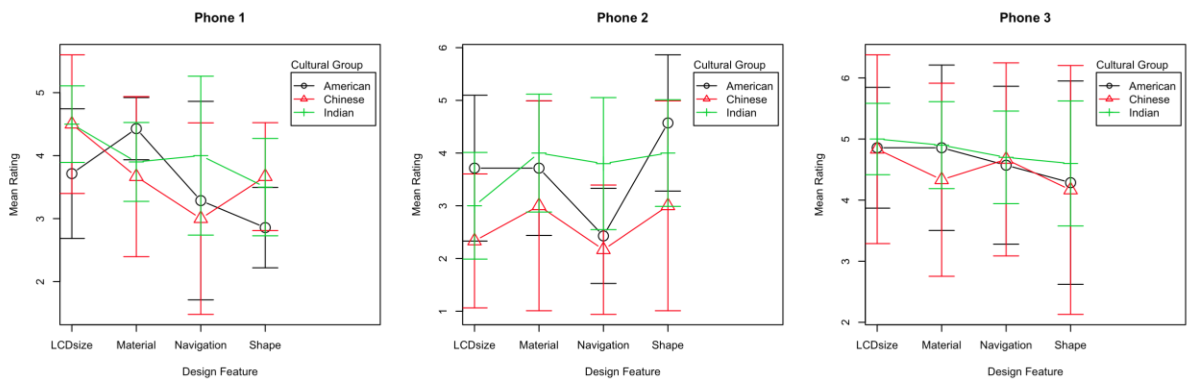

Figure 4. Ratings for the "Cool" kansei word of the three experimental phones by design feature (on the x-axis) and cultural groups (separate lines).

Durable

For the "Durable" kansei word, the phone-cultural groups interaction was found to be significant (Table 7, in Appendix L). Chinese responses were significantly different than Indian and American scores when considering the different phone types. Phone 3 was considered to be less durable and more fragile than Phone 1. Americans rated Phones 1 and 2 similarly, but rated Phone 3 lower. Indian participants rated Phones 1 and 3 similarly, but tended to rate Phone 2 lower. Chinese participants rated Phone 3 lower than Phone 2, and both phones lower than Phone

1. A grouping of similar ratings for all three cultures can be seen for Phone 1, while the scores are more separated for Phone 3. This suggests that while the cultural groups agreed that Phone 1 had good durability, they were in less harmony when considering Phone 3 (Figure 5).

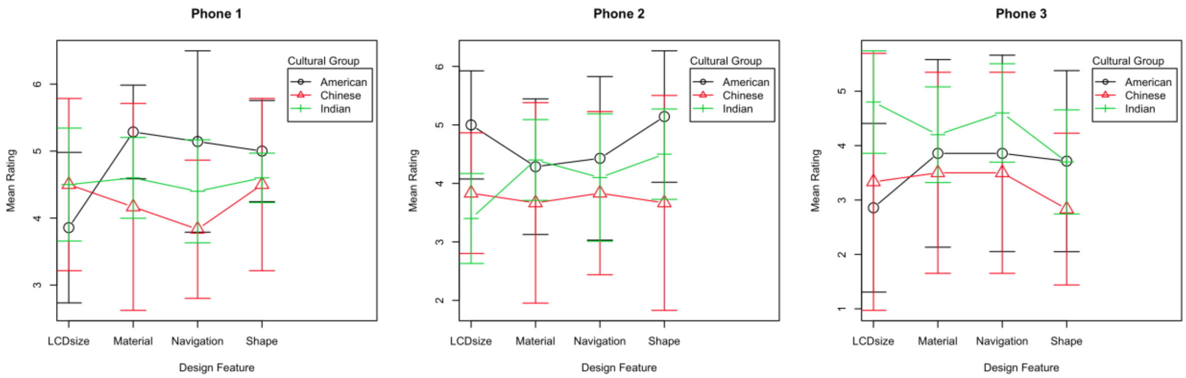

Figure 5. Ratings for the “Durable” kansei word of the three experimental phones by design feature (on the x-axis) and cultural groups (separate lines).

Ergonomic

The phone-design feature interaction was found to be a significant contributor to the “Ergonomic” kansei word (Table 8, in Appendix L). Phone 1’s navigation, LCD screen size, and material were all rated fairly similarly across the three phones. However, the largest difference is seen when considering the shape of the phones. Phone 2’s egg shape was highly ergonomic, as opposed to the perceived inconvenient fit of Phones 1 and 3 (Figure 6).

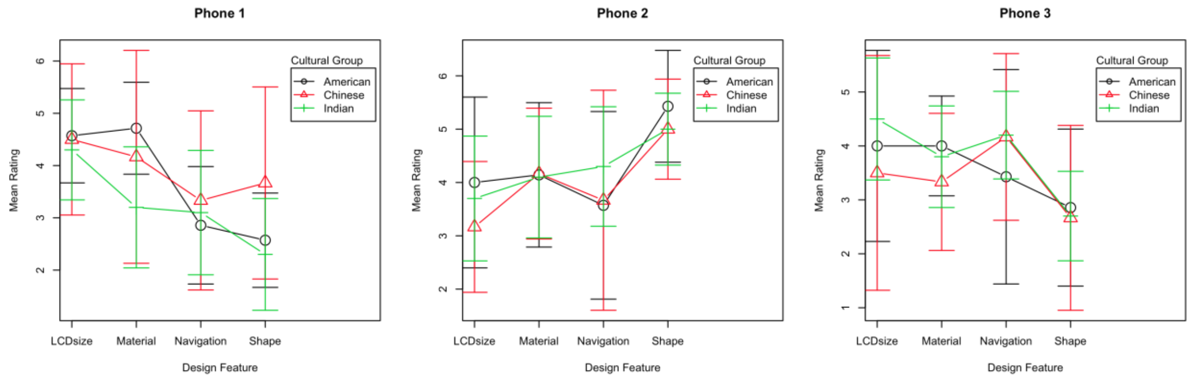

Figure 6. Ratings for the “Ergonomic” kansei word of the three experimental phones by design feature (on the x-axis) and cultural groups (separate lines).

Modern

Again, the phone-design feature was determined to be a significant effect on kansei rating scores (Table 9, in Appendix L). Phone 3’s rectangular shape was significantly higher than Phone 1’s squared shape and Phone 2’s egg shape. Considering the material of the phones, Phone 1 was rated slightly higher than Phone 2, but Phone 3 obtained significantly higher ratings than both. For LCD Screen size and Navigation, ratings went to opposite way for Phone 1 and Phone 2- Phone 2 obtained lower scores than Phone 1. Both design features peaked with Phone 3. Overall, Phone 3 was deemed to be more modern across design features (Figure 7).

