

Advances in Affective and Pleasurable Design

Edited by
Yong Gu Ji



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Preface

This book focuses on a positive emotional approach in product, service, and system design and emphasizes aesthetics and enjoyment in user experience. This book provides dissemination and exchange of scientific information on the theoretical and practical areas of affective and pleasurable design for research experts and industry practitioners from multidisciplinary backgrounds, including industrial designers, emotion designer, ethnographers, human-computer interaction researchers, human factors engineers, interaction designers, mobile product designers, and vehicle system designers.

This book is organized in nine sections which focus on the following subjects:

- I: Designing for Diversity
- II: Cultural and Traditional Aspects
- III: Ergonomics and Human Factors
- IV: Product, Service, and System Design
- V: Human Interface in Product Design
- VI: Emotion and UX Design
- VII: Design and Development Methodology
- VIII: Diverse Approaches: Biosignals, Textiles, and Clothing
- IX: Novel Devices, Information Visualization, and Augmented Reality

Sections I through III of this book cover special approaches in affective and pleasurable design with emphasis on diversity, cultural and traditional contexts, and ergonomics and human factors. Sections IV through VII focus on design issues in product, service, and system development, human interface, emotional aspect in UX, and methodological issues in design and development. Sections VIII and IX handle emotional design approaches in diverse areas, i.e. biosignals, textiles, and clothing, and emerging technologies for human interaction in smart computing era. Overall structure of this book is organized to move from special interests in design, design and development issues, to novel approaches for emotional design.

All papers in this book were either reviewed or contributed by the members of Editorial Board and Interaction Design Lab at Yonsei University. For this, I would like to appreciate the Board members listed below:

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This book is the first approach in covering diverse approaches of special areas and including design and development methodological researches and practices in affective and pleasurable design. I hope this book is informative and helpful for the researchers and practitioners in developing more emotional products, services, and systems.

April 2010

Yong Gu Ji
Yonsei University
Seoul, Korea

Editor

Section I

Designing for Diversity

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Emoticons: Cultural Analysis

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ABSTRACT

As computer-mediated communication (CMC) continues to replace face-to-face (F2F) interaction, the nature of communication has changed. Emoticons (emotional icons) are facial expressions pictorially represented by text and punctuation marks. Emoticons have become substitutes for the visual cues of F2F communication in CMC, and have been used for many years to diversify communication in informal text messages. This study compares and analyzes syntactic typographic structures and variables between two different cultural emoticons, American and Korean, and examines whether emoticons can be culturally neutral.

Keywords: computer-mediated communication, emotion and typographic emoticon, typographic syntactic variables

1 INTRODUCTION

All over the world people connect through CMC. According to The Radicati Group, in the Email Statistics Report, 2011–2015, “the number of worldwide email accounts is expected to increase from an installed base of 3.1 billion in 2011 to nearly 4.1 billion by year-end 2015”. Instant Messaging (IM) is also continuing to grow in popularity, especially the younger generation. “Worldwide IM accounts are expected to grow from over 2.5 billion in 2011 to more than 3.3 billion by 2015” (Radicati Group Inc, 2011). Short messaging service (SMS) has become an important mode of communication throughout the world and its use is increasing rapidly (Global Mobile Statistics, 2011).

As CMC replaces some forms of F2F interaction, the nature of communication has also changed. As one is unable to view the other person in CMC, there is a lack

of nonverbal cues, such as facial expressions and body gestures. This lack of nonverbal information means certain information cannot be fully transferred (McKenna & Bargh, 2000). As a result, utilizing other ways of expressing intended emotions in CMC becomes important. Using icons to express emotions (emoticons) has become a substitute for nonverbal cues used in F2F interactions. Walther and D’Addario (2001) defined emoticons as graphic representations of facial expressions that are embedded in electronic messages. These often include alphabetic characters and punctuation marks to create emotional expressions. Frequently used typographic (e.g., text-based) emoticons include facial expressions representing happy, sad, angry, etc, as shown in Table 1.1. Recently, graphic emoticons have been introduced in IM, resulting in an improved visual language for expressing human emotion.

Many researchers have noted the importance of emoticons to convey meaning in CMC. Emoticons help accentuate meaning during development and interpretation (Crystal, 2001). Lo’s study (2008) showed that most internet users cannot perceive the correct emotion, attitude, and attention intent from pure text without emoticons. Adding emoticons significantly improves the receiver’s perception of a message. They not only carry the warmth of F2F communication, but also add breadth to the message (Blake, 1999).

Basic human facial expressions are not learned, but are universal across cultures (Ekman in Matsumoto, 1992). Based on this reasoning, this author hypothesizes that the basic emotions in emoticons are also culturally neutral. This paper reviews two types of studies that: (1) analyze syntactic structure and variables in two different cultural emoticons, and (2) examine whether emoticons can be culturally neutral. This study focuses only on typographic emoticons.






Typographic Emoticons	: - )	: - (	: P	: <	: O
Graphical Emoticons					

Table 1.1 Typographic Emoticons and Graphic Emoticons

2 METHOD

The study consisted of 60 American undergraduate student participants majoring in graphic design. Female participants comprised about 60% and male participants 40% of the sample. About 90% of participants were aged in their 20s, and approximately 40% had been exposed to Eastern (e.g., Korean, Japanese) style emoticons (Table 2.1). This group is called the exposed group and the other group the non-exposed group in the analysis of the results. The study used a combination of fixed-response (i.e., structured) and closed-ended (i.e., non-structured) questions. The fixed-response questions were: (1) demographic information, (2) frequency of emoticon usage, (3) media usage of emoticons, (4) frequency of typographic and

graphic emoticon usage, (5) attitude toward emoticons, (6) difficulty in understanding emoticons, and (7) experience in Eastern emoticons. The closed-ended questions were: (1) commonly used emoticons, and (2) perceived emotions on both types of cultural emoticons.

	Participants	10s	20s	30s	40s	Have been exposed to Eastern style emoticons?
Male	25	–	22	2	1	9
Female	35	1	33	–	1	17
Total	60	1	55	2	2	26

Table 2.1 Participant Demographics

3 RESULTS

3.1 Typographic Elements and Structure

The typographic emoticons in Korea are made up of Korean ‘Hangul’ characters with punctuation marks (e.g., asterisk, tilde, grave accent) in a similar way to American emoticons, which use alphabetic characters with punctuation marks (e.g., colon, round bracket, slash). Countless emoticons can be formed using different combinations of characters in both types of cultural emoticon. The most popular American emoticons include punctuation marks such as the colon - : - representing the eyes, and brackets - () - representing the mouth. The most popular Korean emoticons include characters ㄱ or ㅍ for the eyes, and – for the mouth.

Orientation of the marks is seen as a significant difference in the formation of the typographic emoticons for both cultural emoticons. American emoticons have horizontal orientation; in other words the eye is on the left and the mouth is on the right. This is the traditional way to write in English; from left to right, the way one reads and writes, and the side-by-side way letter characters are formed. However, Korean emoticons have vertical orientation; the eye is topmost and the mouth is bottommost. This is the traditional way to write in Korean and also the way characters are formed; top to bottom. Examples are shown in Table 3.1.1.

Emotions	American Emoticons	Korean Emoticons
happy/smile	:) :D	^^ ^o^
sad/cry	:( :-(	ㅍ_ㅍ ㅠ_ㅠ
flirtatious	;) :-)	^~ ^_~
angry	:\ >:\	`' .V.

Table 3.1.1 Structural Difference Between American and Korean Emoticons

3.2 Syntactic Variables

The face as a whole indicates human emotion. Specific emotional modes, such as happiness or sadness, are expressed through a combination of five different facial features: eyebrows, eyes, nose, cheeks, and mouth. The enormous complexities of physiognomy have been reduced to the bare essentials through emoticons. The human face has been simplified; two eyes become dots and a mouth becomes a line. Emoticons are made up of typographic facial motifs to represent emotions. For example, the closing round bracket -) - represents a smiling mouth to indicate happiness, whereas (represents a downturned mouth to indicate unhappiness, and / indicates confusion. Therefore, facial expressions in emoticons rely on typographic syntactic variables (i.e., formal mode of visual signs) such as shape, size, proportion, direction, and orientation of the five facial features. The unambiguous typographic syntactic variables correspond with certain facial expressions, used to effectively convey intended emotions.

Table 3.2.1 lists facial features from the most popular American emoticons known to participants. Interestingly, a wide variety of syntactic variables are found for the mouth, followed by those for the eyes. Interestingly, for Korean emoticons, the author found more syntactic variables for the eyes, followed by those for the mouth (Table 3.2.2).

Features	Facial Syntactic Variables in American Emoticons						
eyebrow	>						
eye	:	--	><	=	**		
	;	,	ii	X			
nose	-						
cheek	' *						
mouth	)	D	P	|	\	[	>
	(	O	T	_	/]	<
	))	X	u	—	.	3	*
	(({	#	@			

Table 3.2.1 American Emoticons: Facial Syntactic Variables

Features	Facial Syntactic Variables in Korean Emoticons					
eyebrow						
eye	^^	TT	^~	` `	**	==
	><	ππ	^-	` '	@ @	z z
	V	--	oO	::		
nose						
cheek	**					
mouth	~	o	-	.		

Table 3.2.2 Korean Emoticons: Facial Syntactic Variables

Figure 3.2.1 indicates culture is a determining factor in the formation of emoticons when representing emotions. In American emoticons, a wide variety of distinguishing variables are found for the mouth. For example, the closing round bracket in the :-) representing happiness can be replaced with the opening round bracket to form :-(to represent sadness. Likewise, the emotion statement can be increased by replacing) with D to form :-D, representing great happiness. It may be that the change in the mouth of an emoticon can be generally understood as a difference in facial expression in American emoticons. Therefore, American emoticons are largely reliant on the syntactic variables of the mouth.

Conversely, a greater variety of distinguishing variables in Korean emoticons are found for the eye (Figure 3.2.1). For example, ^^ are used for smiling eyes, representing happiness, and can be replaced with TT for crying eyes, representing sadness, or ` ` for vicious eyes which represent anger. For this reason, Korean emoticons are more reliant on syntactic variables of the eye. This suggests American emoticons use visual stimuli from the mouth to express emotions, whereas Korean emoticons use the eyes.

Other facial features, such as eyebrows, nose, and cheeks are not significant in the formation of emotions in either culture's emoticons. Some features are excluded from an emoticon such that the remaining items gather importance. Eyebrows and noses rarely contribute to different emotional expressions in Korean emoticons, compared to American emoticons. For instance, a smiling face ^^ excludes a nose and mouth. The only expressive features, the eyes, become more prominent. This indicates that American emoticons rely on a variety of facial features to convey emotional expression, whereas Korean emoticons express emotions using a minimal number of facial features.

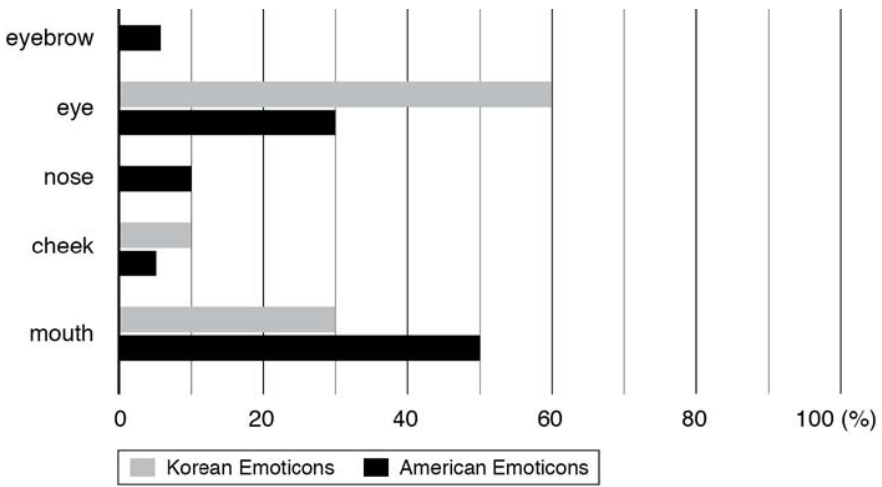


Figure 3.2.1 Frequency of Facial Syntactic Variables

3.3 Culture and Emoticons

Facial expressions are a form of nonverbal communication which convey emotional states during F2F communication. Most anthropologists believe facial expressions are learned, and therefore vary from culture to culture (Jack et al., 2009). On the other hand, Ekman showed facial expressions of emotion are universal across cultures (Ekman in Matsumoto, 1992). If this is the case, regardless of culture, the same emotion from different cultural emoticons should be recognized. Every emoticon bears visual resemblance to facial expressions. The author hypothesizes that the probability of correct interpretation of other culture’s emoticons is high as people can derive meaning from the iconic illustration, regardless of culture.

When shown several popular Korean emoticons representing the basic emotions of happiness, sadness, anger, and flirtatiousness, participants were asked to give their perceived emotions on each emoticon (See Table 3.3.1).

^^	^o^	TT_TT	TT_TT	‘_’	^_~
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Table 3.3.1 Korean Typographic Emoticons

Some participants accurately interpreted a number of emoticons, regardless of their knowledge of Eastern style emoticons. Others, however, found interpretation difficult. 62% of the non-exposed group accurately identified emoticons of smiling eyes (^ ^ and ^o^) and 75% of the exposed group correctly identified them. With the 2x2 Chi-Square calculation, the Chi-Squared value $\chi^2 = 0.8181$. It leads to the two-

tailed p-value of 0.3657 ($p > 0.05$). This difference between the exposed and non-exposed group is not statistically significant. Therefore, the smiling emoticons (happiness) are culturally neutral. For the emoticon of winking eyes ($^{\wedge}_{\sim}$), the same percentages are observed from the both groups as for the smiling emoticons. Therefore the emoticon of winking eyes (flirtatiousness) is also culturally neutral. For the emoticons of crying eyes (\top_{\top} and \top_{\top}), 18% of the non-exposed group accurately identified them and 71% of the exposed group accurately identified them. With the 2x2 Chi-Square calculation, the Chi-Squared value $\chi^2 = 16.62$. It amounts to the p-value of 0.001 ($p < 0.05$). By conventional criteria, this difference between the two groups is considered to be extremely statistically significant. Therefore, the emoticons of crying eyes (sadness) are culturally dependent. The reason for this cultural dependency is clear when they are made up of Korean 'Hangul' characters. For the emoticon of angry eyes ($\underset{\sim}{_}$), 53% of the non-exposed group and 58% of the exposed group accurately identified it. With the 2x2 Chi-Square calculation, the Chi-Squared value $\chi^2 = 0.165$. It leads to the two-tailed p-value of 0.6846 ($p > 0.05$). This difference between the exposed and non-exposed group is not statistically significant. Therefore, the emoticon of angry eyes is culturally neutral.

