

AN ABSTRACT OF THE THESIS OF

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Title: Emotional Effect of Curvilinear vs. Rectilinear Forms of Furniture in Interior Settings

Abstract approved:

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This study focused on people's emotional responses to curvilinear and rectilinear lines in interior environments. Emotional reactions towards simulated interior settings were tested by having subjects complete an online survey. The survey tested respondents' emotional reactions triggered by different forms of furniture. The survey included questions about six simulated interior settings with three different form styles: two settings with only curvilinear lines, two settings with only rectilinear lines, and two settings with a combination of curvilinear and rectilinear lines. Each specific form style was tested twice with a different furniture style and layout. It was hypothesized that curvilinearity would provide more pleasant and arousing emotions compared to the rectilinear lines. In other words, it was hypothesized that the settings with *only* rectilinear lines would be the least arousing and pleasing settings among all the interior settings used in this study.

The survey questions utilized Mehrabian and Russell's (1974) "Semantic Differential Measures of Emotional State or Characteristic (Trait) Emotions" scale, and "Verbal Measures of Approach - Avoidance" scale. The questions included in those scales measured pleasure, arousal, and approach-avoidance reactions towards the simulated settings. Those responses were tested with Wilcoxon signed rank tests. The pleasure and arousal responses were also interpreted using Russell's (1980) circumplex model of emotions. There were also open ended questions and a demographic section in the survey.

The findings based on significant p values from Wilcoxon signed rank tests indicated that the emotional responses differed between the groups of settings with different furniture styles and layouts. This revealed that furniture style and layout influenced emotional responses towards different types of forms. Accordingly, the emotional responses collected for each form type were compared in two groups: the settings with the same furniture style and layout were grouped together and compared with each other.

The findings also indicated that the settings with only curvilinear lines elicited more pleasant emotions and the respondents desired to approach those settings more compared to the settings with only rectilinear lines. The results supported the literature about the preference for curvilinear forms due to the pleasant emotions triggered by them. The circumplexes also supported that the curvilinear forms elicited more pleasant emotions such as happiness, excitement, and feeling relaxed compared to the other forms.

The results based on Wilcoxon signed rank tests comparing the settings with only rectilinear lines and the settings with a combination of curvilinear and rectilinear lines were inconsistent in the data. The hypotheses about the relationships between the two form types were not supported in regard to pleasure and arousal. Existence of curvilinearity and the variety of forms in the latter settings didn't trigger more pleasant and arousing emotions in the participants than did the rectilinear lines as expected. It is believed that the results were influenced by the limitations of the study and those findings need further research. Finally, Spearman correlation tests were used for investigating the association between pleasure, arousal, and approach-avoidance dimensions. The results supported the literature: people approach and affiliate with others more in the settings that they find more pleasant compared to the unpleasant ones.

In conclusion, emotions influence the way people react, affiliate, approach and avoid their near environments. Emotional effect of curvilinear vs. rectilinear forms of furniture in enclosed simulated settings were compared and discussed in this study. The findings of this study suggested use of curvilinear lines to design more welcoming and pleasant environments because the use of curvilinear lines creates positive emotions in people. Also, people approach those settings more and engage with other people in those settings more. The findings also provide foundation for further research.

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Emotional Effect of Curvilinear vs. Rectilinear Forms of Furniture in Interior Settings

by
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I understand that my thesis will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my thesis to any reader upon request.

Sibel Seda Dazkır, Author

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LIST OF ABBREVIATIONS

AA:	approach – avoidance.
AR:	arousal.
PL:	pleasure.
The Type B setting:	a setting with a combination of curvilinear and rectilinear lines.
The Type C setting:	a setting with only curvilinear lines.
The Type R setting:	a setting with only rectilinear lines.

CHAPTER 1: INTRODUCTION

It is important to understand how near environments influence people and their emotions in order to design better interactions between the two. The study of people and their near environment has many interacting variables: those that derive from the artifact such as physical attributes; those that derive from the person/user such as his/her appraisal mechanism, experiences, gender, personality, and culture; and those that derive from the context of interaction such as activities that are done in that physical setting. This study aimed to examine the relationship between the designed built interior environments and emotions that are triggered by those settings, specifically from the form of the furniture included in those environments.

Emotions play an important role in our lives. They guide and enrich our lives; they provide meaning to everyday existence (Desmet, 2002). There are many definitions of emotion in the literature. According to Scherer (2005), emotions have behavioral, physiological, expressional, cognitive, and feeling components. Admiration, boredom, pleasure, content, desire, disappointment, satisfaction, stress, joy, and hate are some of the possible emotions that people can generate with regards to the near environment.

Results from empirical studies show that emotions also play an important role in people's evaluation and interaction with their environments and with the products they use. Mehrabian and Russell (1974) stated that a person's behavior in an environment is influenced by how that environment affects his/her emotions. Evoking emotions through design provides rich interactions, in other words, it influences satisfaction. Artifacts - whether designed settings or products - can appeal to human emotions through their usability, social or cultural context, semantics, and affordability. They can also appeal through their visual appearances such as with their color, form, complexity, texture, and size. According to Demirbilek and Şener (2003), products communicate with users and can never be contextually neutral in terms of their appearance.

Finally, among physical properties, form is a three dimensional element of design. Form can be geometric, organic, abstract, complex, simple, and etc. It can evoke certain emotions or possess meaning associations. For example, curvilinear/rounded forms might

evoke more positive emotions in people compared to rectilinear ones because they might be associated with cuteness (Papanek, 1995) or with nature (Salingaros, 1998). Previous studies also support preference for curvilinear lines (Madani Nejad, 2007; Hopkins, Kagan, Brachfeld, Hans & Linn, 1976; Salingaros, 1998; Papanek, 1995; Shepley, 1981; Hesselgren, 1987; Kuller, 1980). Papanek (1995) explained that curved shapes of internal spaces invoke feelings of "joy, harmony, and well-being" (p. 229); and Madani Nejad (2007) found out curvilinear forms to be pleasant, elevating, and reducing stress.

Statement of Purpose and Objectives

The main objective of this study was to understand the influence of form on emotion in interior settings. Emotional responses to simulated interior settings displaying curvilinear lines of furniture were compared with the settings displaying rectilinear lines of furniture. It was expected that there is a difference - in regard to emotional responses - between different forms of furniture in interiors; different forms trigger different emotions.

The aim of this study was also to apply the findings from the existing literature on emotions and curvilinearity in a more specific context by testing emotional responses elicited by specifically interior settings. Also, the influence of furniture style and layout on emotions triggered by different form types was tested. In addition, not only curvilinear and rectilinear lines were compared but also settings with a combination of curvilinear and rectilinear lines were tested in order to find out the emotional influence of mixed forms in interior environments. It was aimed that the findings of this study would provide foundation for further research and extend design of more pleasant and welcoming environments because emotions play an important role on assessment of the near environment.