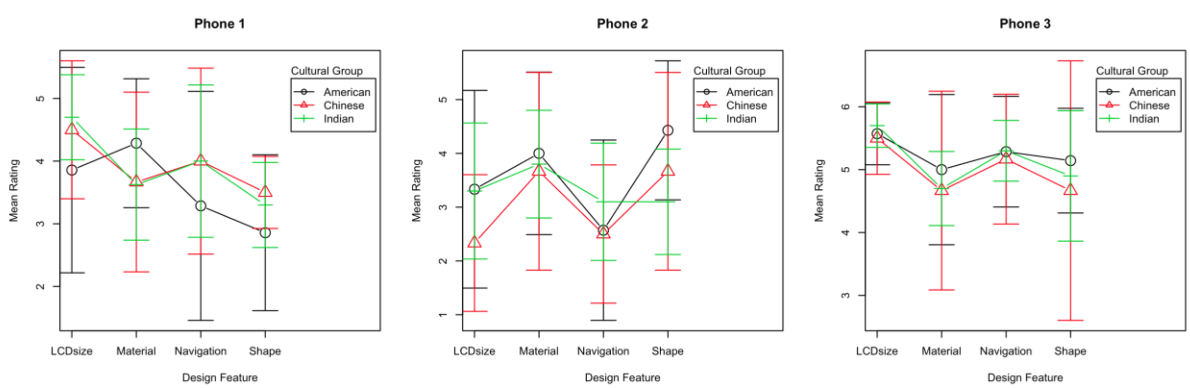

Figure 7. Ratings for the “Modern” kansei word of the three experimental phones by design feature (on the x-axis) and cultural groups (separate lines).

User-friendly

The gender main effect and phone-design feature interaction were found to be significant (Table 10, in Appendix L). Tukey's HSD test showed that male participants tended to rate the design features as being more user-friendly than female participants across two of the three phones ($p = .023$) (Table 13, in Appendix L). Scores between females and males are closely rated for design features on Phone 2, which suggests that participants agreed on the level of kansei elicited by this phone (with the exception of the Navigational Tools design feature). Looking at the interaction effect, the greatest difference was found between Phone 2 and 3's ratings for the LCD screen size. Participants perceived Phone 3's large screen as more intuitive than Phone 2's small screen (Figures 8, 9).

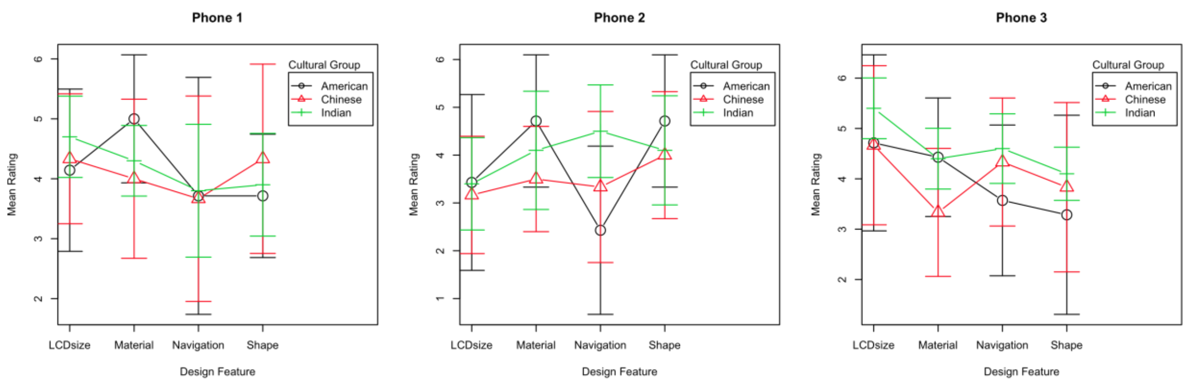

Figure 8. Ratings for the "User-friendly" kansei word of the three experimental phones by design feature (on the x-axis) and cultural groups (separate lines).

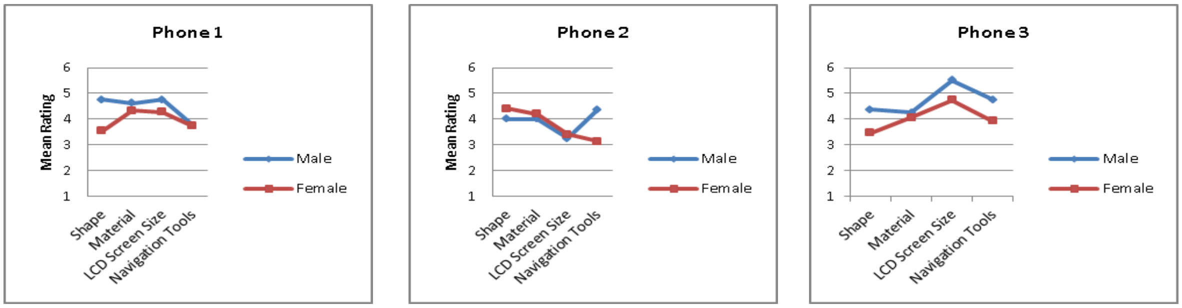

Figure 9. Ratings for the "User-friendly" kansei word of the three experimental phones by design feature (on the x-axis) and gender (separate lines).

Likeability

Though this was not selected as a kansei word, likeability scores were examined for significant score contributors; the phone-design feature interaction was found to be one (Table 11, in Appendix L). Consistent with the many of the other results found, the LCD screens of Phones 1 and 3 were overall more liked than Phone 2. However, Phone 2's shape was more preferred than Phone 1. Material received similar scores across all three phones indicating that participants may not have had a strong preference for the three different materials presented. Phone 3's navigation was marginally more likeable than Phone 1 and Phone 2 (Figure 10).

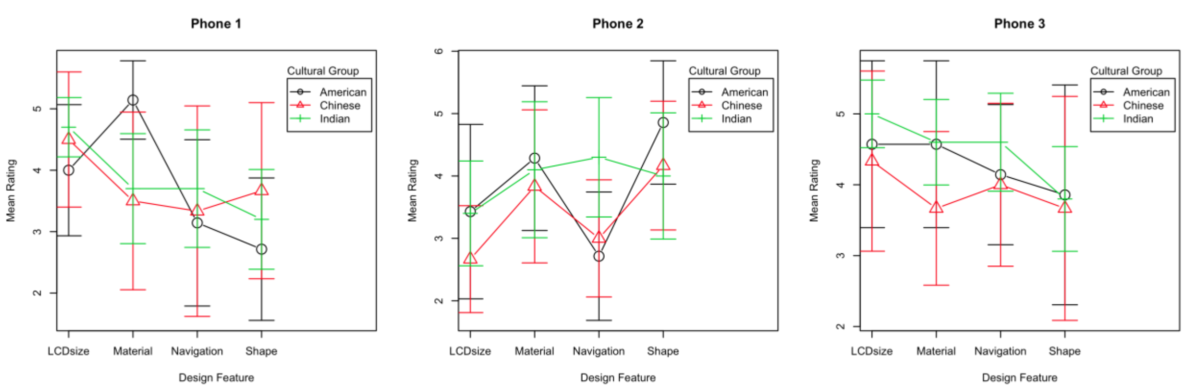

Figure 10. Ratings for the likeability of the three experimental phones by design feature (on the x-axis) and cultural groups (separate lines).