The study concluded that certain emoticons correspond with facial expressions, irrespective of cultural background, and are therefore culturally neutral unless the emoticons are made up of the culturally oriented characters.

4 CONCLUSIONS

Typographic emoticons are made up of typographic syntactic variables. American emoticons focus on variables of the mouth, whereas Korean emoticons emphasize variables of the eyes. The orientation of constructing emoticons is another factor in distinguishing between two cultural emoticons: American uses horizontal format, while Korean uses vertical. Even if emoticons between two cultural backgrounds are in the different orientation focusing on different facial features, there is a great probability that two different cultural groups can recognize emoticons that bear visual resemblance to facial expressions. The study concluded that certain emoticons are in general culturally neutral unless they are made up of the culturally oriented characters.

This study compared and analyzed syntactic typographic structures and variables between two different cultural emoticons, and examined whether emoticons could be culturally neutral. Further studies into cross-cultural comparisons of a more extensive number of emoticons are required to validate the level of cultural neutrality, and to investigate whether the gender variable plays a meaningful role in the interpretation of emoticons.

REFERENCES

- Blake, Gary. "E-mail with feeling." *Research Technology Management* 42 (6) Nov/Dec 1999: 12–13.
- Crystal, David. *Language and the internet*. Cambridge, UK: Cambridge University Press. 2001.
- "Email Statistics Report, 2011–2015." *Radicati Group, Inc.* Accessed January 5, 2012 <<http://www.radicati.com/wp/wp-content/uploads/2011/05/Email-Statistics-Report-2011-2015-Executive-Summary.pdf>>.
- "Global Mobile Statistics 2011." *MobiThinking*. Accessed January 2012 <<http://mobithinking.com/mobile-marketing-tools/latest-mobile-stats>>.
- "Instant Messaging Market 2011–2005." The *Radicati Group, Inc.* Accessed January 2012 <<http://www.radicati.com/wp/wp-content/uploads/2011/11/Instant-Messaging-Market-2011-2015-Executive-Summary.pdf>>.
- Jack, Rachael E, Caroline Blais, Christoph Scheepers, Philippe G. Schyns & Roberto Caldara. "Cultural Confusions Show that Facial Expressions Are Not Universal." *Current Biology*, 19 (18) 13 August 2009: 1543-1548.
- Lo, Shao-Kang. "The Nonverbal Communication Functions of Emoticons in Computer-Mediated Communication." *CyberPsychology & Behavior* 11 2008: 595–597.
- Matsumoto, David. "More Evidence for the Universality of a Contempt Expression." *Motivation and Emotion*, 16 (4) December 1992: 363–368.
- McKenna, K. Y. A., & Bargh, J. A. "Plan 9 from cyberspace: The implications of the Internet for personality and social psychology." *Personality and Social Psychology Review* 4 2000: 57–75.
- Walther, J. B., & D'Addario, K. P. "The impacts of emoticons on message interpretation in computer – mediated communication." *Social Science Computer Review* 19 2001: 324–347.

CHAPTER 2

Designing Spaces for Aging Eyes

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ABSTRACT

If the least conservative estimates are used, by the year 2040 the average life expectancy of older people could increase by 20 years. Some projections are that by the middle of the 21st century, there will be 16 million Americans over 85 years of age. The sensory, cognitive and motor abilities decline as we age. With a rapidly aging population, design for the elderly is going to have to be given greater consideration than it has in the past. Often times it is the architects that design the interior spaces of the assisted living environments, and quite often these four key legibility variables have not been factored in to the design. The purpose of this research is to produce some preliminary guidelines for the wayfinding, organization, and experience design of assisted living environments. The study will establish critical legibility factors related to aging vision and designing supportive environments that enhance comfort, safety and independent functioning. This study involves an in-depth look at an assisted living facility in Ames, Iowa. The methodologies will consist of overall observation and one-on-one interviews with the staff. The case study will reveal how the overall experience in assisted living environments can be improved.

Keywords: universal design, wayfinding, experience design, vision, aging

1 INTRODUCTION

The sensory, cognitive and motor abilities decline as we age. With a rapidly aging population, design for the elderly is going to have to be taken in greater consideration than it has in the past. If the least conservative estimates are used, by the year 2040 the average life expectancy of older people could increase by 20 years. Some projections are that by the middle of the 21st century, there will be 16 million Americans over 85 years of age. Prognosticators also say that the average 65-year-old will spend 7.5 years of his or her remaining 17 years living with some functional disability (Spiriduso, Francis & MacRae, 2005). When looking at many

designed spaces today it does not seem that the needs of the aging population are even being considered.

The need for sensitivity to usability issues will only become more pressing in the coming decades as user populations become more diverse. One significant trend is the increasing longevity of the human race, worldwide. Another factor is improved medical technologies that allow more critically injured and seriously ill people to survive (Story, Mueller and Mace, 1998).

The ability to perform the activities of daily living (ADLs) becomes more challenging as one ages. As these ADLs become more difficult, many older adults have turned to assisted living environments. The Assisted Living Federation of America, which was created in 1990, defines assisted living as “a long-term care option that combines housing, support services and health care, as needed” (alfa.org). Assisted living is designed for individuals who “require assistance with everyday activities such as meals, medication management or assistance, bathing, dressing and transportation.” In addition, “some residents may have memory disorders including Alzheimer’s, or they may need help with mobility, incontinence or other challenges” (IBID).

The following content reveals a case study involving an in-depth look of an assisted living facility in Ames, Iowa. The methodologies used consisted of overall observation and one-on-one interview sessions with the staff. The two aspects of design researched in the study were: wayfinding and experience design. The goals of the study were to find how the overall experience of assisted living environments, particularly the assisted living facility in Ames, Iowa, and the overall universal design codes could be improved.

2 THE BACKGROUND OF THE ROSE OF AMES

The Amenities

The Rose of Ames is a fifty-six unit, one and two-bedroom private senior-living apartment complex that offers assisted living services as well as 24-hour monitoring. The facility offers social programming, coin-free laundry facilities, a nurse’s office, and dining room meal service with a private chef. According to the Rose of Ames website, each apartment unit features a “fully equipped kitchen, mini-blinds on all windows, a shower with a built-in seat, and a large in-unit storage closet.” The property features a beauty salon, a mini-theater, a small computer room, activities room, a library and fireplace, a whirlpool, front and back porches with patio furniture and a guest suit.

Pricing

Like most rental units, there are several application fees. Rent varies from \$546 to \$716 for 1-bedroom apartments and 2-bedroom apartment units are \$849/month with gas and electric included in the unit rent cost. There is an income guideline that the seniors cannot exceed during move-in. A household size of one person cannot make more than \$21,680/year, while a household of two people cannot make more than \$37,200/year. The pricing is very competitive when compared to the national average. According to the American Association of Homes and Services for the

Aging, “the average daily cost for a private room in a nursing home is \$214.00 (\$6,390 per month and \$77,745 annually), while the average monthly cost of assisted living facilities is \$2,969.00 or \$35,628 annually” (Caregiverlist.com).

The Location

Located in Ames, Iowa, approximately 30 minutes from Iowa’s state capital, Des Moines. Ames is also less than a day’s drive from Minneapolis, Kansas City, Omaha, Chicago, St. Louis and Milwaukee. According to the City of Ames website, in 2002, Ames was ranked one of the “Best 20 places in America to Live and Work” by BestJobsUSA.com. Also in 2002, it was ranked 20th on the “Best Place to Live in America” by *Men’s Journal* magazine. Ames, Iowa is also home to Iowa State University.

The Rose of Ames is conveniently located, as it is less than a block to Iowa State University’s CyRide bus stop. This transportation system runs every single day of the week during many hours of the day and all throughout the city of Ames.

The Development and Purpose of the Rose of Ames

According to an article published in the *Nursing Homes* magazine, “In 2001, a statewide study by the Iowa Finance Authority indicated that more than 50% of the elderly aged 75 years and older could not afford what was currently available on the assisted living market” (<http://www.itlmagazine.com/>). At that time, the average monthly costs apartments within assisted-living facilities ranged between \$1,272 and \$2,517. Yet, according to the article, “one in four seniors statewide aged 75 and older had a monthly income at or below \$884 (from the U.S. Census Bureau, 2000), and 50% of the annual median area income ranged from \$17,300 to \$23,550 (from the U.S. Department of Housing and Urban Development)” (IBID).

This is where the Rose of Ames comes into play: they wanted to close the gap between what was *needed* and *what people could afford*. Their goal was to respond to this critical need by providing an “assisted living community that would not only offer an affordable option for moderate-to-low-income seniors,” but, “also would maintain the same quality and scope of housing and services as those available in market-rate assisted living facilities” (IBID).

In order to create an environment at such low-costs, their plan has to separate the housing from the services by making the services optional and purchased separately. Seniors may rent apartments in the facility and either obtain the optional services from the building owner or its affiliates, or obtain them from any provider they choose. The same is true with their meals: residents may purchase flexible meal plan or cook on their own (IBID).

2.1 LITERATURE REVIEW

Wayfinding

According to author, licensed architect and Professor of Architecture, Arvid E. Osterberg, “signs that provide directions to rooms or spaces and to accessible means of egress need to be accessible.” Signage requirements, provided by the *Americans*

with *Disabilities Act Accessibility Guidelines* (ADAAG), are listed in his book, *Access for Everyone*. They include:

- Signs that are not required to be accessible are the building directories, menus, occupant names, building addresses, and company names and/or logos (Access for Everyone). Though they are not required to meet the accessibility requirements, Osterberg and Kain, recommend making the information readily available to all people whenever it is possible.
- Signs provide important information about locations and services, including information about accessible locations and services. All people should have access to all types of information provided by signs. To assist the greatest number of people, signs should be placed at appropriate locations and heights, contain characters and backgrounds that meet specific requirements for readability, and use symbols that have been adopted internationally to indicate accessible locations and features.
- The design and placement of signs should be uniform in and around the buildings and sites. People will be able to find and use signs more easily and quickly if the placement and heights of the signs are consistent.
- Accessible signs may include tactile characters (such as raised characters, Braille, and/or pictograms), visual characters, or both visual and tactile features. Where signs are required to be both tactile and visual, you may install one sign that includes both types of information or you may install two signs, one visual and the other tactile (Osterberg and Kain, 2005)

Experience Design

The second portion of the study focused on experience design, or the overall comfort level of the Rose of Ames. Experience design is the practice of designing products, processes, services, events and environments based on the consideration of an individual or group's needs, desires, beliefs, knowledge, skills, experiences and perceptions. It involves emotions and memories as well as overall feelings of satisfaction or disgust (Diller, Shedroff, Rhea, 2005).

Experience design is not driven from a single design discipline; rather, it's a cross-discipline perspective. It considers many aspects of the brand/business/environment/experience- from product, packaging and retail environment to clothing and attitude of employees (Diller, Shedroff, Rhea, 2005). It involves all human senses.

2.2 ASSESSMENTS

The outside of Rose of Ames is quite inviting because of the large, white covered porch (Figure 1). The benches and seats on the porch seem to get a lot of attention from the residents. Trees outline the vicinity of the porch, giving the resident a sense of being on a patio of their own home. Bird feeders are seen

hanging from the nearby trees, which aides in a form of entertainment for the residents as well. Inside felt much more home-like than institution-like with the warm, earth tone colors all throughout the facility. The tones were rich and deep, giving a sense of being in a home, not an apartment complex or an assisted living facility. The carpets were deep green and red, and natural colored wood was everywhere. Facilities such as a hair salon, laundry on each floor, a computer room with two computers, candy and soda machines, a small movie theater and a whirlpool room facilitated in entertainment and made it a place where residents wanted to be. The reading room felt very peaceful with the nice wooden framed paintings overhead the fireplace. The plush couch and chairs and the nice selection of books gave it a sense of warmth. The décor throughout the facility was rich and really quite lavish. Framed pictures outline all of the walls, and plants were seen in areas such as the reading room and dining area.

Finding *The Rose of Ames* facility was quite easy because of the large, detailed sign directly in front of the parking lot (Figure 2). The facility is located amongst several other apartment complexes in a residential community. The sign reads, “The Rose of Ames Senior Residencies”. From the outside view, there is no confusion that it is a living facility is for seniors.

Before entering *The Rose of Ames*, one is greeted by a white covered porch with wooden benches to sit upon (Figure 3). The main entrance is not clearly marked, but with the help of the automatic doors, it is fairly obvious that is the main entrance. No doors have any markings, except for one, which is the handicap accessible main entrance (Figure 4). The handicap accessible button to push the door open was quite far (about 3 feet) from the actual door to get in. If the button is pushed, the door will open slowly and allow the person to walk in. If the person is able to pull the door, he or she will find it to be quite heavy. The door was surprisingly narrow for a main entrance to an assisted living facility, but it is feasible with a wheelchair. There was minimal to no threshold under the door, which would make passing over with a wheeled chair very easy.