Hypotheses

The research question for this study was: How do curvilinear and rectilinear forms of furniture affect people's emotions in interiors? Based on the literature, it was hypothesized that the settings with curvilinear forms would elicit more pleasant and more arousing emotions than would the settings with rectilinear forms and for this reason, people would approach to the former more than they would to the latter. It was also hypothesized that the settings with a combination of curvilinear and rectilinear forms would elicit more pleasant and arousing emotions than would the settings with only rectilinear forms and for this reason,

people would approach to the former more than they would to the latter. Below are the six hypotheses that were tested in this study:

- 1) The settings with only curvilinear lines would elicit more pleasant emotions than would the settings with only rectilinear lines.
- 2) The settings with only curvilinear lines would elicit more arousing emotions than would the settings with only rectilinear lines.
- 3) People would approach to the settings with only curvilinear lines more compared to the settings with only rectilinear lines.
- 4) The settings with a combination of curvilinear and rectilinear forms would evoke more pleasant emotions in people compared to the settings with only rectilinear forms.
- 5) The settings with a combination of curvilinear and rectilinear forms would elicit more arousing emotions compared to the settings with only rectilinear forms.
- 6) People would approach to the settings with a combination of curvilinear and rectilinear forms more compared to the settings with only rectilinear forms.

Research Framework

Considering the studies found in the literature: (1) artifacts and the near environment influence human well-being; (2) emotions influence the interaction between the near environment and humans; (3) physical characteristics of artifacts can trigger emotions and influence the interaction with the artifact/near environment; (4) form, as a physical attribute, influences emotions and aesthetic experience. Especially, curvilinear forms or shapes provide positive emotions and might improve human well-being.

Emotions, specifically hedonic and utilitarian emotions, aesthetic experience, how physical characteristics of artifacts elicit emotions, and how they affect people's evaluation or approach to that environment were discussed in the next chapter. Mehrabian and Russell (1974) considered that emotional responses of the observers play an important role on aesthetic evaluation of the environment. However, the built environment, particularly the interior environment, has so many interacting variables and its full evaluation seems almost impossible. Still, visual appearance can determine the first impression or the "gut" reaction to an artifact or near environment through emotions. For this reason, hedonic emotions and gut reactions were given a specific attention in this study.

It is important to note that emotions such as pleasure and excitement are not only triggered by the appearance of the artifacts but also from their semantic content such as associating them with a social class, style, belief, or memory. Apart from the artifact

appearance, artifacts can also provide satisfaction through ownership and usability. This ownership dimension was not investigated for this study because this study was related to intuitive aesthetic emotions rather than pragmatic emotions and marketing concerns. The focus was on emotions related only to physical characteristics of the furniture and the interior environments.

Definition of Terms

Aesthetic experience:	Disinterested pleasure (Kant, 2001). It varies according to the observer and the context (Goldman, 2006).
Affect:	Internal subjective experiences such as emotion, mood, emotional trait, sentiments, which influence people's relationships with their near environment (Desmet, 2002).
Appraisal:	Judgment of the meaning of a situation, a concern, the cognitive component of a response, experience or evaluation (Desmet, 2002).
Attitudes:	Low intensity affective states such as love, relatively enduring beliefs and predispositions towards specific objects or persons (Scherer, 2005).
Circumplex model:	A circular ordering of words according to their similarities in regard to their amount of variables used as two main axes: axis (x) and axis (y) (Russell, 1980).
Cognition:	Perception, a process of knowing, reasoning, and judging (Scherer, 2005).
Emotion:	An internal short-term physiological reaction to an external stimulus combining subjective feeling, appraisal, and expression (Scherer, 2005).
Feeling:	A subjective component of emotion (Desmet, 2002; Scherer, 2005).
Hedonic:	Associated with aesthetic and sensory experience and does not include pragmatic concerns (Jordan, 2000).
Interpersonal stances:	Affective states that "develop ... in the interaction with a person or a group of persons, coloring the interpersonal exchange in that situation (e.g. being polite, distant, cold, warm, supportive,

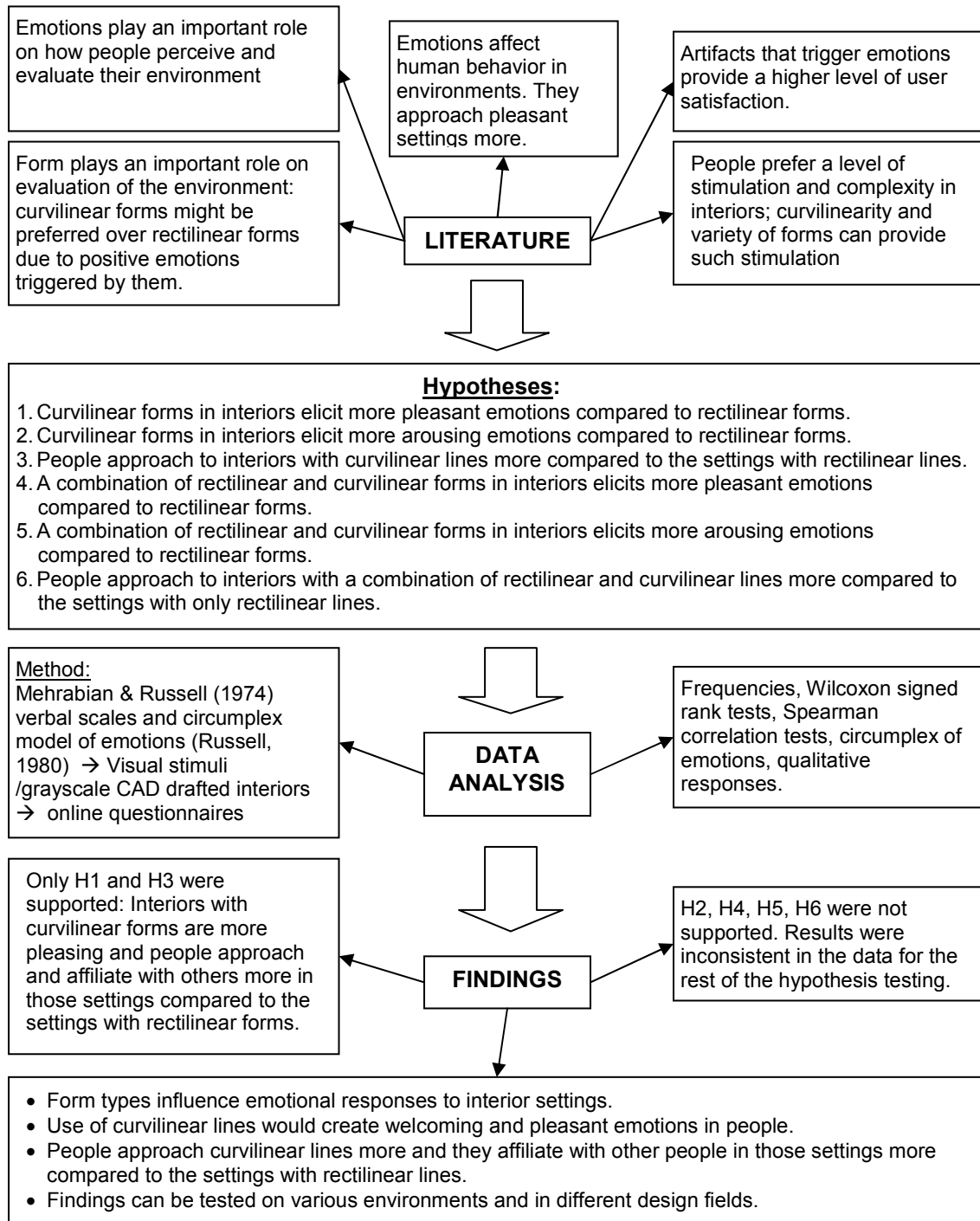
contemptuous)". They have high behavioral impact, they are highly event focused, and they have low appraisal drive (Scherer, 2005).