These results suggest that there are only some areas where difference exists between the cultural groups, when considering mobile phone design preferences and the kansei associated with those design features. For most groups, particular phone features elicited the same positive kansei while other kanseis were less perceived As such, the null hypothesis can be partially rejected; the durability and coolness of the phone yielded significant differences between Americans, Chinese and Indians. However, the other four kansei words did not show any significant cultural differences. Mainly Chinese participants were found to respond differently to the given kanseis than Americans and Indians. Though a clear explanation is not known, several possibilities can be speculated. The Chinese cultural group may have a tendency to rate scores closer to the neutral point while other groups may be more prone to giving ratings at the extreme ends of a scale. Something else to consider is that the kanseis may not be as strongly elicited for this group as it may be for others.

Discussion

Previous studies have supported the importance of emotive appeal in visual product design (Jordan, 2000; Koehler & Harvey, 2004; Norman, 2004; Lee, 2007). This feeling that is experienced by the consumer aids in the decision-making process when selecting to purchase/use a product. As such, KE was developed to identify, translate, and implement these feelings, as dictated by the target consumer. However, it has typically been used in homogeneous cultures, and there are large cultural differences in how consumers view products and how elicited feelings translate into product design desires in America, which this study attempted to account for. Several design features were explored to determine which would obtain the highest ratings on a given descriptive kansei word. There were a total of three phones (Motorola CHARM, Samsung t249, HTC HD7), four design features (Shape, Material, LCD Size, Navigation) and six kansei words (Durable, Attractive, Modern, Cool, User-friendly, Ergonomic).

Of those, 15 were found to hold significantly different results from the other features (Table 14). If designers were interested in appealing to the general population of RIT students in the 18 to 30 years old age range (target end users) the data suggests that the most ideal phone would have a rectangular body shape, be comprised mostly of glass and a metal-like material, have a large or medium-sized LCD screen size (approximately 2.8”- 4.3”), and use a touchpad to control most of the navigation. Use of the rectangular shape design feature or glass and metal-like material as main material components would elicit the kanseis of “Attractive”, “Modern”, and “Cool”, though on the downside, it may also elicit a feeling of being too fragile or having an inconvenient fit. To account for the lack of durability or ergonomic feeling, designers may want to consider using an egg-shaped phone or one is that comprised mainly of rubber/painted plastics. A design featuring a large or medium-sized LCD screen would bring out kanseis of

“Attractive”, “Modern”, “Cool”, “User-friendly” and “Ergonomic”. However, the use of a smaller screen may cause consumers to think that the phone is old-fashioned or lame. The use of a touchpad navigation system would bring about all six kanseis. On the other hand, designers will want to steer clear of designs that involve the use of a 5-way controller for main navigation as this may be perceived to be old-fashioned and lame.

Limitations

There were several noted limitations with this study which may explain the results derived through statistical analyses. One of the components of the KE Model is the testing for the validity of the model (Jindo & Hirasago, 1997). This is done to determine how accurately the proposed KES worked. However, due to time-line constraints and design limitations, this phase was beyond the scope of this study’s timeline. As such, the design recommendations can only be suggested as being desired or preferred by the main target group. Future testing should involve testing the proposed model to see if it yields similar results.

While the total sample size was 25, sub-cultural groups consisted of 7 Americans, 6 Chinese, 10 Indians, and 2 Koreans. With the sub-group sizes being so small, one must offer a caveat concerned with the threat to external validity when using such a small sample size. Future studies should use larger samples when testing the difference between multiple groups to minimize this threat. The sample sizes of the phones and design features were also small. This study only explored three variations of four features across six kansei words. Future studies should consider using a larger sample of products to provide more variability and develop a more accurate and realistic KE system.

Another limitation is concerned with the method used for identifying cultural groups. The researcher of this study opted to use cultural self-identification as a means of identifying cultural groups after initially using the CVSCALE. The self-identification method has its flaws as participants may believe that they have values reflective of one culture when that may in fact be false. However, the results from the CVSCALE did not seem to match how students may view themselves. For example, of the 296 Americans, only two were determined to have American values. The issues with the CVSCALE can be attributed to one of two possible reasons: (1) Hofstede's dimensions were not designed to explore cultural differences concerned with product design reference, or (2) the sample of university students used is a melting pot of cultures where similar values exist. Culture is not easy to measure or define; however, future studies should try to find a more robust way to measure different cultural groups who reside in the United States.

Something else to consider that may have skewed or influenced the kansei rating scores results would be the participant's current phone and their views on that phone. If a participant has a particular design that he/she has had good experiences with, they may rate a phone with a similar design feature highly. The same is true for the opposite; if a participant has had a negative experience with a phone, they may rate a similar design feature lower on the SD scale. Future studies should explore the involvement of this by looking into which phone the participant currently has and their views on that phone's design features.

Also, reviewing the literature on KE highlighted a common issue- the lack of rigidity in the method used to go through the full KE process. The literature mentions that there are several different ways to collect and determine kansei words- researchers can acquire words through feedback from the target group by asking them to use words to describe specific elements associated with the product. Also, researchers can ask designers to provide these subjective words or even search print and online resources for trending words associated with specific products or brands (Jindo & Hirasago, 1997; Ying & Yan, 2006; Chen, Chiu, & Lin, 2007). This research chose to utilize the first option as this was thought to reveal the words that were most relevant to the target group as they were determined by said group. However, by using this method, there is a risk in a researcher understanding and interpreting what descriptive words mean to different cultural groups, especially in cases where those words are translated into English and standardized to be used for evaluations in multiple cultures. A future goal of this study is to use the native words collected from participants and have them interpreted by native speakers of the indicated languages to see if there were differences in the descriptive words collected.

In order to synthesize the data between the Semantic Space and Product Elements Space, several analysis techniques were used by past researchers: factor analysis (Quantification Theory Type III), multiple regression analysis (Quantification Theory Type I), cluster analysis, rough set analysis, neural networks, and correlation statistics (Nagamachi, 1995; Jindo & Hirasago, 1997; Schutte & Eklund, 2001; Nagamachi, 2002; Lai, Lin, Yeh, & Wei, 2006; Ying & Yan, 2006; Chen, Chiu, & Lin, 2007; Roy, Goatman, & Khangura, 2009). All were done with the intention to determine the relatedness and influence of kansei words and product design features. However, review of past research did not yield a clear, robust way to analyze data or rationale for choosing the statistical analysis method used. This study opted to explore the use of Analysis of Variance for statistical significance of the data set as the main goals of the analyses were to determine if there were any significant differences between the variations of four mobile phone design features, and determine if there were any significant differences between the cultural group's rating of the mobile phone features across kansei words.