Once inside the main building, it was very difficult to tell where to go. Straight ahead was a beautiful wooden staircase with green, carpeted stairs (Figure 5), and to the immediate left was a hallway that led into another much larger room (Figure 6). There was no signage directing one to what was upstairs, how to get upstairs if one was not capable of climbing, or what was around the corner. The staircase would be an impossible feat for someone in a wheelchair or who fell short of breath easily.

After walking around the corner, a map became visible (Figure 7). The map was clearly printed by one of the staff members, as it was not professional and was enclosed within an 8.5” x 11” glossy sheet protector. The glare on the paper was troublesome at times and the text was very small and hard to read for someone with 20/20 vision. This was a very bad hazard. Around the corner and into the hallway into the actual facility was an easily assessable staff office. Nearby was a fireplace with chairs (Figure 8) and to the left of the office was a large dining room offering plenty of natural light (Figure 9).

The exit signs were clearly marked, lit, and easy to find. In addition, all of the rooms had signs posted flush against the wall right outside the door to let residents know what was inside each room. Each sign also had Braille (Figures 10 & 11). Unfortunately the signage was a very similar color to that of the painted walls. For

someone with 20/20 vision this was not a concern, however, it would be very hard to distinguish for someone with limited vision.

Each floor had color-coded entryways to the residents' rooms, which was extremely helpful to differentiate the floors from one another. In addition, every resident's room was also clearly marked with his or her name outside the door. Each resident was able to decorate the area right outside their door with pictures, stuffed animals, shelving units— whatever they so desired as long as it did not come into the hallway (Figures 12 & 13). This helped to aid in wayfinding, in addition to allowing the residents' to customize their own entryway. Some residents had doorbells installed outside their doors as well.

The hallways were long, and although there were wooden handrails on each side, there was not an area for someone to sit and rest during his or her walk (Figure 14). The location of the elevators was not marked as clearly as it could have been. There was a seating area right outside the elevator so someone could sit to wait (Figure 15). Once inside the elevator, the buttons were nicely marked and lower to the ground, which is helpful to people in wheelchairs.

2.3 RECOMMENDATIONS

“The Rose of Ames” could be screen printed onto the main entrance door so that it was very clear which door was the main entrance. The doorway itself could actually be extended so that it was two doorways wide. This would also help people realize that this was the main entrance because of the emphasis on the large doorway. Also, the handicap press for the door could be closer to the door as well.

A sign is needed to let people know what is upstairs and what is around the corner right when entering. Also, the map needs to seem more important and be larger. The map could also be closer to the main entrance, so that way people know immediately where they are and where they need to go.

All of the rooms were marked just fine, but since the hallways were dark, the signs seemed to blend in with the walls. Some signs do not need to stick out, such as the maintenance closet, but some, like the laundry facility, or the elevator, could stick out up above the doorway. This would help people who have a difficult time walking far distances to see how far they actually have to go. This would also help emphasize the importance of that room. Some people might walk past the room because they were not looking at each sign as they walked by. Color contrast within each sign might also help show importance. Signage around corners, such as arrows pointing to which room numbers were down that particular hallway would be helpful, too

The patterned carpet was very nice, however, it may be too dark for the residents. A non-patterned carpet would have been a better solution. The staircases were especially dark. In fact, because there was a window at the end of each hallway (Figure 16), and the staircases were also at the end of each hall, there was quite a bit of a difference between the lighting of the end of the hallway and then once one enters inside the staircase area (Figure 17). It takes the elder's eyes a bit more to adjust to light changes, and so this was a definite hazard.

3 CONCLUSIONS

Overall the experience and wayfinding signage at the Rose of Ames was very nice. The facility was very inviting, intimate and private. The designer's paid special attention to small details that made the facility feel home-like to the residents' that lived there. From the outside covered porch to the small movie theater, residents' had a sense of community. The warm earth-tone colors of the green, patterned carpet and wooden doors made the facility feel very inviting. Little touches such as allowing the residents' to customize their entryways really made the facility have a friendly feeling.

There were potential hazards, however. The dim lighting in the hallways and the bright natural lighting coming from the windows could be a potential hazard. The signage needed some distinguishing features to differentiate the different rooms, as well.

As visual communicators, it is our responsibility to consider first the needs, and then the wants of society. We also need to understand just how influential our designs become; beyond printed matter and digital interfaces, designers can actually assist people in remaining active, independent individuals in society.

FIGURES



Figure 1 & 2. Rose of Ames facility and signage



Figure 3. Main entrance porch



Figure 4. Main entrance



Figure 5 & 6. Immediately inside

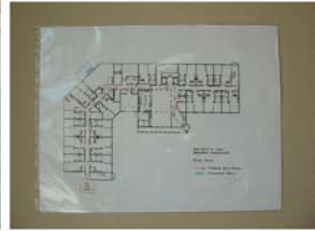


Figure 7. Interior Map



Figure 8. Fireplace



Figure 9. Dining Hall



Figures 10 & 11. Signage



Figure 12 & 13. Residents' doors



Figure 14. Hallway



Figure 15. Bench outside elevator



Figure 16. Hallway



Figure 17. Stairway

REFERENCES

- “A Breakthrough in Creating Affordable Assisted Living.” *Nursing Homes*. 2005. Retrieved February 25, 2012. <http://www.itlmagazine.com/article/breakthrough-creating-affordable-assisted-living>
- “Ames Iowa.” *Community Information*. Retrieved June 11, 2007. <http://www.ames.ia.us/>
- Baumeister, R.F., & Leary, M.R. The need to belong: Desire for Interpersonal Attachments as a Fundamental Human Motivation. *Psychological Bulletin* 117, 497-529. 1995.
- Berger, Craig M. *Wayfinding: Designing and Implementing Graphic Navigational Systems*. Switzerland: RotoVision SA. 2005.
- Diller, Stephen, Nathan Shedroff, Darrel Rhea. *Making Meaning: How Successful Businesses Deliver Meaningful Customer Experiences*. New Riders Press. 2005.
- “Heartland Senior Services.” Retrieved June 11, 2007. <http://www.heartlandseiorservices.com>
- “Home Healthcare.” *Lutheran Services in Iowa*. Retrieved June 11, 2007. http://www.lsiowa.org/home_healthcare.asp
- “How to Choose a Senior Assisted Living Community.” Retrieved January 20, 2012. <http://www.caregiverlist.com/AssistedLiving.aspx>
- Lidwell, William, Kritina Holden, Jill Butler. *Universal Principles of Design: 100 Ways to Enhance Usability, Influence Perception, Increase Appeal, Make Better Design Decisions and Teach Through Design*. Massachusetts: Rockport Publishers. 2003.

- “The Rose of Ames.” *Evergreen Real Estate Development Corporation*. Retrieved June 11, 2007. <http://www.evergreenredc.com/roseofames.php>
- Noble and Bestley, *Visual Research: An Introduction to Research Methodologies in Graphic Design*. London: AVA Publishing. 2005.
- Osterberg, Arvid and Donna Kain. *Access for Everyone*. Ames, Iowa: Iowa State University. 2005.
- “Senior Living Options.” Retrieved January 20, 2012.
http://www.alfa.org/alfa/Assisted_Living_Information.asp
- Story, M. F., Mueller, J. L., & Mace, R. L. (1998). A Brief History of Universal Design. In *The universal design file: Designing for people of all ages and abilities*. North Carolina: The Center for Universal Design. Retrieved June 7, 2007.
- Spirduso, W., Francis, K., & MacRae, P. (2005). *Physical Dimensions of Aging* (Second Edition). Champaign, IL: Human Kinetics.

CHAPTER 3

New Concept for Newspaper Kiosk through Understanding Users' Behavior

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ABSTRACT

This study is concerned with obtaining design specifications for generating a new concept of newspaper kiosk, located in the streets of Tehran. Despite of the importance of newspaper kiosk in Persian culture, they have many shortcomings. In order to obtain a better understanding regarding newspaper kiosks' problems, there was a need for conducting a study. For this aim a precise observation was carried out and thirty users were interviewed regarding their feeling and interactions with kiosk. Samples were chosen randomly among the people who were interacting with the newspaper kiosk. They were from different social groups and were various in gender and age. As a result of this study, four key words were obtained. The customers were asked to mention their opinions regarding each of these key words. The data were analyzed statistically with Excel software and key words were classified due to the customers' priorities. The Quality Function Deployment (QFD) method was used to translate the voice of customer to the design parameters. The outputs of QFD can help to generate new concept for newspaper kiosk.

Keywords: QFD, User behaviour, Kiosk

1 INTRODUCTION

Modern urban life involves a variety of elements for different activities. Sometime urban life is so complicated that people hardly can find their ways and also has no understanding about different spaces. The spaces in cities are both physical and non physical. The non physical spaces are the sole of the city, which are affected by design of different elements. In order to provide better understanding of urban life for people, there is a need for clearly defining urban spaces and structures (Ho, Wang and Lee, 2007). Also for improving the quality of urban life, adequate urban elements and equipments are required. Street furniture is the common term for these equipment and facilities. A classic publication by Design Council (1979: 5) stated: "Public and open spaces are essential parts of people's living space. Poorly designed environment and facilities, including street furniture and open space facilities, can be a nightmare for residents and visitors". Moreover in recent years a lot of designers and researchers such as Rapuano (1994), Orr (2002) and Siu (2008) recognized that public spaces not only provide the functional needs of city users, but also fulfill their social, cultural, psychological and ideological needs.

Devereux (2007) noticed that "user and their views and needs are very important for companies and designers. They are seeking more innovative ways to understand their users' needs and desires". In case of street furniture, the main goal is to harmonize the form, scale, materials and placement to obtain beauty, accessibility and safety through understanding users' needs.

Sometimes users have difficulty for describing design problems and, in many cases, are not even consciously aware of them (Yanagisawa et al., 2009). Therefore, observing people while using a product, allows designers to understand how they interact with a product and the environment. This can provide an understanding for unexpected design problems. Sohan and Nam (2009) stated that the behavior patterns are helpful for analyzing a design problem. Also, the unconscious human behaviors could help to find design solutions.

The newspaper kiosk is one of the street furniture that is very popular in Tehran streets. It has been recognized as the main center of selling the newspapers and magazines in Persian culture. Therefore they are frequently visited by people of different age and backgrounds. Due to the close relationship of people with newspaper kiosks, the quality of these products plays an important role in improvement of urban life quality. According to general observation, it seems that the current kiosks have some problems during the using process and they can not sufficiently provide users needs and desires. These problems are not limited to the end users, and include all people that live and work in the city such as pedestrians and vendors. Therefore, deeper investigation into these problems and their reasons seems necessary. In order to find users needs and desires regarding newspaper kiosks in urban space, there is a need for performing a study. Therefore, a study was carried out and will be explained as fallow.

2 METHODS

The study was carried out by observation and interview to collect data. Quality Function Deployment (QFD) method was used to translate the voice of customer to design specifications.

Eight different kiosks were chosen in Tehran for this study. Four of them are located in very crowded streets in downtown and the other four are placed in less crowded streets. The newspaper kiosks, which were studied, have similar appearance however they are different in dimensions. The main structure of the studied kiosks, are made of iron, which is covered by fiberglass composite panels. The color of the panels is white. The studied kiosks have cubic form and their dimensions are about 400*200*300 or 300*200*250 centimeters. Some of them have a little colorful plastic canopy for protection against sunlight, although, it is not big enough to protect people and newspapers from sun.

2.1 Observational study

Observation is included gathering high quality data through looking and listening very carefully. In this method the particular information about users' behavior is discovered. It can help to study people in their natural ways without their behavior being influenced by the presence of a researcher. For this study reaction and behavior of different people including end users, vendors and pedestrians who pass the kiosk were observed and recorded through videotaping and photography. The users were various in age, gender and social classes. The data were collected, considering five key points of Who, What, Where, When and How.

2.2 Interviews

Interview can assist investigating users' psychology and opinions. It helps to find out the problems that users are experienced during the process of use. For this study thirty people between ages seventeen to seventy years old were selected randomly among users. As the users of the newspaper kiosk are mostly male, in this study seventy percent of samples (21 persons) were male and the rest thirty percent (9 persons) were female. The questions were about what they think about kiosks' appearance and performance. In addition they were asked to explain their feeling during the process of use and describing their opinions about their interactions with kiosk. Through these methods the user's needs and expectations were found out and by investigating them it was tried to identify the shortcomings.

2.3 Results

As a result of the study, the problems were identified. The results were classified in four key words to make them comparable statistically. As table 1 show the key words are form, color, material and newspapers placement, which the most

important one is the newspapers placement. Twenty seven people out of thirty interviewees believed that the main problem is putting the large number of newspapers on the floor. In order to choose or take a newspaper, the users need to bend in an unsafe posture or even sit on their knees (figure1).

Twenty six of thirty people complained about the form of these kiosks. They believe that the cubic form of kiosk is boring and unattractive. Also they stated that the newspaper kiosk is unrecognizable and has no identification. Twenty five of thirty people said that they had problem to access the newspapers due to the incorrect placements of them (figure2). They also believe that the white color of kiosk is not recognizable in the crowded public space and is unattractive. The result of photography proves many problems regarding newspapers placements, users and pedestrians. As it can be seen in figure 3 pedestrian pathways is properly blocked by the users of kiosk while they read or buy newspapers. Excessive accumulation in front of kiosk is also a big problem, especially when people intend to talk to vendor or pay for a newspaper (figure 4).

Table 1 data collection via study on users' behavior

keyword	Voice of customer	persons
newspapers placement	Excessive accumulation in front of kiosk	22
	Putting the large number of newspapers on the floor	27
	Lack of access to the newspaper	25
	Very messy appearance of kiosk	14
	Block up pavement	24
form	Unattractive and un recognizable form	26
	lack of safety against wind and rain	15
	Shortage of sun protection shade	17
color	Unattractive and un recognizable color	25
material	Dirty and stainable body	10

Seventeen people mentioned that the canopy of kiosk is not appropriate to protect the newspapers and the customers against the sun (figure 5).