Mood: An affective state that can last hours or days (Ekman, 1992; Frijda, 1986); they last longer than emotions such as being in a cheerful mood.

Emotional traits: Dispositional and non-intentional affective states (Desmet, 2002). They have lifetime personality characteristics such as being a cheerful or jealous person (Desmet, 2002).

Sentiments: Affective states that can be intentional and dispositional (Desmet, 2002). They refer to likes and dislikes or our attitudes towards an object (Frijda 1986).

Figure 1: Overview of the study.



CHAPTER 2: REVIEW OF THE LITERATURE

People – place relationship is a broad concept because there are many factors that affect this relationship and many of those factors are interrelated. Accordingly, emotional response to physical attributes can't be isolated from those other variables. For this reason, the second chapter begins with a general literature review specifically on environmental psychology. The second part of this chapter will discuss emotions; what they are, how they work, how they influence people's interaction with their near environment and aesthetic evaluation, and how they are measured. The next sections will cover circumplex model of emotions and the importance of emotions in design practice. The chapter ends with theories on physical attributes of environments and form. In overall, second chapter discusses design, near environment, and emotion.

Theories on People - Place Relationship

The physical setting (physical characteristics of the environment), the person (psychological, social attributes, conceptions, meaning, educational background, gender, culture, preferences, and etc.), and the activities (Canter, 1977; Relph, 1976; Sack, 1997; Stedman, 2002; Stokols & Schumaker, 1981) are three of the categories defined by many scholars in regard to people-place relationship. Gustafson (2001) also emphasized the importance of other people.

Jorgensen and Stedman (2006) emphasized multidimensionality of sense of place. How people conceptualize places, how they produce meanings and maintain them has a dynamic structure; unique at a specific time and place (Massey, 1994; Lang, 1992; Smaldone, Harris & Sanyal, 2005). Massey (1994) explained that identities of places are unfixed because the social relations out of which they are constructed are themselves by their very nature dynamic and changing. Furthermore, people's relationships to places can be a conscious process in which people are active shapers of their lives as they interact with the physical environment to suit their needs, express themselves and develop their self-concept. People are the creators of places and sense of place is personally and socially constructed (Stokowsky, 2002). For this reason, place meanings are dependent on many personal and social factors in addition to physical attributes of the place. Those factors are identified by some researchers as culture (Lang, 1992; Albrow, 1997), gender (Hartsock, 1983; Manzo, 2003; Massey, 1994), education (Hubbard, 1996), social position (Hubbard, 1996; Manzo, 2003), distinction of inside and outside of a place (Massey, 1994), age,

personality, feelings, and experiences (Manzo, 2003). Other factors include philosophical or political concepts and what the building says about its occupants (Gifford, 1987), consumption behaviors (Douglas & Isherwood, 1979; Featherstone, 1991; Lury, 1996; McCracken, 1990), individual preferences (Nasar, 1994), feelings and attitudes of other people to a place or relating a place with a person and his/her absence (Lang, 1992; Smaldone et al., 2005). Similarly, the emotional response, or reaction to meaning, triggered by an artifact, varies for people with different backgrounds, e.g. social class, educational level, religion, and etc. (Demirbilek & Sener, 2003).

Place attachment is defined as a bond to places based on thoughts and emotions (Altman & Low, 1992; Stedman, 2002) or on the physical aspects of the built environment (Dent, 1998). Certain places can evoke various feelings in people, including comfort, security, belonging, being anchored, self-expression, and freedom to be oneself (Gunter, 2000; Moore, 2000; Smith, 1994; Tognoli, 1987). According to Dent (1998), what a building or a place say through their physical appearance is important for the observer to generate meanings and mark that place in his/her mind with a specific identity. For this reason, it is important to study how physical characteristics of the settings, such as form and color, create attachment to place. Sense of place explains a person's overall relationship with a place - including cognition, emotions, and behaviors (Altman & Low, 1992; Stedman, 2002; Steele, 1981).

Manzo (2003) stated that, we should not only restrict our relationship with places to positive ones. Places that we do not like also affect our approaches to specific settings and our dislikes are also important to utilize design to reflect ourselves. Sometimes places can have negative images in our minds. Finally, people's emotional relationships to places encompass a broad range of physical settings and emotions because various places work together to create a web of meaning in people's lives and they exist within a larger socio-political milieu (Manzo, 2003; Smaldone et al., 2005). Taking all those aspects of people-place relationships, studying specific physical characteristics of the settings will contribute to understanding one of the many influences that work together to form this relationship.

User experience literature also provides insight on human interaction with the near environment. Hassenzahl and Tractinsky (2006) defined user experience as a consequence of user's internal state (expectations, needs, motivations, and etc.), the characteristics of the designed system (usability, functionality, complexity, and etc.), and the context (or the environment) within which the interaction occurs (whether the interaction occurs in a social

setting, at work, whether the person involves in the activity voluntarily or not, and etc.). User experience has many dimensions. Those dimensions refer to how people use it such as physical, sensual, cognitive, emotional, and aesthetic dimensions of usage (Forlizzi & Battarbee, 2004). The physical characteristics of the product such as the material (how it feels when you touch), the form, the color, how it sounds, as well as user-friendliness, practicality, social and cultural meanings it has, and how the person feels after the usage and more affect the quality of the user experience. Designers cannot design the user experience as they cannot interpret the cognitive processes of the user for sure but they can design for experience (Wright, McCarthy, & Meekison, 2003) or for emotion.

People's preferences and tastes for interiors would be linked to the context of the environment and how the inhabitant relates himself/herself to there. Demirbilek and Sener (2003) explained that artifacts make a statement through shape, form, color, texture, and etc. and they communicate with users, and provide self-expression. When semantics is provided successfully, artifact becomes more emotionally and psychologically comfortable for the inhabitants.