Conclusion

In this thesis, we implemented the KE process and examined how it influences mobile phone designs. Hardware design features (i.e., shape, material, LCD size, navigation) of three phones were explored with the consideration of six kansei words: (1) attractive, (2) cool, (3) durable, (4) ergonomic, (5) modern, and (6) user-friendly. It was determined that a desirable phone for the sample group of participants should have a rectangular shape, be made of glass and metal, have a large LCD screen, and have a touchpad navigation interface.

We also explored the role that cultural differences play in the perception of the relationship between mobile phone design mobile phone design features and the desired kansei. Three cultural groups were examined: (1) American, (2) Chinese, and (3) Indian.The Indian and Chnese groups were found to be significantly different when evaluating the "Cool" kansei, with Chinese participants giving the lowest ratings across design features.

While the KE model has been tested in the past, and has been determined to yield reliable results, future studies should consider developing a model which aims to behave similarly to the KE process, while accounting for many of the loopholes discovered during this research. By designing multiple models and testing those against the existing KE model, a more robust design method is expected to emerge with which designers/consumers can accurately find design features that meet their desired kanseis.

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Appendix A

Informed Consent Form

Rochester Institute of Technology

Department of Psychology

Title of the Research Project:

PRODUCT DESIGN AND CULTURAL DIFFERENCE

Purpose of the Study:

The purpose of the "Product Design and Cultural Differences" study is to examine the effects that cultural differences have on consumer preferences for product designs, in this case mobile phone designs.

Please read this form and fill free to ask any question you may have before agreeing to participate in this research.

PROCEDURE

If you agree to participate in this study, after you have asked any questions concerning the study and signed this consent form, you will be asked to participate in two sessions, approximately one month apart. The first session will take approximately 10 to 20 minutes and you will answer questions from all three sections of the package given to you.

1. First section will contain questions related to your demographics and mobile device selection behavior.

2. Second section will contain questions related to your mobile device feature preferences.

3. Final section will contain questions related to cultural values.

The second session will take approximately 20-30 minutes to complete. You will receive an email asking you to come in for the next session. You will then be given a survey in which you will rate specific mobile device features on given rating scales.

CONFIDENTIALITY/SAFEGUARDS

Every effort will be taken to protect your identity in this study. The information that you provide will be identified by code number only. It will not be associated with your name or any personal identifying information either in filing or in any report or presentation of this study or its results. The only individuals who will have access to the information that you provide to the study are the research staff (Loni M. Watson and Dr. Esa M. Rantanen) and Institutional Review Board (IRB) at Rochester Institute of Technology. The IRB has been created to protect the rights of the individuals who are participating in research studies. No information about you or provided by you during this research will be disclosed to others without your written permission.

Your identity will not be revealed in any report or publication of this study or its results. Any information obtained for this study that can be used to identify you will remain confidential to the fullest extent permitted by law. Your name will not appear anywhere on the questionnaires that you complete. Any documents that have your name and/or other identifiable information (e.g., this consent form) will be kept in a locked file cabinet to which only the Investigator and supporting faculty member will have access.

RISKS

There is minimal to no risk related to participation in this study. If you should feel uncomfortable in answering any question in any of the questionnaires, please be assured that you may omit answering these questions without penalty of any kind.

BENEFITS

Participants have a chance to win one of two $50 Visa gift cards after the second session has been completed. Also, your participation is of great importance to the student researcher who is conducting this study (under the direction of the supporting faculty member, Dr. Esa M. Rantanen) as part of the Applied Experimental & Engineering Psychology Master's Degree program at Rochester Institute of Technology.

RIGHT TO WITHDRAW

Your participation in this research is strictly voluntary. Deciding not to participate or choosing to leave the study will not result in any penalty or loss of benefits to which you are entitled, and it will not harm your current or future relations with Rochester Institute of Technology. If you decide to leave the study, the procedure is to notify the investigator (Loni M. Watson) of your decision. Upon that decision, any documents that you have filled out so far will be destroyed immediately.

CONTACT INFORMATION

If you wish to talk to anyone about this research because you think you have not been treated fairly, feel that joining the study has hurt you, or would like to learn more about the study and its results, please feel free to contact Loni M. Watson at lmw4009@rit.edu or Dr. Esa M. Rantanen at esa.rantanen@rit.edu.

YOU WILL BE OFFERED A COPY OF THIS FORM TO KEEP.

PARTICIPANT COPY

PRODUCT DESIGN AND CULTURAL DIFFERENCES

Participant Consent Form

You are making the decision whether or not to participate in the Product Design and Cultural Differences study. Your signature indicates that you are 18 years of age or older, that you have read and understood the information provided and have decided to participate in the study.

______________________________ ________________________

Name (PRINTED) Date

______________________________ ________________________

Name (SIGNATURE) Date

____

Signature of Witness

OFFICE COPY

PRODUCT DESIGN AND CULTURAL DIFFERENCES

Participant Consent Form

You are making the decision whether or not to participate in the Product Design and Cultural Differences study. Your signature indicates that you are 18 years of age or older, that you have read and understood the information provided and have decided to participate in the study.

________________________________ __________________________

Name (PRINTED) Date

________________________________ __________________________

Name (SIGNATURE) Date

____

Signature of Witness

Appendix B

Demographic and Mobile Device Questionnaire

INSTRUCTIONS: Select the answer below that best represents you.
(1) Do you currently own a mobile phone?
____ Yes
____ No

(2) How often do you purchase a new mobile phone?
____ As soon as new trending design becomes available
____ When my mobile phone service company offers a discount/upgrade
____ When my phone becomes worn/damaged/unusable
____ When my service contract expires

(3) When deciding to purchase a new phone, which do you consider first?
____ Aesthetics
____ Brand Image
____ Phone Capabilities
____ Popularity of phone
____ Price / Promotional Offer

(4) What is your gender?
___ Male
___ Female

(5) What is your age?
___ 18 to 20
___ 21 to 23
___ 24 or older

(6) What is your nationality?
____

**Email Address (will be used to contact you for second session):
____

Appendix C

Individual Cultural Values Scale (CVSCALE)

INSTRUCTIONS: Use the scale below to indicate the extent to which you agree with the value expressed in each statement. Select the number below each question that best represents your response.

Strongly Disagree	Slightly Disagree	Neutral	Slightly Agree	Strongly Agree
-2	-1	0	1	2

P1. People in higher positions should make most decisions without consulting people in lower positions.

P2. People in higher positions should not ask the opinions of people in lower positions too frequently.