Also fifteen people were complained about lack of facilities for protection against wind and rain, which results to wet and damaged newspapers. At this

moment vendors put a piece of stone or metal on the newspapers to protect them against wind (figure 6). It causes difficulty in the process of choosing and taking newspapers. Fourteen people believed that the appearance of kiosk is very messy. Ten people out of thirty had a bad feeling about the kiosks, due to dirtiness of appearance.



Figure 1 Unsafe posture



Figure 2 Difficult access to newspapers



Figure 3 Blocked pedestrian pathway



Figure 4 Excessive accumulation



Figure 5 Lack of protection by canopy



Figure 6 Stone for saving newspapers

The results of data collection were analyzed by excel software, which are presented in figure 7.

After analyzing the problem and determining the keywords, it is necessary to translate these problems to design parameters. To perform this translation, the quality function deployment was employed.

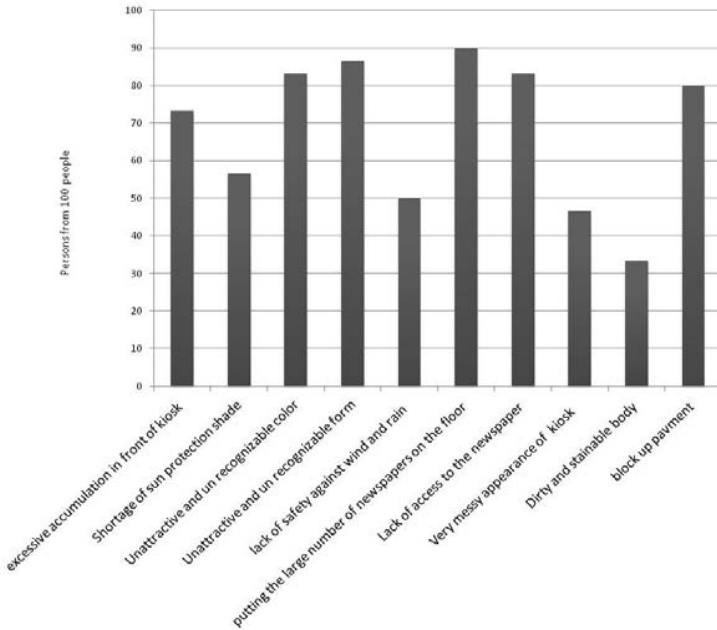


Figure 7 Results of data collection

2.4 Quality Function Deployment (QFD)

Quality Function Deployment is an exhaustive method for translating customer requirements to engineering characteristics or design parameters. This process is applied to extract design parameters by focusing on quality of product (ReVelle, 1998). In fact QFD is a strong tool, which transforms voice of customer into engineering characteristics and design specifications. QFD method works with a matrix for mapping the voice of customer to the voice of engineer or designer. This matrix is called House of Quality, which is shown in figure 8.

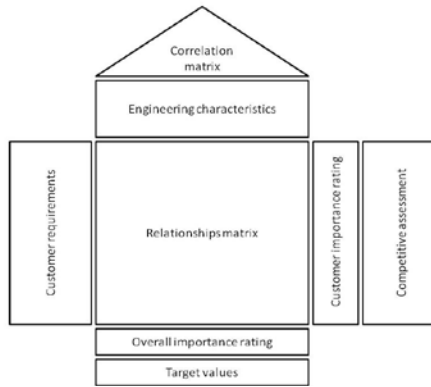


Figure 8 Typical House of Quality Matrix (QFD)

QFD has typically seven steps (Cross, 2000), which were applied for this study and are explained as follow.

1. Identifying customer' requirements in terms of product attribute

Customer requirements contain customer wants, needs and expectation for the product. They are establishing a clear understanding of all customers' needs that are called "voice of customer". In this study voice of customer was determined by translating the results of data collection to words and clear design instructions.

2. Determining the relative importance of the attributes

In this step voice of customer is rated to determine relative importance of requirements. This rating was performed based on the data which were collected and presented in figure 7.

3. Evaluating the attributes of competing products

Customers often make judgments about product attributes. Therefore, determining the competitors' position in the market and evaluate their attribute is a good way of finding the weaknesses and shortcomings of a product that needs to be developed. For this aim a market research was performed to find the best kiosks in Iran's market. The result of conducting market research showed that the newspaper kiosk has no variety in Iran. Therefore, the available samples of other countries were chosen for the benchmark. Technical specifications and design parameters of newspaper kiosks were obtained through design books and manuals. These specifications were classified to several items such as; color, form, material, texture, canopy color, canopy form, canopy material, canopy dimensions, canopy texture, stand color, stand form, stand dimensions, and overall dimensions. The summery of benchmark table is presented in table 2.

4. Drawing a matrix of product attributes against design characteristics

In this step a matrix was prepared by placing the voice of customer in the column and design specification which were obtained through benchmark in the raw.

5. Identifying the relationship between design characteristics and product attributes

The relationships between customer attributes and design characteristics have been assessed as strong, medium or weak in the matrix. The strength of the relationships was indicated by symbols. The orange bold point with a weight of five was used for strong relationship. The orange circle with a weight of three was used for medium relationship and a green triangle with a weight of one for weak relationship. The relationships were identified and sum of each column was calculated and placed in overall importance rating that was shown as EC importance in the bottom of house of quality matrix. Importance ratings can help the trade off decision making process through identifying which design characteristics has more influence on customers’ overall perception of the products.

Table 2 the Benchmark Table

design Characteristic	Kensington kiosk	Pausanias kiosk
material	Brass plywood	Stainless steel Fiberglass panel
form	curved	rectangular
color	Yellow and ocher	silver
texture	opaque	opaque
dimension	3*3*4m	3*3.50*2m
Roof material	Stainless steel	Stainless steel
Form of roof	curved	rectangular
Color of roof	silver	silver
Texture of roof	opaque	opaque
Window material	plexiglass	-
Form of window	rectangular	-
Canopy material	-	Stainless steel
Form of canopy	-	rectangular
Color of canopy	-	silver
Texture of canopy	-	opaque
Dimension of canopy	-	3*1m



6. Identifying any relevant interactions between design characteristics specifications

It’s also called correlation matrix. Correlation matrix is used to recognized how design specifications support or conflict with one another. The roof matrix of house of quality provides this check. These rating are usually quantified

between 2 and -2. In the roof of the matrix, interaction between design characteristics has been identified by numbers. The strong support was shown by 2 and strong conflict by -2. Also 1 indicates weak support and -1 shows weak conflict.

7. Setting target figures to be achieved for the design characteristics

Another part of QFD is the targets, which can be set for the measurable parameters of the design characteristics in order to satisfy customer requirements. For setting the targets, reference is required. Reference is made through the comparisons with two competitors, given on the right-hand side of the matrix. The analysis of two competitors helped to find the strength and the weakness of the competitors' products in the market. Two kiosks, Kensington and Pausanias, were compared with a five point scale rating. As it can be seen in figure 9, Kensington kiosk has got better rate in all items (voice of customer) against Pausanias kiosk except the canopy.

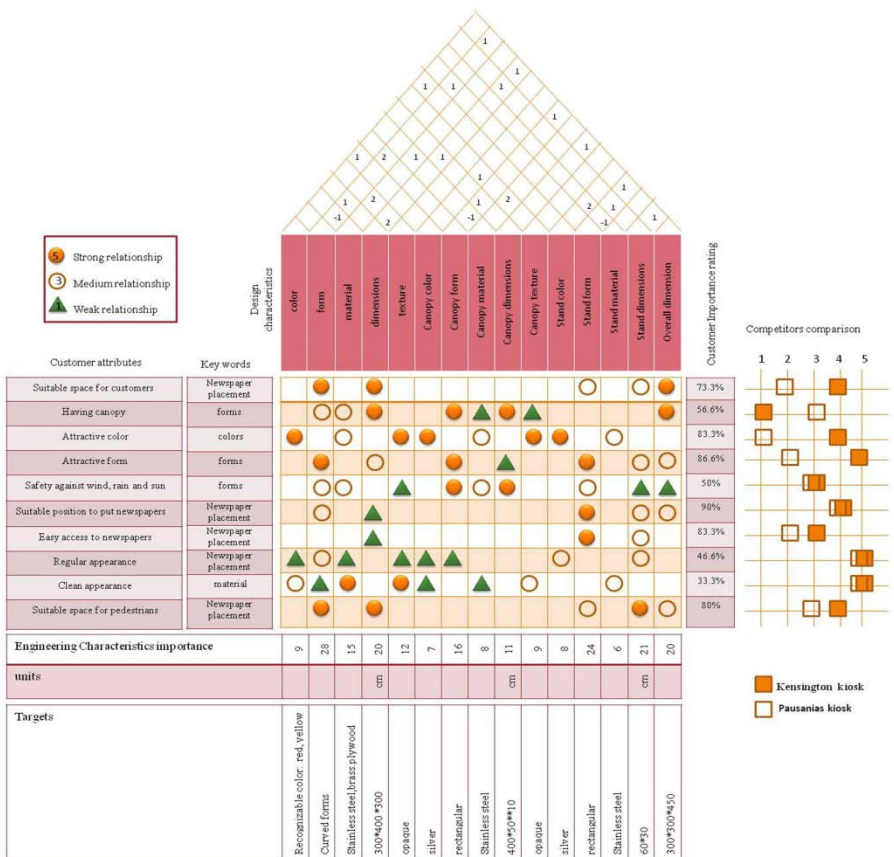


Figure 9 performing QFD Matrix

3 DISCUSSION

As the result of study shows, the most important item for the customer is putting the large number of newspapers on the floor. 90% of people who were interviewed complained about the placement of newspapers. Also the result of observation showed that people have difficulty in choosing and taking the newspapers. As the main function of the kiosk is presenting the newspapers, there is a need for an appropriate way of presenting them. Therefore, designing a suitable place such as good stand is vital. Considering user behaviors, Iranian users' have the habit of reading the titles of newspapers before taking them. In fact, most of the users choose their newspapers by reading the titles and even some of them just read the titles without buying any newspaper. As a result of this behavior, many people gather in a very small place in front of the kiosk, which cause difficulty in having access to the newspapers and the vendor. According to QFD matrix, suitable position of newspapers has a strong relationship with form of stands. The second important problem is the main form of newspaper kiosk. Eighty six percent of people believed that the form of kiosk is not attractive. As QFD matrix explains the attractive form has a strong relationship with the form of kiosk, canopy and stands. In the other hand, EC importance in QFD matrix shows, that the form of kiosk with score of 28 is the most important factor. The next score belongs to the form of stand with the score of 24. Thus, the form of the kiosk is the first important item in design, which should be considered. Even it can influence the existence and form of stand for newspapers, which earlier mentioned as the most important factor for the main function of the kiosk. Obviously the second important design item is the form of stand, which can provide and appropriate placement for the newspapers and organize the users.

4 CONCLUSION

The historical, social, cultural, economical and environmental context determine user behavior. A good design considers users behaviors and attempts to improve the social behaviors of people without changing their culture.

In this study user behavior was recognized through observation. Observing people is a good way of understanding their interaction with street elements in the particular context. Through observing users, their behaviors and interactions are determined. Then it was tried to realize the shortcomings of the kiosk from the point of view of the users by interviewing them. Also their needs and desires were obtained and used in QFD method for translating voice of customer to design specifications. Quality Function deployment is a powerful method that helps designer to make decisions about product's attributes by considering users' requirements. Through QFD matrix it was found that firstly, suitable position for putting newspapers was the most important factor from customers' point of view, which has a strong relationship with form of stand. Secondly, the forms of kiosk and stand are the most important design characteristics that should be considered in new

concept of newspaper kiosk. Thirdly, through competitors' comparison it was found what the competitors achieved regarding design characteristics of their products. The outputs of House of Quality matrix can be used for concept generation and evaluation.

REFERENCES

- Cross, N. 2000. *Engineering Design Methods: Strategies for Product Design*. 3rd Ed. England: John Wiley & Son Ltd.
- Design Council and the Royal Town Planning Institute. 1979. *Street ahead*. London: Design Council.
- Devereux, C. 2007. *People power: Designing the perfect costumer*, report for CNN.
- Ho, Y., Wang, H. and Lee, R. 2007. The Sustainable Value of Urban Design. *Proceeding of second IASDR (International Association of Societies of Design Research)*. Hong Kong, 12-15 November.
- Orr, D. W. 2002. *The nature of design: Ecology, culture, and human intention*. Oxford: Oxford University Press.
- Rapuano, M., Pirone, P. P., and Wigginton, B. E. 1994. *Open space in urban design: A report* (Revised ed.). Cleveland, OH: Cleveland Development Foundation.
- ReVelle, J. B., Moran J. W., and Cox, C. A. 1998. *The QFD handbook*. New York: John Wiley and Sons Inc.
- Siu, K. W. M. 2008. Better design quality of public toilets for visually impaired persons: An all-round concept in design for the promotion of health. *The Journal of the Royal Society for the Promotion of Health*, 128(6), 313-319.
- Sohn, M. and Nam, T. 2009. Design Method for Sustainable Interaction-Understanding and Applying Unconscious Human Behaviors in Design. *Proceeding of third IASDR (International Association of Societies of Design Research)*. Seoul, Korea, 18-22 October.
- Yanagisawa, H., Kozuka, Y., Matsunaga, M. and Murakami, T. 2009. Observation support system for recording, reviewing and sharing observed design problems. *Proceeding of third IASDR (International Association of Societies of Design Research)*. Seoul, Korea, 18-22 October.

Connectivity Model: Design Methods for Diverse Users

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ABSTRACT

When we design a product or an artifact, the design solution should consider the user's social, cultural, and emotional needs as well as their physical constraints. This paper introduces a framework of the connectivity model and demonstrates how this model can be applied to the design process of products and services for diverse users. The connectivity model is a design and evaluation method based on the mental trilogy, *kansei* engineering, and activity theory. This new model contextualizes usability in terms of its social and emotional appropriateness as well as its physical, cognitive, and cultural contexts.