Jordan and Persson (2007) explained that although understanding users is important for designing effective products, the types of products also significantly affect the user experience. The researchers used different sets of products in their experiment where respondents were asked to evaluate those products. Different types of products evoked different attributes; some products were evaluated more in terms of their technology; some were more familiar products so the respondents could evaluate them both in terms of functionality and aesthetics (e.g. domestic appliances such as an oven or a refrigerator); some were low-interest products (i.e. coffee makers) and in this case the respondents evaluated the product aesthetics rather than their functions as they were not interested in the product (Jordan & Persson, 2007). This study revealed that while measuring emotional effect of furniture forms in interior settings, the type of furniture used in the settings and the type of the interior environment would influence the emotional responses to that environment.

A person, who works in an open office layout, would be able to evaluate the function and aesthetic attributes of such environments in depth but someone who works in a fast-food restaurant would response differently when s/he is asked to evaluate the open office environment. People have more experience in public places such as hospitals, retail stores, banks, coffee shops, and etc. So, they would be more comfortable comparing the different places they've been before due to their experiences in those places. On the contrary, when

people are asked to evaluate the appearances of places they have never been before, they would evaluate such places differently compared to the places they have been before. In addition, when people are asked to evaluate a laboratory, a living room, a classroom, and a hotel they will emphasize different attributes of each place (i.e. functionality, comfort, safety, technology or aesthetics) independent of their personalities. Accordingly, no contexts were identified for the simulated settings used in this study and the settings were designed in a way that the respondents would feel familiar with them; uses of surprising elements in the settings were avoided.

Emotions

In order to understand the emotional responses towards physical settings, one should understand what is meant with the word emotion. While emotion has been studied extensively, it doesn't have an operational definition. Kleinginna and Kleinginna (1981, as cited in Cila, 2008) compiled 92 definitions of emotion and 9 skeptical statements from a variety of sources in the literature of emotion. Due to uncertainty on its definition scholars preferred to distinguish emotions from other affective states in order to more clearly define them (Desmet, 2002; Ekman, 1994; Scherer, 1999). Such affective states are sentiments, preferences, attitudes, moods, and personality traits (see "definitions" section for more information on those affective states). Those states are known to be different than emotions (See Table 1 and 2 for characteristics of emotions that distinguish them from other affective states). For example, being in a cheerful mood; sentiments such as likes, dislikes, and love; preferences; attitudes; interpersonal stances such as being distant or cold; emotional traits such as being jealous or nervous are different than emotions. Finally, It is important to understand that feeling is a component of emotion. Confusion about the terminology of affective states is probably due to similar or related attributes of each phenomenon. It would be difficult to isolate one's emotional states from his/her sentiments, interpersonal stances, emotional traits, and etc. Influence of each on other's occurrence would also limit measuring and studying those concepts.

Note that Desmet (2002) defined emotions as only intentional states. However, Ekman (1992) explained that emotions can be either intentional or non-intentional; the stimulus for an emotion (the cause that elicits emotion) can be an event in the environment or some changes in our thoughts or memories. So, emotions have an identifiable source such as an object or a person, and they can be conscious. However, sometimes a person may be

unaware of the cause of his/her emotion. For example, someone would be thrilled by a movie or a designed setting without knowing the reason for this fascination (Ekman, 1994). This does not mean, however, that there is no cognitive component in an emotional state.

Table 1: Differentiating affective states (Desmet, 2002, p. 4).

	Intentional	Non-intentional
Acute (limited in time)	Emotions	Moods
Dispositional (has no identifiable beginning or ending)	Sentiments	Emotional Traits

All the affective states influence each other and they also influence how design elicits emotions. Desmet (2002) explained that sentiments strongly interact with the product experience. Sentiments are likes and dislikes and they influence our emotions and our feelings about a designed setting. On the other hand, while studying how artifact appearance elicits emotions, the influence of moods and emotional traits on our emotional responses are independent of product appearance. For example, a cheerful person, regardless of the product appearance, might enjoy using a product. Thus, both moods and emotional traits should be excluded from measuring emotional responses towards artifacts. For example, a person experiencing pleasure while sitting in a room, walking in a designed setting may not find the same pleasure at a different time in the same setting because of his/her change in mood. Note that by product appearance Desmet (2002) eliminated product experience that includes ownership and buying.

Appearance of the artifact or the near environment can also affect mood of the user or the inhabitant; a good design, which is aesthetically pleasing and easy to use, would create a better mood because of the emotions that the designed artifact or the environment elicits. Norman (2002) explained that in pleasant, positive situations people are more likely to be tolerant of minor difficulties and irrelevancies; although poor design is never excusable, when we feel good, we overlook design faults. If a pleasing design is used, one that looks good and feels good, the behavior seems to go along more smoothly and easily.

Characteristics of emotions

The majority of the scholars defined emotions as short-term (Frijda, 1986; Scherer, Wallbott, & Summerfield, 1986; Scherer, 2005); emotions are a matter of seconds not

minutes or hours (Ekman, 1992; Trabasso & Stein, 1992; Desmet, 2002). Ekman (1992) explained that people usually experience emotions as happening to, not chosen by them. One cannot elect when to have which emotion but one can choose to put themselves in situations in which an emotion is likely to occur. For this reason, emotional responses were measured at the time of experiencing the visual stimuli in this study.

Table 2: Two different sets of characteristics of emotions.

Ekman (1992)	Scherer (2005)
<ol style="list-style-type: none"> 1. Signal (different facial expressions) 2. Physiology (distinctive patterns of central nervous system activity for each emotion) 3. Antecedent events (common elements in the contexts in which emotions are found to occur) 4. Automatic appraisal (appraisal happens very quickly to attend to some stimuli and happens with or without awareness) 5. Short duration (emotions are a matter of seconds) 6. Unbidden occurrence (one cannot choose when to have which emotion) 7. Rapid onset (emotions can begin very quickly) 8. Coherence among responses (coherence among expressions and autonomic changes during emotion) 9. Presence in other primates (comparable expressions in animals) 	<ol style="list-style-type: none"> 1. Having behavioral impact (they affect action tendencies, which interrupt ongoing behavior sequences and generate new goals and plans) 2. Relatively high intensities 3. Event-focused (elicited by specific events such as an environmental stimuli, behavior of others or own or internal physiological changes) 4. Appraisal driven 5. Relatively short in duration 6. Synchronized with responses 7. Rapidly changing (appraisals of events change quickly to adapt the changing circumstances or evaluations)

Many of the studies about emotions focused on basic emotions. Ekman (1992) defined basic emotions as universal across cultures and he explained that mixed emotions include more than one emotional state. Basic emotions are defined by Ekman (1992) as surprise, joy, sadness, disgust, fear, and contempt. People's experiences with artifacts and their environments are more complex than the basic emotions. As a result, the instruments developed for measuring basic emotions would not work for measuring the types of emotions people produce towards the design characteristics of their near environment.