P3. People in higher positions should avoid social interaction with people in lower positions.

P4. People in lower positions should not disagree with decisions by people in higher positions.

P5. People in higher positions should not delegate important tasks to people in lower positions.

C1. Individuals should sacrifice self-interest for the group (either at school or the work place).

C2. Individuals should stick with the group even through difficulties.

C3. Group welfare is more important than individual rewards.

C4. Group success is more important than individual success.

C5. Individuals should only pursue their goals after considering the welfare of the group.

C6. Group loyalty should be encouraged even if individual goals suffer.

M1. It is more important for men to have a professional career than it is for women.

M2. Men usually solve problems with logical analysis; women usually solve problems with intuition.

M3. Solving difficult problems usually requires an active, forcible approach, which is typical of men.

M4. There are some jobs that a man can always do better than a woman.

U1. It is important to have instructions spelled out in detail so that I always know what I'm expected to do.

U2. It is important to closely follow instructions and procedures.

U3. Rules and regulations are important because they inform me of what is expected of me.

U4. Standardized work procedures are helpful.

U5. Instructions for operations are important.

Very Unimportant	Slightly Unimportant	Neutral	Slightly Important	Strongly Important
-2	-1	0	1	2

L1. Careful management of money

L2. Going on resolutely in spite of opposition

L3. Personal steadiness and stability

L4. Long-term planning

L5. Giving up today's fun for success in the future

L6. Working hard for success in the future

Appendix D

Phone Feature and Descriptive Word Selection

INSTRUCTIONS: Use the options below to rank the top 3 *hardware design features* of the mobile phone that are most important to you when deciding to purchase.

_____ Color

_____ Navigational Tools (e.g. scroll ball, directional pad)

_____ Phone Interaction (e.g. slide, flip, swivel)

_____ Phone Material (e.g. plastic, metal) / Texture of Phone Material (e.g. Matte, glossy.)

_____ Shape of Phone

_____ Size of Display Screen

_____ Size of phone

_____ Text Input Method (e.g. hard keyboard, touch screen)

_____ Weight

Part 2: List 3 descriptive words that you would use to describe your ideal mobile device, considering the *hardware design features* that you selected above. Please use words that are specific to the HARDWARE of the phone and not the interface of the phone.

(e.g. modern, durable, colorful)

1. ____

2. ____

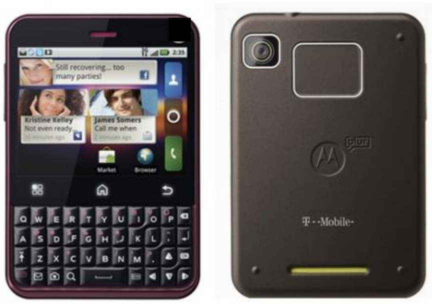
3. ____

*For those who self-identify as Indian/Chinese, please write down how you say these words in your native language, next to the three descriptive words that you have chosen.

Appendix E

Demographic Questionnaire #2 & Semantic Differential (SD) Scale Questionnaire

Phone # 1



Screen size: 2.8" LCD screen

Material: Glass, Painted plastic

Navigational tools: Hard Buttons

Phone #2

Screen size: 1.8" LCD screen

Material: Painted plastic, Rubber

Navigational tools: 5-way controller

Phone #3

Screen size: 4.3" LCD screen

Material: Glass, Metal

Navigational tools: Touch pad

Section 1: Culture

1. Which item below is the most accurate description of how you self-identify culturally?

For example, choose "Chinese-American" if you are both Chinese and American, but feel a stronger tie to the 'Chinese' culture. Choose "American-Chinese" if you identify with both of these cultures, but feel a stronger tie to the 'American' side.

____ American

____ Chinese

____ Indian

____ Korean

____ American-Chinese

____ Chinese-American

____ American-Indian

____ Indian-American

____ American-Korean

____ Korean-American

2. How old are you? _______________

3. How many years have you lived in America? ______________

Section 2: Mobile Phone Design Ratings- *Phone #1*

1. Rate the sample set of phone features on the following scales:

(Please refer to the phone in front of you.)

2. Rate only one phone at a time.

3. Remember to consider *ONLY* the indicated design feature, and not the entire phone.

4. If you recognize any of the brand names, please try your best to ignore branding and focus on the indicated feature.

*Please **DO NOT** turn the phone on. Only focus on the external design features.

Design Feature: Shape of Phone

(The outline/contours of the phone's body)

Fragile	1	2	3	4	5	6	Durable
Unattractive	1	2	3	4	5	6	Attractive
Old-fashioned	1	2	3	4	5	6	Modern
Lame	1	2	3	4	5	6	Cool
Unintuitive	1	2	3	4	5	6	User-friendly
Inconvenient Fit	1	2	3	4	5	6	Ergonomic

How much do you like this phone's design feature **(Shape of Phone)? (**Circle One**)**

1	2	3	4	5	6

Design Feature: Phone Material

(The constructive make-up of the phone- e.g., painted plastic, metal, rubber, etc.)

Fragile	1	2	3	4	5	6	Durable
Unattractive	1	2	3	4	5	6	Attractive
Old-fashioned	1	2	3	4	5	6	Modern
Lame	1	2	3	4	5	6	Cool
Unintuitive	1	2	3	4	5	6	User-friendly
Inconvenient Fit	1	2	3	4	5	6	Ergonomic

How much do you like this phone's design feature **(Phone Material)? (**Circle One**)**

1	2	3	4	5	6

Design Feature: Size of Display Screen

(The diagonal length of the LCD screen primarily used to view the user interface)

Fragile	1	2	3	4	5	6	Durable
Unattractive	1	2	3	4	5	6	Attractive
Old-fashioned	1	2	3	4	5	6	Modern
Lame	1	2	3	4	5	6	Cool
Unintuitive	1	2	3	4	5	6	User-friendly
Inconvenient Fit	1	2	3	4	5	6	Ergonomic

How much do you like this phone's design feature **(Size of Display Screen)? (**Circle One**)**

1	2	3	4	5	6

Design Feature: Navigational Tools

(The buttons used to navigate through the phone- e.g., touch pad, hard buttons, scroll ball, etc.)

Fragile	1	2	3	4	5	6	Durable
Unattractive	1	2	3	4	5	6	Attractive
Old-fashioned	1	2	3	4	5	6	Modern
Lame	1	2	3	4	5	6	Cool
Unintuitive	1	2	3	4	5	6	User-friendly
Inconvenient Fit	1	2	3	4	5	6	Ergonomic

How much do you like this phone's design feature **(Navigational Tools)? (**Circle One**)**

1	2	3	4	5	6

Appendix F

Moderator Guide

[Set phones face up in coded order (1 to 3) on table in front of participants.]