The framework of the connectivity model has been used in product/artifact design development and evaluation especially targeted to diverse user groups including older adults and those with physical and cognitive disabilities. To demonstrate how the connectivity model can be applied to the design process, a design development process model is also introduced in this paper.

Keywords: design methods, connectivity model, diverse users

1 INTRODUCTION

In the field of design, experience design treats the designed artifact (i.e., the IT product or the *environment* being designed) as part of a holistic system; that is, it considers the artifact in the context of its use. From this perspective, the social and emotional needs of the user are considered along with the physical, organizational, and social constraints of the project. In our previous work (Kang and Satterfield, 2009), we proposed the connectivity model as a framework for design and

evaluation (figure 1), and presented a case study on how the Connectivity Model can be adopted as a design and evaluation process. The Connectivity Model demonstrates the fact that design solutions should only be considered as optimal solutions when they encompass not only the local but also these global constraints and requirements. Of course, most projects that consider these elements – the social, emotional, and physical constraints – will have a plethora of optimal solutions; nevertheless, the framework offers a useful model for designing and evaluating those factors that will be instrumental in constructing design solutions that address both local and global solution requirements.

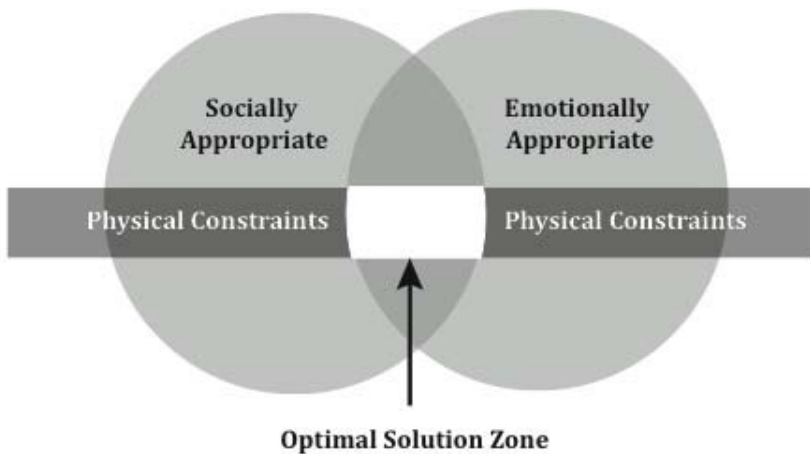


Figure 1 Optimal Solution Zone based on the intersection of Physical Constraints and spheres of Socially and Emotionally Appropriate Behaviors

The Physical constraints are related to the design elements, size, shape, weight, color, material, and so on. Also they relate to the target audience's physical ability including vision, mobility, cognitive ability, and sensory recognition. As we stated in our previous paper, the framework of *Kansei* engineering methods are well developed to understand people's emotions and experiences as they relate to physical constraints (Kang and Satterfield, 2009). We have adopted *Kansei* engineering methods in the design evaluation process to understand people's emotion and experiences towards a product/artifact.

Social appropriateness is considered in the context of gender, age, organization, and society. Activity theory (Vygotsky, 1978) sought to understand people's activities based on the social and cultural context.

Emotional appropriateness is considered how the artifact empowers the individual to meet needs, goals or concerns. A cane, for example, is an assistive tool

for working but some people may be embarrassed by using a cane. The testimonial, “I realize that being ashamed of using a cane has kept me from doing things, and using the cane helps me do more, safely (aota.org),” shows that emotion encompasses physiological, affective, behavioral, and cognitive components (Brave and Nass, 2003). In the cane case however, the motivation to work safely encourages the user to overcome the emotional feeling of embarrassment. LeDoux (2002) defined motivation as “neural activity that guided us toward goals, outcomes that we desire and for which we will exert effort, or ones that we dread and will exert to prevent, escape from or avoid.” Finding motivating factors is very important in the design development process. Fogg (2009) suggests that there are three motivator factors with three pairs; pleasure/pain, hope/fear, and social acceptance/rejection. According to Fogg, hope is most powerful motivation factor in his Behavior Model. Motivation, ability and triggers are the three factors that Fogg includes in his Behavior Model (FBM). Someone who has high motivation and high ability will most likely increasing their performance to the targeted behavior. However, the behavior will not occur even though motivation and ability are high without an appropriate trigger (2009).

2 DESIGN INQUIRIES

Understanding the target audience’s physical constraints is very critical in the design process. There are many cases that physical ability is fully functional but cognitive ability are limited or vice versa. Each constraint in context should be addressed in the beginning stage of the design process and also evaluated at the end of the design process. Usability is an important factor. It makes the artifact easy to use while desirability is an important factor that enhances the motivation of the target audience to use the artifact.

Also understanding how the society accepts the concept or perceives behavior. We have addressed following questions in the design each development and evaluation process.

2-1. Identifying Target Audience’s Needs

Fogg states that “increasing motivation is not always the solution” and he suggests “increasing ability (making the behavior simpler) is the path for increasing behavior performance” (2009). As illustrated in figure 1, understanding target audience’s physical constraints are backbone of the Connectivity model.

The following three key areas to understanding the target audience’s needs should be answered in the design process:

Physical needs: Do the physical aspects of this design meet the physical needs of the target audience in terms of size, weight, material choices, interaction qualities, sensory qualities, and other visceral considerations?

Social needs: Is this design appropriate to the social needs of the target audience? Is it age appropriate? Is it appropriate to the gender and culture of the target audiences?

Emotional needs: Does this design have a quality of empowerment or desirability that appropriately meets the needs of the target audience?

2-2. Identifying Target Audience's Motivating Factors

Fogg et al. (2008) state that “creating successful human-computer interaction requires skills in motivating and persuading people.” But how do we trigger the target audience's motivation? Satterfield (2009) has used an approach through ethnographic observation to identify the audience's primary motivational factors especially for children with cognitive and development disabilities. Satterfield (2009) suggested that following questions should be answered to identify motivation factors:

Identify primary motivating factors in human behavior: Have the primary motivating factors of the various target audiences been identified and incorporated into a meaningful design solution?

Identify the role of emotion in human interaction design: Have the primary motivating factors of the various target audiences been identified and incorporated into a meaningful design solution?

Does the solution allow the user to negotiate for reinforcement by allowing the user to tailor the experience?

Identify the role of human interaction in communication: Can this design be a catalyst or facilitation tool for human interaction between children with autism, epilepsy, and cerebral palsy and their neurologically typical peers?

2-3. Identifying Communication Methods

It is important to identify what is the best way to communicate the functionality of the interface and interaction with the targeted artifact. Satterfield (2009) suggested that following questions should be answered to enhance communication (2009):

Identify multi channel sensory systems that can enhance communication: Have the sensory systems of the body been researched and analyzed? Was information from fields such as perceptual psychology, occupational therapy, and neurology used in order to inform the design, interaction, educational, and communication decisions?

Identify micro and macro sensory experiences: Are the Communication experiences designed to make use of both fine and gross motor involvement for the user? Has research in body movement, spatial orientation and tactile responses been used as a basis for developing effective educational experiences?

Effectively utilize multiple learning styles: Does this solution recognize and effectively incorporate strategies that accommodate multiple learning styles of target audience?

2-4. Identifying Design Elements

This is step the final step to identify design elements that can motivate the target audience group. The look and feel of the interface can create an immediate connection with the social, emotional, and cultural identity of the various target audiences. Visual interface design should answer following areas:

Color: Does the dominant color in this design set the appropriate emotional tone for the target audience? Is there an identifiable color palette? Does the color palette support the emotional tone expected by the target audience? Does it have appropriate color relationships and an effective visual hierarchy that allows the design to effectively communicate its intentions and functions?

Typography: Does the choice of typography effectively create the correct visual ethos for this design? Does it allow for effective typographic hierarchy and information design?

Style and material selection: Does the use of style and material selection create the correct visual ethos for this design? Do the material choices support the style and function of the design in appropriate ways? Do the material combinations create an effective visual hierarchy that enhances the style and usability of the design?

3 RESEARCH METHODS

Connectivity Model uses various research methods including *Kansei* engineering to measure audience's emotional feeling and their perceptions, combined with ethnographical research methods. A focus group study, interviews, surveys are also adopted in the design development and evaluation process. Through interviews and a focus group study qualitative data sets are collected. And via a survey and *Kansei* engineering methods quantitative data sets are collected. Being able to understand the role and scope of qualitative and quantitative data sets and how to work between these two sets is critical to understanding the problem to be solved and seeing the possible solutions. Qualitative data has a sensory richness and has many possible solutions. Quantitative data, on the other hand, has a more exact or limited set of solutions. In essence, for the designer, quantitative data indicates what the problem is and qualitative data indicates how the problem could be solved. It is crucial that the designer have access to both sets of data and knows how to work with them. Quantitative data identifies who has a problem and what the problem is like. Qualitative data helps designers to understand the social and emotional aspects of their target audiences and reinforces the idea that the target audience is real group of people with real needs. By identifying with the people and the needs, a greater sense of urgency is created, thus making problem solving timelier and more relevant. It also gives the designer an evaluation tool by providing a situation that can serve to determine if the proposed design is in fact a viable and creative solution to their specific problem.

Usability studies allow us to identify how well the interface design communicates its function through the implementation of appropriate physical and

visual affordances. Through the usability study we also collect qualitative data as well quantitative data sets.

3 APPLICATION OF CONNECTIVITY MODEL TO DEVELOP A DECISION AID TOOL FOR REPRODUCTIVE HEALTH CARE

The Connectivity Model has been applied for various projects. Figure 2 presents how the Connectivity Model was adopted in the design and evaluation process to develop a decision aid tool for reproductive health care targeted at college student ages from 18 to 25 years old.

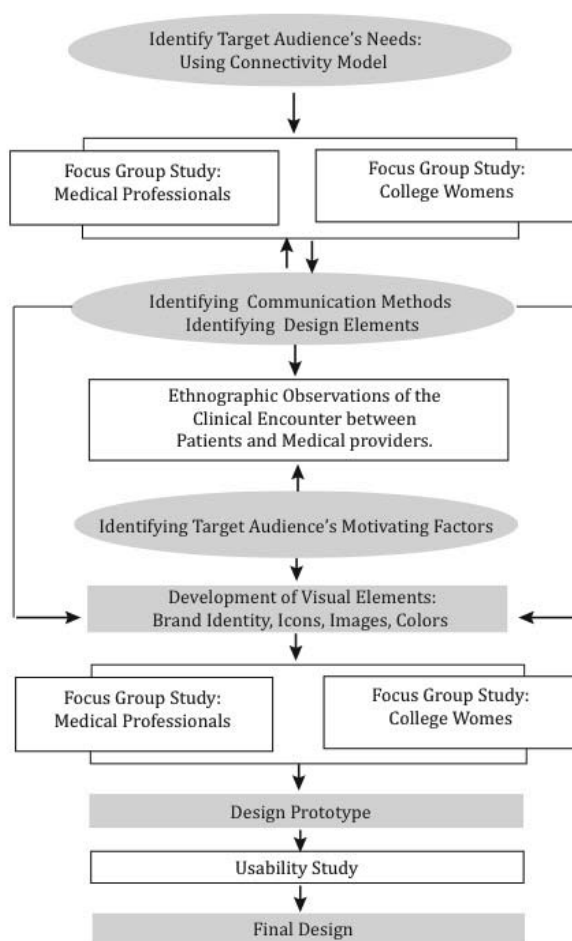


Figure 2 Design and Evaluation Process of Designing a Decision Aid Tool for Reproductive Health Care for College Women with Connectivity Model

The goal of the decision aids tool is to provide information that young women can use to communicate their needs with medical professionals. As the first step, we conducted a study of existing material to examine the needs for this target audience. At the same time we conducted a focus group study with college women and another focus group with medical professionals to identify and understand both target audience's perceptions on existing materials and needs for future designs. Ethnographic observations were used to observe the interaction between patients and medical provides during the clinical encounter to identify the motivating factors of both groups. The clinical encounter observation provides information on how to prepare the communication strategies for the final design (Satterfield et al., 2011).

With the analysis data from two focus group data sets and observation of the clinical encounter, we developed a brand name, icons, images, and color palettes. With six design variables in each category, we conducted focus group studies with young women. We are in the final design stage working with the design preferences in brand identity, icons, colors, and images indicated by our target audience. The final design will be a web-based intervention communication tool that works for both smart phones and computers.

4 CONCLUSIONS

The Connectivity model has been applied to various projects. This model considers physical constraints as the backbone in the design development and evaluation process. The design elements and physical constraints should be acceptable to society and they should be emotional appropriate to target audience group. This model is a very flexible method to adopt into the design and evaluation process for any target audience. The ultimate goal of the Connectivity Model is to provide a design tool that considers the physical, social, and emotional needs for all people.

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REFERENCES

- Brave, S., and Nass, C., 2008. Emotion in Human-Computer Interaction. In *The Human Computer Interaction Handbook*, eds. Jacko, J. and Sears, A. CRC Press.
- Fogg, B.J., 2009. A Behavior Model for Persuasive Design. *Proceedings of Persuasive'09*, Claremont, California, USA.

- Fogg, B.J, Cuellar,G., and Danielson, D., 2008. Motivating, Influencing, and Persuading Users: An introduction to Captology, In *The Human Computer Interaction Handbook*, eds. Jacko, J. and Sears, A. CRC Press.
- Kang, S, R., and Satterfield, D., 2009. Connectivity Model: evaluating and designing social and emotional Experiences. *Proceedings of IASDR*, Seoul, Korea.
- Satterfield, D., 2009. Designing Social and Emotional Experiences for Children with Cognitive and Developmental Disabilities. *Proceedings of the Interactive Creative Playwith Disabled Children workshop*, The 8th International Conference on Interaction Design and Children, Como, Italy.
- Satterfield, D., Kang, S. R., Bruski, P., Malven, F., Quam, A., and Ladjahasan., 2011. Developing a Reproductive Health Care Decision Aid for Women Ages 18-25 and Their Medical Providers. *Proceedings of IASDR*, Delft, Netherland.
- The American Occupational Therapy Association, Occupational Therapy Helps Prevent Decline in Seniors, Accessed Feb. 20, 2012.
<http://www.aota.org/News/Consumer/Well-Elderly.aspx>,
- Vygotsky, L. S., 1978. Mind in society: *The development of higher psychological Process*, Cole, M., John-Steiner, V., Scribner, S., & Souberman, E. (Eds.), Cambridge, Mass. and London, England: Harvard University Press.