Table 2 shows unique features of emotions (i.e. signal, physiology, antecedent events), which distinguish one emotion from another; and the common characteristics of emotions, which distinguish emotions from other affective states (Ekman, 1992). Scherer (2005) also listed seven characteristics of emotions that distinguish them from other affective phenomena (See Table 2). Both scholars listed similar attributes (see Table 2). However,

Ekman's (1992) study based more on facial expressions and evolution theory whereas; Scherer's study based more on behavioral impacts and appraisal component of emotions.

Components of emotions

Table 3 shows the components of emotion and their relationship with functions of emotion. Table 4 lists and compares components of emotions defined by different researchers. According to those components, experience of an emotion includes evaluation/appraisal of the stimuli using cognitions; bodily physiological responses e.g. with blood pressure or heart beat; an action tendency e.g. touching; responses with facial or vocal features e.g. smiling; and experience of a feeling e.g. excitement. All of those happen in a few seconds.

Table 3: Relationships between the functions and components of emotion (adapted from Scherer, 2005, p. 5).

Emotion function	Emotion component
Evaluation of objects and events	Cognitive component (appraisal)
System regulation	Neuro-physiological component (bodily symptoms)
Preparation and direction of action	Motivational component
Communication of reaction and behavioral intention	Motor expression component (facial and vocal expression)
Monitoring of internal state and organism-environment interaction	Subjective feeling component (emotional experience)

These components of emotions would help researchers develop different methods to measure emotions. Those components also help us understand what emotions are, how they happen, and how they are experienced. In order to fully measure emotional responses, one needs to measure all those components, which hasn't been achieved yet (Scherer, 2005). Emotion is a multidimensional complex concept. Only some aspects of emotion can be measured. Researchers may focus on specific components of emotion according to the focus of their studies. If a researcher desires to find out what features of an artifact or environment make it desirable by consumers or inhabitants, the researcher might need to measure the appraisal mechanism behind the decisions or behaviors. In this study, ownership and buying dimensions are neglected. The participants were not required to think about whether they would buy or live in such places as shown on the visual stimuli. Rather

than the functional and practical aspects of the interior settings the aesthetic and hedonic features of the environment were investigated in this study. For this reason, the appraisal component of the emotional responses collected via surveys won't be discussed for this study.

Table 4: Components of emotions defined by different scholars.

Scherer (2005)	Cornelius (1996)	Izard (1977); Lazarus, Kanner, & Folkman (1980)
Cognitions (appraisal)	Cognitions (evaluations about the event and, judgments)	-
Action tendencies	Instrumental coping behavior (e.g. running, hiding)	Behavioral reactions
Bodily symptoms	Physiological reactions (e.g. increased heart rate, enlarged pupil size)	Physiological reactions
Facial and vocal expression	Expressive reactions (e.g. smile, frown)	Expressive reactions
Subjective feelings	-	Subjective feelings

Theories on emotions

In the previous section it was explained that the researcher should choose which component/s of emotion to measure according the focus of his/her study. In the literature, there are examples of such approaches. Which component should researchers focus while studying emotions, how does a researcher decide on which component of emotion to focus?

Many studies on emotions include the evolutionary perspective and focus on bodily changes. Evolutionary perspective accepts emotions as universal among human and animals; they are adaptive and functional (Darwin, 1872, as cited in Desmet, 2002). Studies on facial expressions, identifying universal basic emotions across cultures are a result of this perspective. According to Lazarus (1991), Toobay and Cosmides (1990), Johnson-Laird and Oatley (1989) emotions direct us to do better in evolution and help us deal with recurrent adaptive situations. Ekman (1992) explained that basic emotions have evolved to prepare us to deal with fundamental life tasks. This theory would suggest that people tend to experience positive emotions towards the settings that have made their survival easier. For example, people might be displeased with chaotic environments because it makes circulation and apprehension of the environment difficult.

According to Desmet (2002), studying emotions in regard to bodily changes is limited because it doesn't allow studying how external stimuli affect the way artifacts elicit emotions. Similarly, the evolutionary perspective fails to explain why two people experience different emotions towards the same artifact. In addition, only basic emotions can be measured with those approaches and the basic emotions are not the only emotions people experience with artifacts. People can also experience emotions such as excitement or jealousy, which are not basic emotions, in designed settings or with the artifacts they interact.

Cognition, in other words, appraisal has been another focus of study in regard to understanding and measuring emotions. Every emotion hides a concern (Frijda, 1986). Appraisal is required for emotions to happen (Arnold, 1960, as cited in Desmet, 2002; Ekman, 1992; Scherer, 2005; Roseman & Smith, 2001). Arnold (1960, as cited in Desmet, 2002) defined appraisal as direct, non-reflective, non-intellectual, automatic judgment of the meaning of a situation. Desmet (2002) further explained the importance of cognitive perspective in regard to the study of emotions below.

...all emotions are initiated by an individual's appraisal of his or her circumstances. An important aspect of this perspective is that it holds not the event, but the meaning the individual attaches to this event, responsible for the emotion ... Positive emotions are elicited by stimuli that are appraised as beneficial and negative emotions are elicited by stimuli that are appraised as harmful. (p.10)

Each emotion has a unique appraisal (Arnold, 1960, as cited in Desmet, 2002; Lazarus, 1991). Appraisal approach explains how different people experience different emotions towards an artifact. Appraisal patterns also help researchers understand what characteristics of the artifacts provide rich interactions. In this way, designers can predict how to design artifacts that elicit specific emotions (e.g. surprise). For example, Cila (2008) tried to identify what dimensions of products elicit fun experiences in usage by looking at the appraisal patterns in responses.

The disadvantage of measuring emotions by looking at the appraisal patterns is that it is difficult to define the specific appraisal for each emotion (Desmet, 2002). Moreover, how a person appraises is something not unique among all people. It would be confusing to define specific emotions with specific appraisal models. In addition to the situation itself, how people assess the situations affects how they produce emotions. For example, in a study subjects would response differently when they are asked to evaluate the artifacts or environments from a consumer perspective (whether they would live in such a place or not or whether they

purchase the artifact or not) and when they are asked to do just an aesthetic evaluation. If the researcher desires to find answers to how such two different approaches influence the emotional responses, s/he would specifically focus on appraisal components of emotions. If the researcher desires to find out which emotions are elicited via different settings through respondents' "gut" reactions, s/he would focus on subjective feeling triggered by those environments.

Apart from the approaches explained above, Scherer (2001) explained that valance (goal/need), activation (urgency), and power (coping potential) are also important in regard to stimulus evaluation. Such similar dimensions are best known as the circumplex model of emotions that was first developed by Russell (1980). According to Scherer (2001), people evaluate their near environment according to its relevance to their needs or expectations and the implications the environment will have on them. For example, a person goes to a restaurant with his infant children; he would evaluate this restaurant according to its relevance to his goals/needs. He would expect this place to be a decent family restaurant and how he defines decent would depend on his social norms. He would expect service for children such as small chairs for them and if he comes across unwanted situations such as a noisy rude customer sitting next to his children, his coping potential would also influence his appraisal. Why he went out for dinner would also influence his evaluations. If it's a celebration of a specific event and if he chose that restaurant specifically with a hedonic orientation, his expectations would be high but if they just stopped by this restaurant randomly with a task orientation, his expectations would be lower.