Hello, thank you again for agreeing to participate in this study today on mobile phone designs. My name is ______________________. As we discussed in the follow-up email, this may take about 20 minutes to complete.

[Hand participant a blank Informed Consent Form.]

Please take the time to read through this consent form. It basically states that you give permission to participate in this study and you are aware of what participating in this study entails.

[Wait for participant to read and sign the form. Then, detach the signed Office Copy and place in folder. Hand questionnaire packet to participant]

So these are the three phones that you will be using today. Please feel free to pick them up, play with them, move them around in your hands- just DO NOT turn them on. The questions that you will respond to are only concerned with the exterior design of the phone, not the internal interface. On the first page, you will find basic information about some of the phone's features- information that could be obtained if you walked into a cell phone provider store and were interested in the phone. Each section is separated by phone, so don't start with the next phone until you answer all questions on the current phone. Please be sure to read all of the directions for each section and don't hesitate to ask me a question if something is not clear to you. You are not being timed, so don't feel rushed.

[Once finished, debrief participant and give participant a copy of Informed Consent form to keep. Be sure to point out where contact information is located.]

Appendix G

Debriefing Form

Thank you for participating in this study. Please read all of the following information:

The purpose of the “Product Design and Cultural Differences” study is to examine the effects that cultural differences have on consumer preferences for product designs, in this case mobile phone designs.

Please remember that your individual responses will remain anonymous and that the data will be examined on a group basis only. Your informed consent form, which contains your name, will be kept separate from the answers that you gave on the questionnaires. The student investigator (Loni M. Watson, Department of Psychology) to whom you have given you responses will maintain all of the consent forms in a locked file to with primary access.

If you have any questions about the study, if you should experience any negative feelings as a result of participating in this study, or if you are interested in knowing the results in the study, please contact Loni M. Watson (lmw4009@rit.edu) or Dr Esa M. Rantanen, Department of Psychology, Rochester Institute of Technology (esa.rantanen@rit.edu).

Again, your cooperation and participation were greatly appreciated.

Appendix H

Email Used To Solicit Participants

Delete | Reply | Forward | Move | Print | Actions

Hello all,

I am currently looking for students who self-identify as American, Chinese, or Indian to participate in a study on mobile phone design preferences. There are two parts to the study. The first part is a survey which will take about 10 to 15 minutes to complete. The second part is also a survey, which will be distributed at a later time.

The link to the survey (1st part):
https://clipboard.rit.edu/take.cfm?sid=BA0D6490
Also, if you participate in both parts of the study, you will entered in a random drawing to win 1 of 2 **$50 Visa gift cards**. Both winners will be contacted at the conclusion of the second part of the study. If you have any questions or concerns, do not hesitate to contact Loni Watson at lmw4009@rit.edu.

Thanks!

Regards,
Loni M. Watson
MS - Applied Experimental & Engineering Psychology
Rochester Institute of Technology '11

Appendix I

Semantic Space

	A	B	C
1	Durable	Shimmering	Concentric
2	Sturdy	Straight-forward	Managable size
3	Cute	Small	Quick
4	Spacious	Thin	Minimalist
5	Attractive	Reliable	User-friendly
6	Thin	User-friendly	
7	Light (weight)	Small	Durable
8	Concise	Fast	Reliable
9	Large	Firm	
10	Convenient	Durable	Functional
11	Gentle	Simple	
12	Functional	Dependable	
13	Light (weight)	Thin	Durable
14	Bossy/Expensive	Technological	Durable
15	Small	Cool	Intuitive
16	Modern		
17	Small/Compact	Accessible Info	
18	Modern	Decent (size)	
19	Good hand-fit	Scratch-Resistant	Water-proof
20	Light (weight)	Durable	Ergonomic
21	Futuristic	Durable	Stylish
22	Compatible	Easy to Use/Simple	
23	Modern	Sleek	Curved
24	Functional	Durable	Small
25	Long-lasting	Sleek	Elegant
26	Durable	Convenient	Sleek
27	Strong	Light weight	Sleek
28	Durable	Thin	Light (weight)
29	Latest	Durable	
30	Stylish	Weightless	Durable
31	Durable	Strong	
32	Tough	Attractive	Ergonomic
33	Usable	Modern	Durable
34	Modern	Weightless	Popular
35	Light weight	Easy to Handle	Modern
36	Useful	Durable	Versatile
37	Efficient	Fun	Slick

Kansei Words

F	G	H	I	J	K	L
Durable	Attractive	Modern	Cool	Intuitive	Functional	Ergonomic
Sturdy	Shimmering	Futuristic	Fun	User-friendly	Usable	Good hand-fit
Scratch-Resis	Stylish	Sleek	Popular	Easy to Use	Useful	Easy to Handle
Long-lasting	Cute	Slick		Simple	Accessible Info	Managable Size
Strong	Elegant	Latest		Straight-forward	Quick	Thin
Reliable	Bossy/Expensiv	Technological			Efficient	Convenient
Firm		Minimalist			Dependable	Large
Tough						Small
Water-proof						

American | Chinese | Indian | Korean | Product Element Space | **Semantic Space** | Part 2 Schedule

Appendix J

Product Element Space

	Raw Data		
2	7	6	1
3	8	4	5
4	1	2	3
5	5	4	2
6	1	2	3
7	4	2	3
8	4	5	1
9	9	6	5
10	6	4	1
11	5	3	6
12	9	7	1
13	6	1	5
14	1	7	5
15	4	5	2
16	9	4	7
17	4	5	6
18	7	6	5
19	9	1	2
20	1	2	3
21	8	1	2
22	9	2	1
23	7	1	4
24	4	6	7
25	5	4	3
26	5	1	2
27	2	5	8
28	7	5	2
29	5	6	7
30	6	4	5

Frequency	
1--->	16
2--->	15
3--->	11
4--->	22
5--->	29
6--->	15
7--->	12
8--->	5
9--->	7
Total	132

Ranked Product Components
Shape of Phone
Phone Material
Color
Size of Display Screen
Navigational Tools
Size of Phone
Phone Interaction
Weight
Text Input Method

Orig. Word List Order
1- Color
2- Nagivation Tools
3- Phone Interaction
4- Phone Material
5- Shape of Phone
6- Size of Display Screen
7- Size of Phone
8- Text Input Method
9- Weight

Design Feature	Shape of Phone	Phone Body Material	Size of Display Screen	Navigational Tools
Range in Features	Egg-shaped; rectangle shape; squared shape	Painted plastic; Aluminum/Metal; Glass; Rubber	Small-1.3 ; Medium-2.4"; Large- 3.5"/3.7"	Lite touch pad; hard buttons; soft buttons
Phone Samples	Nokia 2330 or Samsung t249; Motorola Droid or HTC HD7; Motorola Charm			
Phone Price	$50 - $100	$400-500	$300	

American | Chinese | Indian | Korean | Product Element Space | Semantic Space | Part 2 Schedule