Educational Play Experiences for Children with Cognitive and Physical Disabilities

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ABSTRACT

Many children are currently diagnosed and living with cognitive and developmental disabilities such as autism, epilepsy, and cerebral palsy. The Center for Disease Control and Prevention (CDC) defines developmental disabilities as a diverse group of severe chronic conditions that are due to mental and/or physical impairments. Individuals with developmental disabilities have problems with major life activities such as language, mobility, learning, self-help, and independent living. Therefore, there is a critical need to develop effective and motivating educational experiences that will mediate social interactions between typical children and children with cognitive or developmental disabilities such as autism, epilepsy and cerebral palsy. The purpose of this research to determine how to design educational play experiences that effectively engage and facilitate children with cognitive and physical disabilities and their neurologically typical peers into effective collaborative learning situations. As a research method, focus group studies with parents, educators, and caregivers of persons with cognitive and physical impairments such as autism, epilepsy, and CP were recruited to identify how designers can best create effective learning experiences that meet the social, emotional, behavioral, and motivational needs of all of these constituent groups. The research data and its implications for evidence-based design will be discussed.

Keywords: educational play, children, cognitive and physical disabilities

1 INTRODUCTION

For children with autism there are many forms of therapy, but fewer activities and outlets for socialization and play. In addition, families with children with autism spectrum disorders (ASD) often struggle with many aspects of socialization and communication as they pertain to peer relationships and making friends for kids with ASD. Therefore identifying those aspects of autism that form the greatest barriers to socialization and communication with typical peers is of critical importance in designing effective educational play experiences that can facilitate better peer relationships.

In order to identify those behaviors and issues that cause the greatest problems for ASD kids, a survey was conducted with parents and caregivers. The survey examined the physical, social, emotional, motivational and behavioral aspects of autism as they impact daily living, communication and socialization.

The ultimate goal of this research to use the data from this survey to inform the design of educational play experiences that effectively facilitate communication and socialization between children with cognitive and physical disabilities and their neurologically typical peers. In this preliminary study, we collected and analyzed information from parents, educators, caregivers, and medical providers through these focus group studies.

2 RESEARCH METHOD

The Connectivity Model (Kang and Satterfield, 2009) is a design and evaluation methodology based on; the mental trilogy, activity theory, and *Kansei* Engineering. It also incorporates ethnographic research strategies from information architecture and educational strategies from Dewey and Vygotsky that are specifically designed to understand and work with the idiosyncratic nature of cognitive and developmental disabilities (Satterfield 2010). These research strategies are used to inform data collection through focus group studies and ethnographic observations. This information is then combined with information design analysis theories to create a comprehensive design and evaluation framework for creating information tools to support decision-making (Satterfield et al, 2011).

In our preliminary study we are using the Connectivity Model to examine the impact of autism on communication and socialization based on the criteria of physical, cognitive, behavioral, social, emotional, and motivational aspects of peer interactions. Through focus group studies, this preliminary research is examining the following questions:

- How long and in what capacity have you known or interacted with children with physical and cognitive disabilities?
- What are the main social skills that negatively impact a child with physical and cognitive disabilities in typical peer social interactions?

- What are the main communication skill issues that impact a child with physical and cognitive disabilities in typical peer social interactions?
- What are the main behavioral issues that impact a child with physical and cognitive disabilities in typical peer social interactions?
- What are other factors that negatively impact the social relationships of children with physical and cognitive disabilities from their peers?
- What assistive or augmentative technologies do you use for social or communication purposes with children with physical and cognitive disabilities?
- How effective are these technologies and what are their main strengths and weaknesses?
- What types of situations or conditions best facilitate social interactions between children with physical and cognitive disabilities and their neurologically typical peers?
- How important are social relationships with their peers to children with physical and cognitive disabilities?
- What other information would you like to add with regard to the needs of children with physical and cognitive disabilities?

3 FINDINGS AND DISCUSSION

This preliminary study is to examine the role of autism and autistic features as they impact peer interactions, communication, socialization, and quality of life for children with autism. The outcomes of this research will be used to determine how to best target communication strategies to enhance educational play experiences for children with ASD and their neurologically typical peers for the goal of improved socialization. Our focus group studies seek to identify the most problematic issues of autism in the areas of socialization, communication, and behavior as determined by parents, caregivers, educators, and medical providers. The outcomes of this study will give insight with regard to how to best identify and manage autism and autistic features with regard to their impact on the social and emotional lives of children with autism and their families. This preliminary research also brings together mixed groups of stakeholders in focus group settings and encourages them to explore these questions from their own viewpoints. In the focus groups, stakeholders are allowed to interact with members of other stakeholder groups. These combined groups encourage better understand of the priorities of members of other stakeholder groups. From this preliminary research we hope to gain valuable knowledge about how to effectively combine stakeholder groups in ways that allow them to interact and identify their differing priorities.

In this ongoing study, this paper will discuss three focus group sessions with a total of 5 parents and one educator. Some participants have more than one child with varying degrees and types of autistic features. These 5 parents have a total of 8 children, seven boys and one girl. One educator who participated in the focus group study has over 20 years of experience working with autism and ADHD (Attention

deficit hyperactivity disorder). The parents have children ages 5 to 12 years with ASD and ADHD. Inclusion in the focus groups was based on self-reported diagnosis of autism or a related cognitive impairment with autistic features. Some questions from the focus groups are combined into one response in the analysis due to the similarity and relatedness of the questions and answers.

3-1 Social skills that negatively impact a child with physical and cognitive disabilities in typical peer social interactions

Most parents expressed that their children do not know what are personal boundaries and how to express themselves verbally. For example, the children lack a firm understanding of issues such as when to say things and what to say. For example they lack a certain level of sensitivity to the feelings of others and may make factual, yet inappropriate statements such as, “you are fat.” In most cases, participants noted that the children exhibited language and behaviors that are not age appropriate. Also they are not doing well in transitioning from one play to the other. For example, going from recess back into school might trigger a tantrum or serious resistance to leaving one activity for another. Also, turn taking among peers posed a problem for many kids.

3-2 Main communication skill issues that impact a child with physical and cognitive disabilities in typical peer social interactions

Similar to their issues with personal boundaries, many children with autism don’t understand innuendos, sarcasm, tone of voice as they change the meaning of spoken words. One parent noted that nothing is intuitive to these children. For one non-verbal boy, his parent expressed that “his number one issue is being able to successfully communicate...it’s an absolute nightmare and a struggle.” Some parents have used Picture Exchange Communication System (PECS) as a method of communication. However, picture exchange systems may be limited in what they can communicate and how they are organized for access and retrieval. Several parents noted that children with autism experience difficulty in discussing their feelings and may either avoid the subject, internalize their feelings, or act out as a way of expressing themselves.

3-3 Main behavioral issues that impact a child with physical and cognitive disabilities in typical peer social interactions

The educator said that “any behavior issues are going to have social impact. So the behavior issue then becomes a social issue because they’ve just had a meltdown now in front of their classmates.” Most participants expressed that calming an autistic child in public places is very hard and frustrating. Many children have inappropriate behaviors such as making inappropriate noises, inconsolable tantrums,

and the need for quiet or private spaces to regain composure. It was noted that in some cases, rather than removing the autistic child from a class or group during these episodes, all of the other children have been coached in how to leave the area where the autistic child is acting out.

Other parents noted that lack of boundaries with regard to ownership is a problem and understanding when they can and cannot touch objects. In an extreme case, another parent described sensory related touching behaviors involving toileting and smearing of fecal matter.

3-4 Assistive or augmentative technologies for social or communication purposes with children with physical and cognitive disabilities

The educator mentioned b-Calm, Kush balls, and PECs communication as an assistive tool to communicate with children. Most parents mentioned that they have used PECs. Some other tools have been used among participants are Dynavox, PODS, and social stories. They expressed that some tools such as PODS and Dynavox are not easy to use.

Some participants suggested i-pads are useful for social interaction because children can read a story together and do music or art activities together. Most participants mentioned that they've tried many different gadgets but most worked only for a very short time. The teacher noted a preference for paper based solutions like note cards or games.

3-5 Types of situations or conditions can best facilitate social interactions between children with physical and cognitive disabilities and their neurologically typical peers

The educator suggested that building social relationships between children with physical and cognitive disabilities and typical kids is a good way to facilitate socialization. Some ideas are being adopted in education as a way to form social bonds such as recess buddies, lunch buddies, and school bus buddies. Keeping children with ASD engaged in a variety of activities would be a good way to facilitate social interaction. One parent noted that her daughter prefers to be active and entertained by her peers. Also, it was noted that preventing bullying will also help children with autism be better accepted. From this discussion the question arose how do you raise a kid to be more accepting of people with disabilities? One parent noted that she had approached the school to discuss kids with autism and bullying as a way to prevent it. It was also no two kids with autism are alike and what works with one child may or may not work with another. They also noted that what works today may not work tomorrow even with the same child.

4 CONCLUSION AND FUTURE STUDY

An observation from these focus groups was the change in situations that occurs for children as they grow older with ASD. This is especially true for the higher functioning children in the Asperger's Syndrome diagnosis. One parent said, "now it's becoming a big deal. When he was in third, fourth, fifth grade... You know it hurt me more than it hurt him, when he had lack of friends or if I saw kids roll their eyes. I mean the mother bear in me would come out and I would want to smack them upside the head. But for him now at this age, at twelve, sixth, seventh grade, it's really starting to be a big deal to him because everything is intensified. I mean you're already at that age. You're already self-conscious. You think you're a dork." The teacher added, "as a teachers, that's one of our main jobs with these kids is to help build those peer relationships at a very young age, knowing that they may change by the time they get out there to middle school because suddenly this person doesn't want to hang out with them any more." For the lower functioning children the socialization problems seem to be less pronounced. They seem to be more insulated from the social expectations and accepted for their own abilities and strengths. This seems to stem from the fact that the higher functioning children seem to be just "normal enough" that the social expectations are still high for them among their classmates.

There was strong agreement that socialization among peer groups is important for all children with ASD. There was also a strong consensus that odd or disruptive behaviors can negatively impact the quality of social relationships for children with autism. Things such as inappropriate touching, loud noises, lack of age appropriate language, the inability to understand boundaries, and the lack of an ability to interpret innuendo, sarcasm, or other affective aspects of language greatly impedes social relationships for children with autism. There was also a strong consensus that these social and behavioral issues are extremely frustrating and embarrassing for families and caregivers, thus greatly increasing the stress levels experienced by these people.

The preliminary findings of this research suggest a strong need to connect design to the social, behavioral and sensory needs of children with ASD. By using this data to design socialization activities and learning experiences, it is hoped that designers can create design solutions for children with autism and their families that have a greater connection to the real world issues of autism.

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REFERENCES

- Kang, S. R., and Satterfield, D., 2009. Connectivity Model: evaluating and designing social and emotional Experiences. *Proceedings of IASDR*, Seoul, Korea
- Maenner, M and Durkin, M., 2010. Trends in the Prevalence of Autism on the Basis of Special Education Data. *Pediatrics* 2010; 126; e1018; originally published online October 25, 2010; DOI: 10.1542/peds.2010-1023.
- Satterfield, D., 2010. Play•IT: A Methodology for Designing and Evaluating Educational Play Experiences for Children with Cognitive Disabilities, *Proceedings of The 7th Design and Emotion Conference*, Como, Italy.
- Satterfield, D., Kang, S. R., Bruski, P., Malven, F., Quam, A., and Ladjahasan,. 2011. Developing a Reproductive Health Care Decision Aid for Women Ages 18-25 and Their Medical Providers. *Proceedings of IASDR*, Delft, Netherland.

CHAPTER 6

Universal Product Family Design for Human Variability and Aesthetics

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ABSTRACT

The present research is motivated by the need to create specific methods for universal product family design based on human variability. Product family design is a way to achieve cost-effective mass customization by allowing highly differentiated products to be developed from a common platform while targeting products to distinct market segments. In this paper, we extend concepts from mass customization and product family design to provide a basis of universal design methods in product design. The objective of this research is to propose a method for identifying a platform for the families of universal products in economical feasible design concepts and integrating human variability into the design process to improve usability and performance as well as aesthetics. We generate platform design strategies for a universal product family based on performance utilities to reflect human variability and aesthetics. A coalitional game is applied to model a strategic design decision-making problem and evaluate the marginal profit contribution of each strategy for determining a platform design strategy in the families of universal products. To demonstrate implementation of the proposed method, we use a case study involving a family of consumer products.

Keywords: universal design, product family and platform design, human variability, aesthetics

1 INTRODUCTION

Universal design is a recently suggested term for designing for persons with a disability (Mace, 1985). Universal design specifically suggests the concepts of equity and social justice. Also, in the context of separate is not equal, universal design suggests the design of solutions that simultaneously and equally serve both the fully able and not fully able. Design of new products for everyone requires numerous functions for many individuals and groups often separated by capabilities and limitations due to age and disabilities (Preiser and Ostroff, 2001). Innovative companies that generate a variety of products and services for satisfying customers' specific needs are invoking and increasing research on mass-customized products, but the majority of their efforts are still focused on general consumers who are without disabilities (Beecher and Paquet, 2005). In a highly competitive market, universal design can be considered as appropriate marketing strategies by providing the broadest market segment.