Emotions versus cognitions

Aboulafia and Bannon (2004) claimed that we lack an overall conception of the human mind encompassing cognitive, social, emotive, and other psychic processes. Therefore, we shouldn't restrict the human being as only cognitive, only affective or social being. This also goes hand in hand with Norman's (2002) and Hekkert's (2006) arguments. According to Norman (2002), affect is not as well understood as cognition. Affect is something judgmental; we produce positive or negative value to the environment rapidly. On the other hand, cognitions interpret and make sense of the world. Affective states are driven by cognitions and cognitions are influenced by affect. So, each influences the other one. Finally, Aboulafia and Bannon (2004) explained that feelings are as effective functions of reflection as the

cognitive processes. Emotions are sensory reflections of the relationship between motives and goals. Norman (2002) claimed that cognition assigns meaning and affect assigns value.

Affect also has a major impact on how well we are able to perform tasks; it broadens the thought processes, making us more easily distracted. Affect therefore regulates how we solve problems and perform tasks. Negative affect can make it harder to do even easy tasks; positive affect can make it easier to do difficult tasks. Affect changes how well we do cognitive tasks; the affective system works independently of thought. Your thoughts are occurring after the affective system has released its chemicals. (Norman, 2002, p. 38)

Lindgaard and Whitfield (2004) claimed that dissociation of emotion from cognition by both behaviorism and cognitivism failed to provide the theoretical resources for probing aesthetics. Also, researching emotion and cognition in separate fields with their own subdivisions, frames of reference, terminology, and research paradigms wasn't coherent in order to understand them. Emotional responses are driven by human personalities, moods, and appraisal mechanisms. Therefore, it is not possible to say that emotions are independent of cognitions. Our cognitions shape our sentiments and our sentiments in turn, affect our emotions. After meeting someone, we may not remember the person's hair color and may only recall it as pleasing (Zajonc, 1980) but what we appreciate as pleasing bases on our appraisal mechanism; our likes and dislikes, our overall evaluation of that person.

Design can be used to enhance desired feelings and emotions in people however; this is a complex topic that might derive from childhood socialization, when their main beliefs, values and thoughts are taking shape. Therefore, a comprehensive understanding of the relationship between people and their near environment is complex and needs to be studied in a cross-disciplinary manner, involving cognitive ergonomics, psychology, semantics, and design studies (Demirbilek & Sener, 2003).

All the above discussions on the relationship between emotions and cognitions explain the importance of emotions in our daily lives. They play an important role on our goals and activities – whether pragmatic or hedonic. This also includes our interaction with the near environment and the artifacts, and user experience. Although the relationship between our emotions and cognitions is complex and it is difficult to separate one from another, it is usually accepted that appraisal is the underlying functional/pragmatic dimension of emotion. Although it is not possible to measure emotions in full context, some aspects of it such as the subjective feelings can be measured. However, there would always be limitations on such

measurements due to complex relationship between cognitions, emotions, and their determinants such as experiences and personality.

Aesthetic experience and emotions

In this section the relationship between emotions and cognitions and their role on aesthetic experience will be discussed as a continuum of the previous section. Scherer (2005) categorized emotions as utilitarian and aesthetic emotions. The utilitarian emotions facilitate our adaptation to events that have important consequences for our wellbeing. "In the case of aesthetic emotions, the functionality for an immediate adaptation to an event that requires the appraisal of goal relevance and coping potential is absent or much less pronounced" (Scherer, 2005, p.706). Aesthetic experience is not shaped by the appraisal of the artifact's ability to satisfy a person's bodily needs, further his/her current goals or plans, or correspond to his/her social values; it is related to the appreciation of the qualities of the beauty of the artifact. "Examples of such aesthetic emotions are being moved or awed, being full of wonder, admiration, bliss, ecstasy, fascination, harmony, rapture, solemnity" (Scherer, 2005, p.706). In short, aesthetic emotions don't include pragmatic concerns. Similarly, Kant also defined aesthetic experience as disinterested pleasure (Kant, 2001, as cited in Scherer, 2005) and he disregarded utilitarian considerations in his definition.

Westerman, Gardner, and Sutherland (2006) explained that user experience literature is divided between the hedonic/aesthetic and utilitarian qualities of computing system interfaces (e.g. Hassenzahl, Platz, Burmester, & Lerner, 2000; Huang, 2005; Voss, Spangenberg, & Grohmann 2003; Westerman et al., 2006). In their studies Huang (2005) and Voss et al. (2003) found dimensions for utilitarian and hedonic constructs in regard to website design. For example, Huang (2005) found hedonic scale with three dimensions (fun-frustrating, enjoyable-unenjoyable, and interesting-boring) and a utilitarian scale with four dimensions (safe-risky, ordered-chaotic, wise-foolish, and reliable-unreliable). Hassenzahl (2004) also made a distinction between hedonic and pragmatic aspects of design. He (2004) suggested that goodness (satisfaction) is associated with both hedonic and utilitarian constructs, but beauty is only associated with hedonic constructs.

Alben (1996) in her model identified aesthetics as a contributing attribute to the quality of experience. Goldman (2006) stated that aesthetic value lies in experience of the work (also mentioned by Hekkert, 2006) and varies according to context and the observer. Furthermore, the concept of aesthetic experience originates not by thinking of it in purely

sensory terms but by equating aesthetic experience with disinterested pleasure. “The idea of disinterested pleasure from passive contemplation derived in turn from exclusive focus on beauty as the only aesthetic property” (Goldman, 2006, p. 337).

Hekkert (2006) explained that the process underlying our emotions is uniform but because of the interpretation differences aesthetic responses can differ. For this reason, the most important question for understanding the aesthetics and emotion is: why do we like things? Hekkert (2006) adopted an evolutionary perspective and claimed that human being always adapts his/her near environment and there are adaptive functions of senses. We like to look at things that support navigation and identification, which also means perceptual organization as described by the gestalt laws. This makes us see relationships and differences; certain things belong together whereas others are unrelated. This helps us make the most likely and economically efficient interpretation of our environment (Hekkert, 2006). For example, we gain pleasure from artworks because they provide this perceptual organization. Also, aesthetics is embedded in how we evaluate the environment and how the place is going to be used.

Hekkert (2006) identified four general principles of aesthetic pleasure. First, the faster we sense the environment and its aesthetic pleasure, the more we prefer it over the more demanding alternative. Second, there should be unity in variety, which is detecting order in chaos. Third, we want familiar things around but we also want their newest versions. Fourth and last, we prefer congruency and appropriateness, which means consistency of impressions. Nice looking furniture should also be nice to touch, and decoration of a good-looking room shouldn't prevent navigation in the room.