Appendix K

R-code Used in Data Analysis

```
# First, read in all the 6+1 data files (by Kansei word)

KEdata_Attractive_NK =
read.table("C:/Users/LWatson/Desktop/LW R Data/KEdata_Attractive_NK.csv",
header=TRUE, sep=",", na.strings="NA", dec=".", strip.white=TRUE)

KEdata_Cool_NK =
 read.table("C:/Users/LWatson/Desktop/LW R Data/KEdata_Cool_NK.csv",
 header=TRUE, sep=",", na.strings="NA", dec=".", strip.white=TRUE)

KEdata_Durable_NK =
read.table("C:/Users/LWatson/Desktop/LW R Data/KEdata_Durable_NK.csv",
header=TRUE, sep=",", na.strings="NA", dec=".", strip.white=TRUE)

KEdata_Ergonomic_NK =
read.table("C:/Users/LWatson/Desktop/LW R Data/KEdata_Ergonomic_NK.csv",
header=TRUE, sep=",", na.strings="NA", dec=".", strip.white=TRUE)

KEdata_Modern_NK =
read.table("C:/Users/LWatson/Desktop/LW R Data/KEdata_Modern_NK.csv",
header=TRUE, sep=",", na.strings="NA", dec=".", strip.white=TRUE)
KEdata_Userfriendly_NK =
read.table("C:/Users/LWatson/Desktop/LW R Data/KEdata_Userfriendly_NK.csv",
header=TRUE, sep=",", na.strings="NA", dec=".", strip.white=TRUE)

KEdata_Likeability_NK =
read.table("C:/Users/LWatson/Desktop/LW R Data/KEdata_Likeability_NK.csv",
header=TRUE, sep=",", na.strings="NA", dec=".", strip.white=TRUE)

# Then perform ANOVAs on all the above data sets.
# For KW "Attractive"
aov.Attractive_NK = (aov(Rating ~ P + Gender + CG + Phone + DF + CG*Phone + CG*DF +
Phone*DF, KEdata_Attractive_NK))
print(summary(aov.Attractive_NK))
print(TukeyHSD(aov.Attractive_NK, "CG", ordered = TRUE, conf.level = 0.95))
print(TukeyHSD(aov.Attractive_NK, "Phone", ordered = TRUE, conf.level = 0.95))
print(TukeyHSD(aov.Attractive_NK, "DF", ordered = TRUE, conf.level = 0.95))
print(TukeyHSD(aov.Attractive_NK, "Gender", ordered = TRUE, conf.level = 0.95))

# For KW "Cool"
aov.Cool_NK = (aov(Rating ~ P + Gender + CG + Phone + DF + CG*Phone + CG*DF Phone*DF,
KEdata_Cool_NK))
print(summary(aov.Cool_NK))
print(TukeyHSD(aov.Cool_NK, "CG", ordered = TRUE, conf.level = 0.95))
print(TukeyHSD(aov.Cool_NK, "Phone", ordered = TRUE, conf.level = 0.95))
print(TukeyHSD(aov.Cool_NK, "DF", ordered = TRUE, conf.level = 0.95))
print(TukeyHSD(aov.Cool_NK, "Gender", ordered = TRUE, conf.level = 0.95))

# For KW "Durability"
aov.Durable_NK = (aov(Rating ~ P + Gender + CG + Phone + DF + CG*Phone + CG*DF +
Phone*DF, KEdata_Durable_NK))
print(summary(aov.Durable_NK))
print(TukeyHSD(aov.Durable_NK, "CG", ordered = TRUE, conf.level = 0.95))
print(TukeyHSD(aov.Durable_NK, "Phone", ordered = TRUE, conf.level = 0.95))
print(TukeyHSD(aov.Durable_NK, "DF", ordered = TRUE, conf.level = 0.95))
print(TukeyHSD(aov.Durable_NK, "Gender", ordered = TRUE, conf.level = 0.95))

# For KW "Ergonomic"
```

```
aov.Ergonomic_NK = (aov(Rating ~ P + Gender + CG + Phone + DF + CG*Phone + CG*DF
Phone*DF, KEdata_Ergonomic_NK))
print(summary(aov.Ergonomic_NK))
print(TukeyHSD(aov.Ergonomic_NK, "CG", ordered = TRUE, conf.level = 0.95))
print(TukeyHSD(aov.Ergonomic_NK, "Phone", ordered = TRUE, conf.level = 0.95))
print(TukeyHSD(aov.Ergonomic_NK, "DF", ordered = TRUE, conf.level = 0.95))
print(TukeyHSD(aov.Ergonomic_NK, "Gender", ordered = TRUE, conf.level = 0.95))

# For KW "Modern"
aov.Modern_NK = (aov(Rating ~ P + Gender + CG + Phone + DF + CG*Phone + CG*DF
Phone*DF, KEdata_Modern_NK))
print(summary(aov.Modern_NK))
print(TukeyHSD(aov.Modern_NK, "CG", ordered = TRUE, conf.level = 0.95))
print(TukeyHSD(aov.Modern_NK, "Phone", ordered = TRUE, conf.level = 0.95))
print(TukeyHSD(aov.Modern_NK, "DF", ordered = TRUE, conf.level = 0.95))
print(TukeyHSD(aov.Modern_NK, "Gender", ordered = TRUE, conf.level = 0.95))

# For KW "Userfriendly"
aov.Userfriendly_NK = (aov(Rating ~ P + Gender + CG + Phone + DF + CG*Phone + CG*DF
Phone*DF, KEdata_Userfriendly_NK))
print(summary(aov.Userfriendly_NK))
print(TukeyHSD(aov.Userfriendly_NK, "CG", ordered = TRUE, conf.level = 0.95))
print(TukeyHSD(aov.Userfriendly_NK, "Phone", ordered = TRUE, conf.level = 0.95))
print(TukeyHSD(aov.Userfriendly_NK, "DF", ordered = TRUE, conf.level = 0.95))
print(TukeyHSD(aov.Userfriendly_NK, "Gender", ordered = TRUE, conf.level = 0.95))

# For generic "Likeability"
aov.Likeability_NK = (aov(Rating ~ P + Gender + CG + Phone + DF + CG*Phone + CG*DF
Phone*DF, KEdata_Likeability_NK))
print(summary(aov.Likeability_NK))
print(TukeyHSD(aov.Likeability_NK, "CG", ordered = TRUE, conf.level = 0.95))
print(TukeyHSD(aov.Likeability_NK, "Phone", ordered = TRUE, conf.level = 0.95))
print(TukeyHSD(aov.Likeability_NK, "DF", ordered = TRUE, conf.level = 0.95))
print(TukeyHSD(aov.Likeability_NK, "Gender", ordered = TRUE, conf.level = 0.95))
```