For mass customization, companies are increasing their efforts to reduce cost and lead-time for developing new products and services while satisfying individual customer needs. Mass customization depends on a company's ability to provide customized products or services based on economical and flexible development and production systems (Silveria et al., 2001). By sharing and reusing assets such as components, processes, information, and knowledge across a family of products and services, companies can efficiently develop a set of differentiated economic offerings by improving flexibility and responsiveness of product and service development (Simpson, 2004). Product family design is a way to achieve cost-effective mass customization by allowing highly differentiated products to be developed from a common platform while targeting products to distinct market segments. A product family is a group of related products based on a product platform, facilitating mass customization by providing a variety of products for different market segments cost-effectively. A successful product family depends on how well the trade-offs between the economic benefits and performance losses incurred from having a platform are managed (Simpson et al., 2005; Moon et al., 2008).

The present research is motivated by the need to create specific methods for universal product family design based on human variability. In this paper, we extend concepts from mass customization and product family design to provide a basis of universal design methods in product design. The objective of this research is to propose a method for identifying a platform for the families of universal products in economical feasible design concepts and integrating human variability into the design process to improve usability and performance as well as aesthetics. We generate platform design strategies for a universal product family based on performance utilities to reflect human variability and aesthetics. One approach to universal design can be to focus on diversity in creating products, services, and environments, which the design is facilitated to a range of customers' needs. To determine a platform strategy that consists of common modules, we will investigate which functional modules will be more contributions in a universal product family. A coalitional game is applied to model a strategic design decision-making problem and evaluate the marginal profit contribution of each strategy for determining a

platform design strategy in the families of universal products. Game theoretic approaches provide a rigorous framework for managing and evaluating strategies to achieve players' goals using their information and knowledge (Osborne and Rubinstein, 2002).

The remainder of this paper is organized as follows. Section 2 describes the proposed design method for developing a universal product family using a coalitional game. Section 3 gives a case study using a family of TV remote controls. Closing remarks and future work are presented in Section 4.

2. UNIVERSAL PRODUCT FAMILY DESIGN

Figure 1 shows the proposed process for developing a universal product family based on the top-down and module-based approaches in product family design. The proposed method consists of three phases: (1) generate design strategies, (2) identify design preference, and (3) determine a design strategy. Customer needs can be collected through surveys and market studies. The market study begins by establishing target markets and customers. In the initial phase, customer needs based on human variability and aesthetics are analyzed to develop market segments for a universal product family. The customer needs are also used to identify required product functionality for individual products and across a range of products. In universal product design, customers' preference is determined by information related to customers' accessibilities or functional limitations. Product reference information can help develop market segmentation for universal product family design by identifying an initial platform based on functional requirements. During conceptual design, products can be designed based on functional requirements, and their functional modules can also be determined. In particular, a family of universal products can be first configured by defining a product platform. A product platform consists of several common modules that can be shared across a family of product. Then, platform design strategies are generated by module-based design concepts. After evaluating different platform design strategies using universal design principles and a game theoretic approach, a platform design strategy is determined to generate universal product family concepts according market segmentations and design constraints.

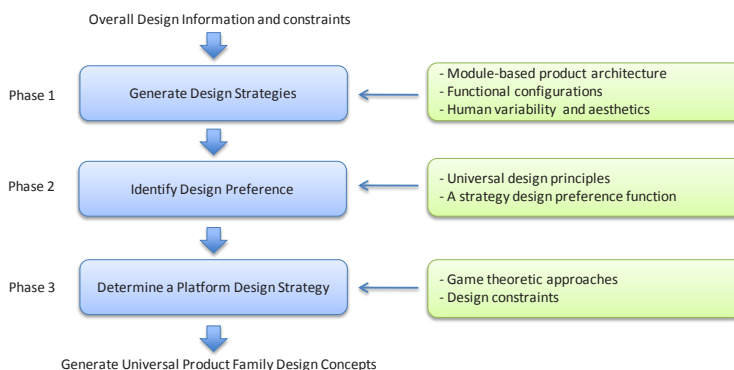


Figure 1: The Proposed Process of Developing a Universal Product Family

2.1 Phase 1: Generate Design Strategies

The universal product platform framework is built on representing the product space in terms of five different modules: common modules, variant modules, universal modules, accessible modules, and typical modules (Moon and McAdams, 2010). The notion of common and variant modules is generally a well understood concept in product family design. Common modules are those shared across the product family regardless of the module's characterization with respect to typical and accessible products. In general, these common modules are suitable candidates for establishing the product platform. Variant modules refer to the differing elements used to introduce variety into a range of products in the family. The common elements plus the variant elements combined create a product family. The framework used to design a product family here is modular, but the notions of common and variant need not be limited to a modular framework.

A module based product family strategy allows for the design and production of economically viable universal product families. Specifically, modules for universal design can be categorized into: 1) universal; 2) accessible; and 3) typical modules. Universal modules are those that are the same in function and form for both typical and disabled users. Accessible modules provide specific functionality or form solutions for persons with limitations due to age and disabilities. Typical modules contain functional and form solutions, or both, that are not suitable for user with a disability. For generating product family configuration concepts, accessible and typical modules can be used to build the product platform with respect to the economy of scale in product development. For example, anthropometric data can provide designers with design alternatives when determining the dimension of an accessible or typical module. Dimensions of modules based on body measurements lead to the modules that are better suited for the intended users' anthropometry. The next section introduces a product preference model for evaluating preference and performance in a universal product.

2.2 Phase 2: Identify Design Preference

To evaluate and measure preference of a product, we use a strategy quality function that is positively related to functional accessibility level (FL) and usability level (UL) as follows (Moon and McAdams, 2010):

$$Q=f(FL,UL) \quad (1)$$

The functional accessibility level represents the interaction of product functionality and product accessibility: it is a measure that indicates what functions are needed to make a product accessible to individuals who have a functional limitation as defined in the ICF (WHO, 2001). To determine the functional accessibility level, we propose the use of the Function-Universal Principles Matrix (FUPM). This matrix is based on impairment and usability measure developed in the ICF and the seven principles of universal design (Connell, 1997).

Table 1 shows a FUPM template. The first two columns enumerate and then list all the potential functions that may be needed by all products in the product family. Across the header row, the 7 principles of universal design are recorded. The last two columns contain the functional accessibility level and the usability level.

Table 1: The proposed Functions-Universal Principles Matrix

No	Function	a	Universal principle 1	Universal principle 2	...	Universal principle 6	Universal principle 7	Functional accessibility level value	Usability level
1	F1	a_1	$a_1\lambda_1up_1$	$a_1\lambda_2up_2$	...	$a_1\lambda_6up_6$	$a_1\lambda_7up_7$	fl_1	ul_1
2	F2	a_2	$a_2\lambda_1up_1$	$a_2\lambda_2up_2$	...	$a_2\lambda_6up_6$	$a_2\lambda_7up_7$	fl_2	ul_2
...
i	F_i	a_i	$a_i\lambda_1up_1$	$a_i\lambda_2up_2$	...	$a_i\lambda_6up_6$	$a_i\lambda_7up_7$	fl_i	ul_i
...
n	F_n	a_n	$a_n\lambda_1up_1$	$a_n\lambda_2up_2$	...	$a_n\lambda_6up_6$	$a_n\lambda_7up_7$	fl_n	ul_n
	λ		λ_1	λ_2	...	λ_6	λ_7	-	-

In the FUPM, the values, fl_i ($i=1,2,\dots,n$), of the functional accessibility level for each function can be calculated as follows:

$$fl_i = \sum_i^n a_i \lambda_p up_{i,p} \quad (2)$$

where a_i is the degree of importance for i th function in terms of accessibilities and the degree is determined based on the accessibility of impairment as follows:

$$a_i = \begin{cases} 1 & \text{for No impairment} \\ 2 & \text{for Mild impairment} \\ 3 & \text{for Moderate impairment} \\ 4 & \text{for Severe impairment} \\ 5 & \text{for Complete impairment} \end{cases} \quad (3)$$

And, λ_p is the importance weight of p th universal principle in terms of functions ($p=1,2,\dots,7$) and can be determined by the Analytical Hierarchy Process (AHP) or group decision-making methods based on product's characteristics and utilization. up_p is a binary variable (0, 1) for indicating the dependence between functions and the p th universal principle.

For the usability level, ul_i , we categorize the usability of a function into five levels based on the difficulty of using the function with respect to impairment and capacity limitation (WHO, 2001): (1) No, (2) Mild, (3) Moderate, (4) Severe, and (5) Complete difficulties. The value of the usability level can be determined as follows:

$$ul_i = \begin{cases} 5 & \text{for No difficulty} \\ 4 & \text{for Mild difficulty} \\ 3 & \text{for Moderate difficulty} \\ 2 & \text{for Severe difficulty} \\ 1 & \text{for Complete difficulty} \end{cases} \quad (4)$$

The expected strategy quality, Q_i , for function i can be estimated by an expected quality function: $f^i: FL \times UL \mapsto \mathfrak{R}$. Hence, the real number of $f^i(FL, UL)$ represents the quality of strategy i having accessibility level FL for

usability level UL . For example, the expected quality for strategy i can be determined as:

$$f^i(FL, UL) = fl_i \times ul_i \quad (5)$$

The proposed strategy quality function will be applied to measure accessibility for determining product qualities in terms of platform design strategies. The next section discusses a coalitional game model for determining a platform design strategy.

2.3. Phase 3: Determine a Platform Design Strategy

A coalitional game is designed to model situations wherein some of players have cooperation for seeking a goal in a game (Osborne and Rubinstein, 2002). A coalitional model focuses on the potential benefits of the groups of players rather than individual players. In the coalitional model, the sets of payoff vectors are used to represent value or worth that each group of individuals can achieve through cooperation. In this paper, we employ a coalitional game to model module sharing situations regarding human variability and solve the functional module selection problem in given universal product family design. To determine modules for a platform, we decide which functional modules provide more benefit when in the platform based on the marginal contribution of each module.

We assume that each module in a product can be modeled as a player. Then, consider the following module selection problem for platform design. Each group of players (coalition) can be represented as a platform design strategy for a universal product family and be independent on the remaining players. To determine modules for platform design, we consider the set of all possible coalitions and evaluate the benefits of coalitions based on individuals' preferences.

In order to formulate the proposed scenario as a coalitional game, we must first identify the set of all players, N , and a function, v , that associate with every nonempty subset S of N (a coalition) (Osborne and Rubinstein, 2002). A real number $v(S)$ represents the worth of S and the total payoff that is available for division among the members of S . And, v satisfies the following two conditions: (1) $v(\emptyset) = 0$, and (2) (superadditivity) If $S, T \subset N$ and $S \cap T = \emptyset$, then $v(S \cup T) \geq v(S) + v(T)$. Based on the definition of the coalitional game, the proposed game can be defined as:

- N : players who represent (variant) modules
- $v(S)$: the benefit of a coalition, $S \subset N$

where a coalition, S , represents a platform design strategy that consists of several modules. In this research, we use the Shapley value to analyze the benefits of family design and determine modules for platform design (Shapley, 1971). The Shapley value is a solution concept for coalitional games and is interpreted as the expected marginal contribution of each player in the set of coalitions.

Based on the results of marginal contributions for variant modules, we can determine a platform strategy according to market segmentations and design constraints. The selected platform strategy provides a guideline for generating universal product family design concepts. A successful universal product family depends balancing the tradeoffs between economic benefits and accessibilities

incurred from having a platform. In the next section, the proposed method is applied to determine a platform design strategy using a case study involving a family of TV remote controls.

3. CASE STUDY

To demonstrate implementation of the proposed method, we investigate a family of TV remote controls that are operated by a touch-screen. These products offer the opportunity to create a product family that is able to accommodate to the wide spectrum of user needs. The remote control design provides a good example of common and different sizes for remote controls related to human variability. We define the seven principles of design when reinventing a remote control as shown in Table 2.

The objective in this case study is to determine a platform design strategy represented by usability for a touch-screen subject to hand sizes. This case study focuses on how to determine the marginal contributions of designs related to the dimension of the touch screen for the new platform design of a remote control family using the proposed game at the conceptual design stage of development.

Table 2: Universal design principles for a TV remote control

Universal Design Principles	Description
Equitable Use	A remote control design buttons should be within easy reach of most users in terms of comfort and ease. The number of menu icons and arrangement of the touch-screen phones are usually determined on a basis of button size and space of buttons.
Flexibility in use	The design of a remote control should also fit nicely into the palm of the users and can be manipulated by both the left and right hand users.
Simple and Instructive Use	The design of a remote control should be user friendly and easy to use even for a novice, regardless of user's experience, knowledge and language skills.
Perceptible Information	Remote control design communicates essential information effectively to the users, regardless of ambient conditions or the user's sensory abilities.
Tolerance for Error	The design of a remote control should be able to minimize hazards and the adverse consequences of accidental and unintended actions. Alternatively, the remote control could hibernate automatically to save power if it is not in use after some lapse of time.
Low Physical Effort	The design of a remote control should facilitate the use such that it is efficient and comfortable and with minimum effort. It is necessary to understand the negative impact of the different controls when using the thumb for touch screen devices.
Size and Space for Approach and Use	Appropriate size and space is to provide for approach, reach, manipulations and use regardless of user's body size, posture or mobility.

3.1 Phase 1: Generate Design Strategies

According to different hand widths and lengths, we can generate the dimension of remote controls that have various dimensions. In this paper, we use anthropometric data to determine the dimensions of the remote controls for generate design strategies. Based on the anthropometric data (Tilley and Dreyfuss, 2001), the hand width and length of the 95 % man are 73 mm and 161 mm, respectively. While the hand width and length of the 95 % woman are 70 mm and 155 mm, respectively. And, the hand width and length of the 95 % children under 12 are 59 mm and 126mm, respectively. The standard dimension of the remote control selected is about 115 x 58.6 x 9.3mm. The dimension is similar to the size of the iPhone. The main reason why we selected the dimension is because the size of the iPhone had been well received by the public. The end user is able to control the screen with one hand and both the left and right handers had no problem manipulating the phone at all. We define the seven design strategies of the dimensions of a touch-screen for a TV remote control based on the standard dimension and the anthropometric data of hand dimensions as shown in Table 3.