Leder, Belke, Oeberst, and Augustin (2004) in their study on aesthetic experience stated that an observer of an artwork starts with a perceptual analysis of the work, compares this to previous encounters, classifies the work into a meaningful category and evaluates the work, resulting in an aesthetic judgment and an aesthetic emotion. According to Hekkert (2006), only the first two (or three) stages are automatic stages where perception is at work and how much our perceptual system detects the structure and how much it assesses the work's novelty / familiarity determines the affect that is generated. At these stages sensuous delight (or displeasure) is mentioned, whereas at later stages cognitive and emotional processes enter the experience. However, those arguments are open to discussion due to lack of clarity on aesthetic experience in the literature.

Hekkert (2006) proposed that an experience of any kind, e.g., of an artwork, a product, a landscape, or an event thus comprises an aesthetic part – that what is perceived through our senses is always pleasurable or not – but the experience as a whole is not aesthetic. In regard to his theoretical statements, experience of a physical environment would be: the entire set of effects that is elicited by the interaction between a user and that environment including the degree to which all our senses are gratified (aesthetic experience), the meanings we attach to that place (experience of meaning), and the feelings and emotions that are elicited (emotional experience). “An emotion is elicited by an evaluation (appraisal) of an event or situation as potentially beneficial or harmful to a person’s concerns” (Hekkert, 2006, p.4). For example, on seeing a bracelet a person may experience desire because she expects that possessing it will fulfill her concern of being admired. The bracelet example he mentioned here would be translated to a piece of furniture, an interior design style, and etc.

Lindgaard and Whitfield (2004) explained that it would be naive to assume that the selection and purchase of the furniture, appliances and objects that surround us are primarily governed by ergonomic and technical considerations. However, how the aesthetic function interacts with other functions is not understood well. Lindgaard and Whitfield (2004) further explained that aesthetics remains as a parallel function of finding expression in the modulation of sensory-perceptual information including the extensive range of artifacts that we produce and consume, and the driver of our urge to control the appearance of the objects that surround us. With their complex social structure, humans applied this as means of social display and standing. Rafaeli and Vilnai-Yavetz (2004) claimed that producing emotion through aesthetics is complicated by the potential gap between the intended sensual effect of an artifact and the actual emotional effects. They (2004) found out that the aesthetic mistake does not refer to the design itself, but rather to the emotions brought about by the design. All above arguments explain importance of aesthetics and emotions in design and user interaction and the lack of consensus on the subject.

Norman (2002) explained that although efficiency comes first, attractive things work better. Therefore, things can also give satisfaction in their appearance even if they are not an artwork. Moreover, design matters but which design is preferable depends on the occasion, the context, and person’s mood (Norman, 2002). When a couple buys a couch, it depends on the context of use e.g. whether it’s going to be used in the living room or in the bedroom. Similarly, preference of a piece of furniture will depend on whether it is going to be used at home, or in an art gallery, in a shopping center or in a hospital lounge. Their design matters

according to building's context; how and by whom it is going to be used, its design concept, regulations, codes, and etc. This poses a limitation on the measurement of aesthetic emotions in this study because emotional reactions to different forms were tested independent of the context or use of the setting.

Measuring emotions

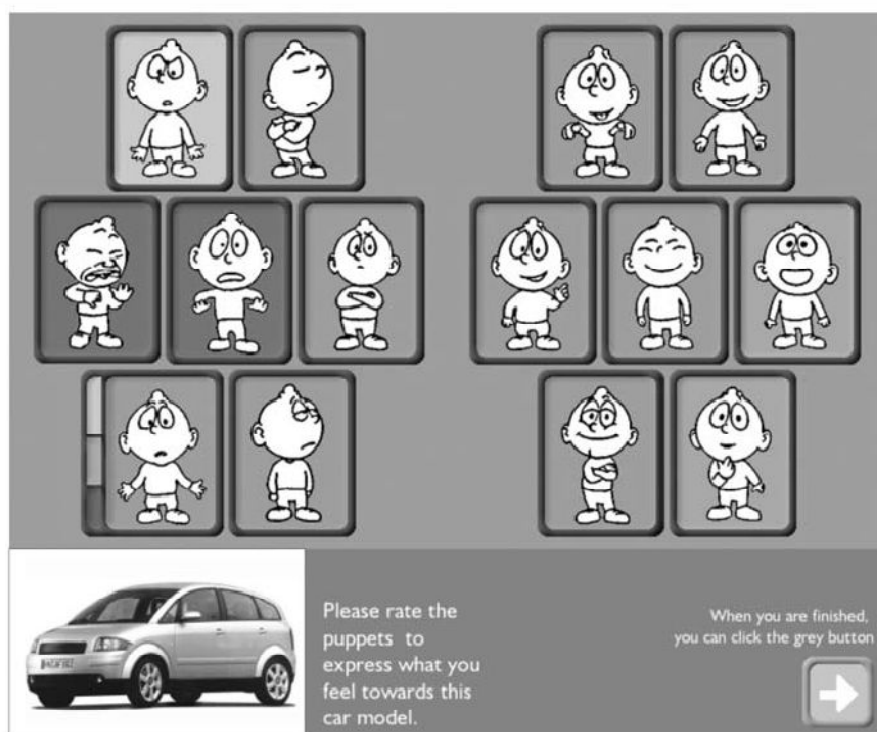
Desmet (2002) summarized the methods to measure emotions: measuring facial and vocal expressions, measuring physiological reactions, and measuring subjective feeling. The first method can only measure basic emotions and as explained before not all emotions elicited by artifacts and environments are basic. This method requires complex equipment and experts to use this equipment and subjects might hide their expressions knowing they are observed. Secondly, measuring physiological reactions include measuring blood pressure, heart rate, brain waves, skin and pupil responses, and etc. This method also requires expensive complex equipment and experts to interpret results. IBM's emotion mouse (Ark, Dryer, & Lu, 1999) and wearable sensors designed by MIT's Affective Computing Group are examples of such measurement instruments. As the results cannot be controlled by the subject, they can be reliable and objective. However, the results can be misleading as internal physiological reactions might be interfering with other stimuli such as excitement of the subject or other inter-organic functions such as being hungry or feeling cold. In addition, this measurement method cannot measure mixed emotions. The last one, measuring subjective feeling includes verbal and non-verbal methods. Verbal methods include rating scales, verbal protocols and non-verbal methods include methods such as use of self assessment manikin (SAM; Lang, 1980) or PrEmo (cartoon characters, see Figure 2) (Desmet, 2002). Although PrEmo (see Figure 2) depicts circumplex model of emotions and can be utilized across nations, it can be hard to identify which emotional reaction each figure represents. Respondents may not be able to associate their emotional reaction to any of them because the figures depict strong emotional expressions and don't provide an option to rate the strength or level of emotional response.