Appendix L

Tables

Table 5

ANOVA Results for Kansei Word: Attractive

Factor	df	Sum Sq.	F	p
P	1	0.05	0.032	0.870
Gender	1	2.77	1.530	0.217
Cultural Group	2	8.32	2.296	0.103
Phone	2	66.24	18.286	0.000***
Design Feature	3	6.57	1.210	0.307
CG*Phone	4	6.76	0.934	0.445
CG*DF	6	5.13	0.473	0.828
Phone*DF	6	31.68	2.915	0.009**
Residual	248	449.19		

Note. *p<.05, **p<.01, ***p<.001

Table 6

ANOVA Results for Kansei Word: Cool

Factor	df	Sum Sq.	F	p
P	1	0.36	0.202	0.654
Gender	1	3.08	1.740	0.188
Cultural Group	2	12.13	3.422	0.034*
Phone	2	79.28	22.375	0.000***
Design Feature	3	7.33	1.378	0.250
CG*Phone	4	10.24	1.445	0.220
CG*DF	6	5.89	0.554	0.767
Phone*DF	6	22.91	2.155	0.048*
Residual	249	441.16		

Note. *p<.05, **p<.01, ***p<.001

Table 7

ANOVA Results for Kansei Word: Durable

Factor	df	Sum Sq.	F	p
P	1	4.21	2.374	0.125
Gender	1	1.12	0.632	0.428
Cultural Group	2	17.24	4.864	0.008**
Phone	2	23.68	6.683	0.001**
Design Feature	3	2.00	0.376	0.770
CG*Phone	4	17.84	2.518	0.042*
CG*DF	6	5.37	0.506	0.804
Phone*DF	6	7.83	0.736	0.621
Residual	250	442.92		

Note. *p<.05, **p<.01, ***p<.001

Table 8

ANOVA Results for Kansei Word: Ergonomic

Factor	df	Sum Sq.	F	p
P	1	0.79	0.3711	0.543
Gender	1	0.93	0.4344	0.510
Cultural Group	2	0.44	0.1033	0.902
Phone	2	23.89	5.6055	0.004**
Design Feature	3	12.01	1.8787	0.134
CG*Phone	4	11.31	1.3271	0.260
CG*DF	6	13.42	1.0492	0.394
Phone*DF	6	83.67	6.5440	.000***
Residual	250	442.92		

Note. *p<.05, **p<.01, ***p<.001

Table 9

ANOVA Results for Kansei Word: Modern

Factor	df	Sum Sq.	F	p
P	1	0.49	0.287	0.593
Gender	1	4.61	2.696	0.102
Cultural Group	2	1.28	0.375	0.688
Phone	2	161.56	47.213	0.000***
Design Feature	3	8.36	1.628	0.183
CG*Phone	4	5.89	0.861	0.488
CG*DF	6	7.74	0.754	0.607
Phone*DF	6	33.77	3.290	.004**
Residual	247	442.62		

Note. *p<.05, **p<.01, ***p<.001

Table 10

ANOVA Results for Kansei Word: User-friendly

Factor	df	Sum Sq.	F	p
P	1	1.98	1.051	0.306
Gender	1	10.25	5.442	0.020*
Cultural Group	2	6.79	1.802	0.167
Phone	2	10.05	2.668	0.071
Design Feature	3	8.24	1.459	0.226
CG*Phone	4	4.28	0.569	0.686
CG*DF	6	20.92	1.851	0.090
Phone*DF	6	31.75	2.810	0.012*
Residual	250	470.82		

Note. *p<.05, **p<.01, ***p<.001

Table 11

ANOVA Results for Likeability of Design Features

Factor	df	Sum Sq.	F	p
P	1	0.62	0.4412	0.507
Gender	1	4.80	3.3990	0.066
Cultural Group	2	6.48	2.2938	0.103
Phone	2	15.67	5.5475	0.004
Design Feature	3	11.08	2.6152	0.052
CG*Phone	4	2.49	0.4410	0.779
CG*DF	6	18.08	2.1330	0.051
Phone*DF	6	39.78	4.6926	0.000***
Residual	250	353.17		

Note. *p<.05, **p<.01, ***p<.001

Table 12

Tukey's HSD Results for Kansei Word: Cool, Factor: Cultural Group

Cultural Group	diff	lower	upper	P
American-Chinese	0.328	-0.178	0.834	0.279
Indian-Chinese	0.520	0.050	0.990	0.026*
Indian-American	0.192	-0.254	0.639	0.569

Note. *p<.05, **p<.01, ***p<.001

Table 13

Tukey's HSD Results for Kansei Word: User-friendly, Factor: Gender

Cultural Group	diff	lower	upper	p
Male-Female	0.397	0.055	0.739	0.023*

Note. *p<.05, **p<.01, ***p<.001

Table 14

Comparison Results of Desired Design Features from Phone Sample Set

Design Feature Category	Kansei Word	Most Desired Phone Feature	Avg Score	Least Desired Phone Feature	Avg Score
Shape	Durable*	Squared	4.72	Oval/Egg	3.48
	Attractive*	Rectangular	4.52	Squared	2.88
	Modern*	Rectangular	5.00	Squared	3.24
	Cool*	Rectangular	4.44	Squared	3.36
	User-friendly	Oval/Egg	4.28	Rectangular	3.88
	Ergonomic*	Oval/Egg	5.08	Squared	2.84
	Durable	Glass, Painted plastic	4.68	Glass, Metal	3.96
Material	Attractive*	Glass, Metal	4.88	Painted Plastic, Rubber	3.72
	Modern*	Glass, Metal	.88	Painted Plastic, Rubber	3.84
	Cool*	Glass, Metal	.80	Painted Plastic, Rubber	3.64
	User-friendly	Glass, Painted plastic	.40	Painted Plastic, Rubber	4.12
	Ergonomic	Painted plastic, Rubber	.16	Glass, Metal	3.84

LCD Size	Durable	Medium (~2.8”)	.36	Large (~4.3”)	3.80
	Attractive*	Large (~4.3”)	.16	Small (~1.8”)	3.41
	Modern*	Large (~4.3”)	5.64	Small (~1.8”)	3.08
	Cool*	Large (~4.3”)	5.00	Small (~1.8”)	3.04
	User-friendly*	Large (~4.3”)	5.04	Small (~1.8”)	3.40
	Ergonomic	Medium (~2.8”)	.44	Small (~1.8”)	3.64
Navigation	Durable	Hard Button	4.56	5-Way	4.12
	Attractive*	Touchpad	.92	Hard Buttons	3.56
	Modern*	Touchpad	.32	5-Way	2.84
	Cool*	Touchpad	.72	5-Way	3.00
	User-friendly	Touchpad	.24	5-Way	3.68
	Ergonomic	Touchpad	.04	Hard Buttons	3.12

Note. *Statistically significant.