Table 3: Seven design strategies of a touch-screen

Touch-screen	Design #1	Design #2	Design #3	Design #4	Design #5	Design #6	Design #7
Dimension (mm)	125 x 60 x 5.2 mm	95 x 50 x 5.2 mm	75 x 35 x 5.2 mm	115 x 54 x 5.2 mm	85 x 42.5 x 5.2 mm	95 x 46.8 x 5.2 mm	95 x 48 x 5.2 mm
Coalition	Man	Woman	Child	M+W	M+C	W+C	M+W+C

3.2 Phase 2: Identify Design Preference

To identify design preferences for the touch-screen of a remote control, we performed a survey that was participated by 5 respondents from each different group of people, Man, Woman and Child (aged 12 and below). We also considered two type colors (cool and warm) for aesthetic of the products. Every respondent is asked to rank from 1 to 6 what are the most important principles they look for when using the remote control. Based on the seven design strategies, the expected strategy qualities for the products can be calculated by the functional accessibility level and the usability level as mentioned in Section 2.2. The Functions-Universal Principles Matrix was used to determine the functional accessibility level for the dimensions of the products as shown in Table 4. The degree of important (a) for touch-screen accessibility and the weight of universal principles (λ) for the touch-screen were determined by characteristics related to the products as shown in Table 4. We assume that the values of the usability levels for the products including the platform strategies are 5.

3.3 Phase 3: Determine a Platform Design Strategy

To determine a platform design strategy for a remote control, we used the performance of a touch-screen, which a user can easily access to the area of the

touch-screen by his/her right or left thumb with free grip posture. Based on the proposed seven design strategies, twelve participants took part in the experiment, aged between 22 and 46 to determine the performance. The results from the experiment, the performances of the proposed designs are shown in Table 5. The proposed coalitional game was applied to obtain the marginal contributions of human variability based on the performances and preferences of the seven design strategies.

Table 4: Functions-Universal Principles Matrix for a touch-screen

Touch-screen	a	Equitable use	Flexibility in use	Simple and intuitive use	Perceptible information	Tolerance for error	Low physical effort	Size and space for use	Accessibility level	Usability level	Preferred color
Man	3	4	6	1	3	0	2	5	249	5	Cool
Woman	3	3	2	4	5	0	1	6	237	5	Warm
Child	3	2	4	3	6	0	1	5	237	5	Warm
□	-	3	4	3	3	1	5	5	-	-	

Table 5: Performances of the proposed touch-screen designs (%)

Touch-screen	Design #1	Design #2	Design #3	Design #4	Design #5	Design #6	Design #7
Performance (average)	77	95.1	100	90.1	99.6	96.9	97.9

The game between three players (man, woman, and child) for platform design of this product family is defined as the proposed coalitional game that is described in Section 2.3. Seven coalitions for the design strategies were defined as Table 3. To determine marginal contributions for each player, the coalitional benefits of the design strategies were calculated by multiplying the performance and the preference. Therefore, the payoff vector of the game is $v(0, 958.65, 1129.305, 1185, 1085.705, 1200.18, 1147.08, 1179.695)$. To determine the marginal contribution of each player, we used the Shapley value as mentioned in Section 2.3. The Shapley values of the players are $(325.685, 384.463, 469.548)$.

Based on the marginal contributions of players, we can decide a platform design strategy for a TV remote control family according to the dimension of Child's hands with the preferred color.

4. CLOSING REMARKS AND FUTURE WORK

In this research, we have introduced a method for developing a universal product family based on human variability and aesthetics through a game theoretic approach. Module-based design was applied to allow a range of trade-off in

determining the specific function configuration for a platform at a conceptual design phase. We proposed a quality function to evaluate and measure accessibility of a product using the Functions-Universal Principles Matrix. Through the case study, we demonstrated that the proposed coalitional game could be used to determine a platform strategy by considering human variability that provide more benefits with respect to hand sizes in remote control design. Future research efforts will be focused on improving the efficiency of the proposed method, developing product cost models and design strategies for various universal product family environments, and comparing to the proposed game with other decision-making methods for determining a design strategy in a universal product family.

REFERENCES

- Beecher, V. and Paquet, V., 2005, "Survey instrument for the universal design of consumer products," *Applied Ergonomics*, vol. **36**, no. 3, pp. 363-372.
- Connell, B.R., M. Jones, R. Mace, J. Mueller, A. Mullick, E. Ostroff, J. Sanford, E. Steinfeld, M. Story, and G. Anderheiden, 1997, *Center for Universal Design*, North Carolina State University, Raleigh, North Carolina.
- Demirbilek, O. and Demirkan, H., 2004, "Universal product design involving elderly users: a participatory design model," *Applied Ergonomics*, vol. **35**, no. 4, pp. 361-370.
- Mace, R., 1985, *Universal Design: Barrier Free Environments for Everyone*. Los Angeles, CA: Designers West.
- Moon, S. K., Park, J., Simpson, T. W., and Kumara, S. R. T., 2008, "A Dynamic Multi-Agent System Based on a Negotiation Mechanism for Product Family Design," *IEEE Transactions on Automation Science and Engineering*, vol. **5**, no. 2, pp. 234-244.
- Moon, S.K. and D.A. McAdams, 2010, "A Platform-based Strategic Design Approach for Universal Products," *International Journal of Mass Customization*, Vol. **3**, No. 3, p. 227-246.
- Osborne, M. J. and Rubinstein, A., 2002, *A Course in Game Theory*, MIT, Massachusetts, MA.
- Preiser, W. F. E. and Ostroff, E., 2001, *Universal Design Handbook*, McGraw-Hill Inc., United States.
- Shapley, L. S., 1971, "Cores of Convex Games," *International Journal of Game Theory*, vol. **1**, no. 1, pp. 111-129.
- Silveria, G. D., Borenstein, D., and Fogliatto, F. S., 2001, "Mass Customization: Literature review and research directions," *International Journal of Production Economics*, vol. **72**, no. 1, pp. 1-13.
- Simpson, T. W., 2004, "Product Platform Design and Customization: Status and Promise," *Artificial Intelligence for Engineering Design, Analysis, and Manufacturing*, vol. **18**, no. 1, pp. 3-20.
- Simpson, T. W., Siddique, Z., and Jiao, J., 2005, *Product Platform and Product Family Design: Methods and Applications*. Springer, New York, YN.
- Tilley, A. R. and Dreyfuss, H., 2001, *The Measure of Man and Woman: Human Factors in Design*, Wiley, New Jersey.
- WHO, 2001, International Classification of Functioning, Disability and Health: ICF Short version, World Health Organization, Geneva.

Section II

Cultural and Traditional Aspects

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Comparison of Evaluation of Kawaii Ribbons between Gender and Generation

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ABSTRACT

“Kawaii” is a Japanese word that represents an emotional value; it has positive meanings, such as cute, lovable, and small. In the 21st century, the emotional values of industrial products become very important. However, since not many studies have focused on the kawaii attributes, we focus on a systematic analysis of kawaii interfaces themselves, that is kawaii feelings caused by the attributes such as shapes, colors, and materials. We have already performed some experiments for abstract objects in virtual environment and obtained some interesting tendencies on kawaii attributes such as kawaii shapes and kawaii colors. This article introduces our trial that dealt with combinations of attributes, including colors and patterns, and applied them to an actual product, a ribbon, using a web questionnaire system. From analysis of the questionnaire results, we compared the selection tendencies of kawaii ribbons by genders and generation.

Keywords: Kansei value, kawaii, cute, ribbon, gender, generation, color, pattern

1 INTRODUCTION

Recently, the kansei value has become crucial in the field of manufacturing in Japan. The Japanese Ministry of Economy, Trade and Industry (METI) has determined that it is the fourth most important characteristic of industrial products after function, reliability, and cost. METI believes that it is important not only to offer new functions and competitive prices but to also create a new value to strengthen Japan's industrial competitiveness.

Several years ago, we began new research to apply our previous research results to the systematic creation of the kansei values of artificial products, especially the large export surpluses of such digital contents as Japanese games, cartoons, and animations (JEITIA, 2002). One of the main reasons for the success of the digital content is the existence of "kawaii" characters and their highly sensitive techniques (Belson and Bremner, 2004). Therefore, we selected kawaii as a crucial kansei value of artificial products.

Kawaii is an adjective in the Japanese language. Recent works (Belson and Bremner, 2004) (Yomota, 2006) (Koga, 2009) (Makabe, 2009) (Sakurai, 2009) have recognized the following common attributes of kawaii:

- An emotional value of Japanese origin.
- Such positive meanings as cute, lovable, and small.

Because the Japanese word kawaii is not exactly the same as "cute" or "lovable," and its use has become international (Sakurai, 2009), we use it directly, both as an adjective and a noun.

Even though such Japanese kawaii characters as Hello Kitty and Pokemon have become popular worldwide, few studies have focused on kawaii attributes; therefore, we systematically began to analyze kawaii interfaces themselves: kawaii feelings evoked by shapes, colors, and materials. Our objective is to describe a method for constructing a kawaii interface from research results.

We previously performed experiments with abstract objects in a virtual environment and obtained interesting tendencies on such kawaii attributes as shapes and colors (Ohkura and Aoto, 2007) (Ohkura et al., 2009) (Ohkura and Aoto, 2010).

This article introduces our new trial, in which we dealt with combinations of attributes, colors and patterns and applied them to an actual product: a ribbon. In addition, we employed a web questionnaire system.

2 METHOD

2.1 Outline Web Questionnaire System

One of the authors developed a web questionnaire system that is accessible through such web browsers as Internet Explorer and Google Chrome using Apache, PHP, and My SQL under a Windows environment (Charoenpit and Ohkura, 2012).

The system was modified and used for this research.

Although the participants of this questionnaire research were only Japanese, we planned to provide it for other countries in the future. Thus, the first several web pages were described in English. The screen shot of the top page is shown in Figure 1. After selecting Japanese as the participant's nationality, the web pages contained both in English and Japanese.

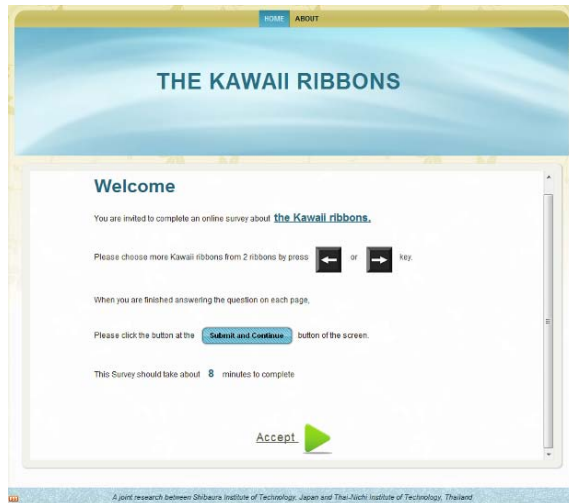


Figure 1 Top page the web questionnaire system

2.2 Candidates of Kawaii Ribbons

The shape and patterns of the ribbon candidates were selected from a reference (MdN Editorial Office, 2010). We chose one shape and three patterns. Six colors were selected from the results of our research, and an achromatic color was added. Thus, the total number of target ribbons became 21 (Figure 2).

2.3 Structure of Questionnaire System

The following is the structure of the questionnaire system:

- (1) Top page: Explanation of questionnaire
- (2) Selection of participant's attributes: Selection of gender, age group, and nationality
- (3) Explanation of selection of ribbons: election of more kawaii ribbons from the displayed two ribbon images in every five seconds. The selection results should be answered using the keyboard's arrow keys.
- (4) Selection of ribbons. The number of the compared pairs of 21 ribbons is 210. Thus, comparisons should only be made between pairs of different patterns of

the same color and different colors of the same pattern, which reduces the number of compared pairs from 210 to 84. Each ribbon appears to compare 8 times. An example of the comparison display is shown in Fig. 4.

- (5) Questionnaire for selection reasons: after the comparison, a 5-scale questionnaire was performed for the selection reason: (5: strongly agree, 4: agree, 3: neutral, 2: disagree, 1: strongly disagree)
- Q1: Patterns were kawaii.
 Q2: Colors were kawaii.
 Q3: Whitish ribbons were kawaii.
 Q4: Total impression
 Q5: First impression
- (6) Questionnaire results: The selection and reason results were saved as a database. Necessary results were extracted by My SQL

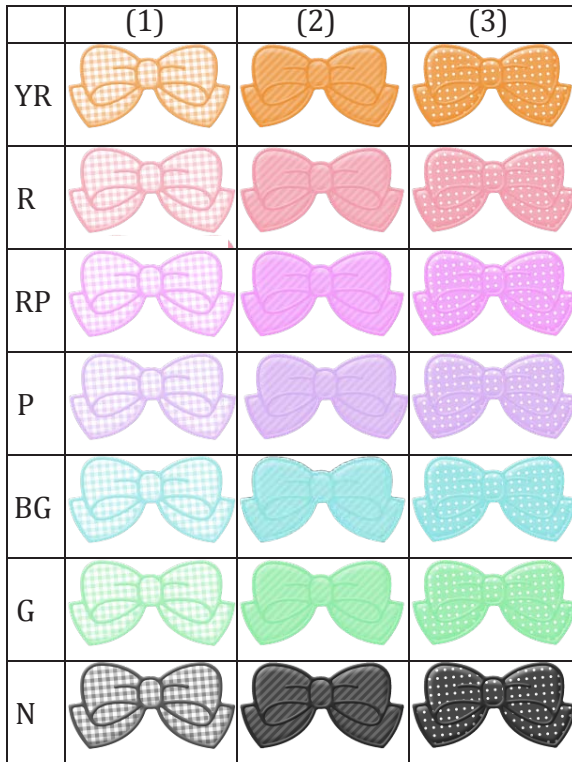


Figure 2 Candidates of kawaii ribbons