Non-verbal protocols can be used across cultures and the subjects don't have to verbalize their emotions but they need to select a source that portrays their emotions. With Lang's (1980) SAM the respondents select puppets that portray their emotions in three dimensions: pleasantness, arousal, and dominance. With Desmet's (2002) PrEmo the respondents select cartoon characters to match their emotions with a given stimuli in regard

to activation and valence. The cartoon characters animate emotions with facial expression, bodily movements, and vocal expressions. Russell (1980, p. 2) claimed that verbal description of emotion can be used for interpreting nonverbal evidence of emotional state and “it would be used in conceptualizing and reporting one's own emotional state”.

The major disadvantage of measuring subjective feeling is that respondents can manipulate the results. In addition, emotions are difficult to verbalize within the use of scales or questionnaires and some verbal protocols do not measure specific emotions but generalized states. However, such methods are the most convenient way to gather data for many researchers and any emotion can be measured with them including mixed emotions. Also, use of scales together with visual stimuli decreases the possibility of memory limitations.

Figure 2: PrEmo animated cartoon characters (Desmet, 2002, p. 61).



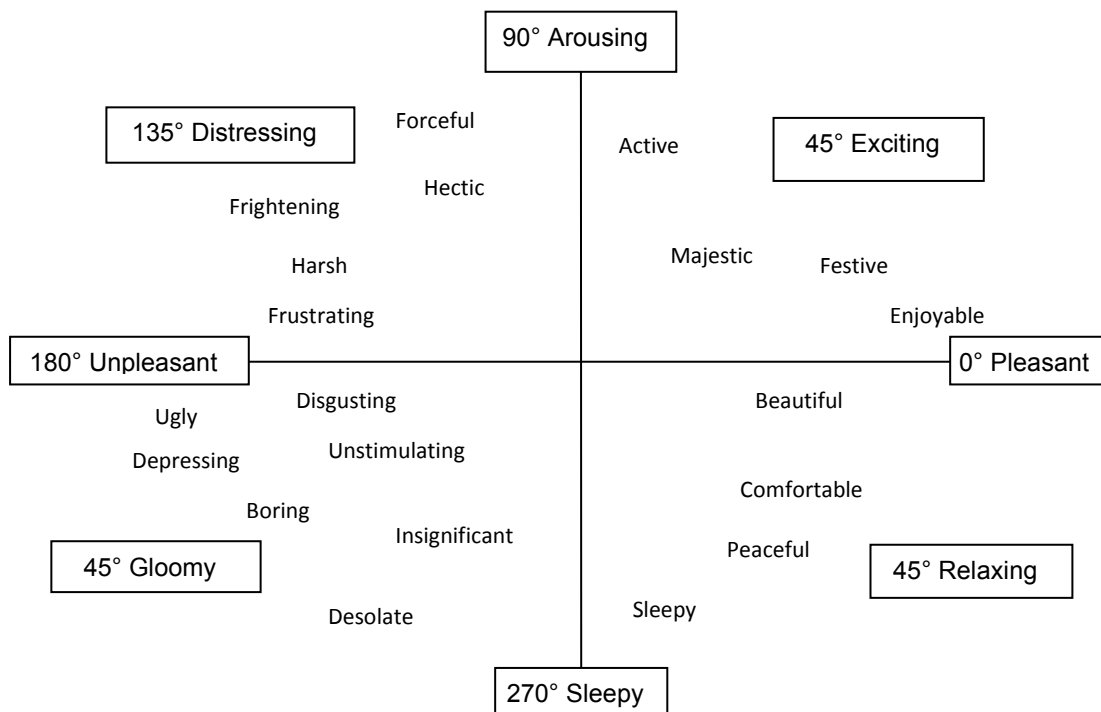
One of the most popular ways of using verbal scales to measure and differentiate emotions from each other is putting emotions into categories on base of their similarities and oppositions to each other and placing them on dimensional scales (e.g. calm-exciting, pleasant-unpleasant, relaxed-distressed, dull-enthusiastic, and etc.). Russell's (1980)

circumplex model (Figure 4) is an example to this approach and the next section will explain and discuss circumplex model of emotions.

Circumplex Model of Emotions

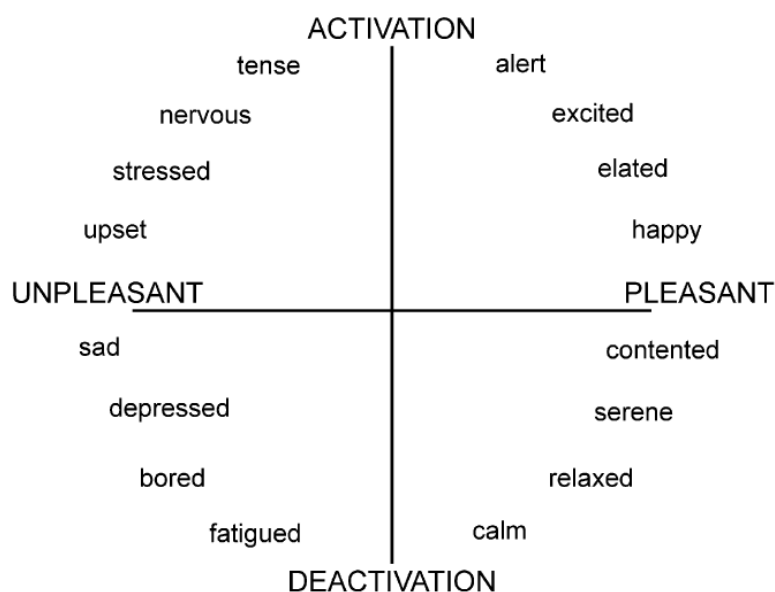
Russell (1992) worked on affective appraisal to measure how people evaluate their environments. According to Russell (1992), affective quality is a key factor determining the human response to an environment. Russell and Mehrabian (1977) conducted a study using verbal reports as functions of settings via color slides and they found out that emotion-eliciting quality of an environment affects a person's approach toward that environment, his affiliation, work performance, and other behaviors. For example, people approach pleasant settings more and they affiliate with a person in a pleasant setting more. When people feel happy or pleasant with excitement, they approach a setting even more. In other terms, people prefer higher levels of arousal in pleasant settings.

Figure 3: Adapted from “affective quality of places” in Russell and Pratt (1980, p. 312).



In order to understand emotion eliciting qualities of the environment, Mehrabian and Russell (1974) proposed three dimensions of emotions that summarize the emotional responses to all types of environments: valence (pleasant - unpleasant), degree of arousal, and dominance. The first dimension covers emotional states such as extreme happiness or ecstasy on one end and extreme unhappiness on the other end. Arousal ranges from sleepy to aroused or from deactivation to activation. Calmness, alertness, nervousness, being depressed, and excitement are combinations of pleasure and arousal in varying degrees. Finally, dominance-submissiveness ranges from feeling extremely controlled by one's environment to feelings of mastery and control over it. Specifically, pleasure was found to drive approach - avoidance and arousal was found as an amplifier of the relationship between pleasure and behavior (Mehrabian & Russell, 1974).

Figure 4: Circumplex model of emotions (Barrett & Russell, 1998).

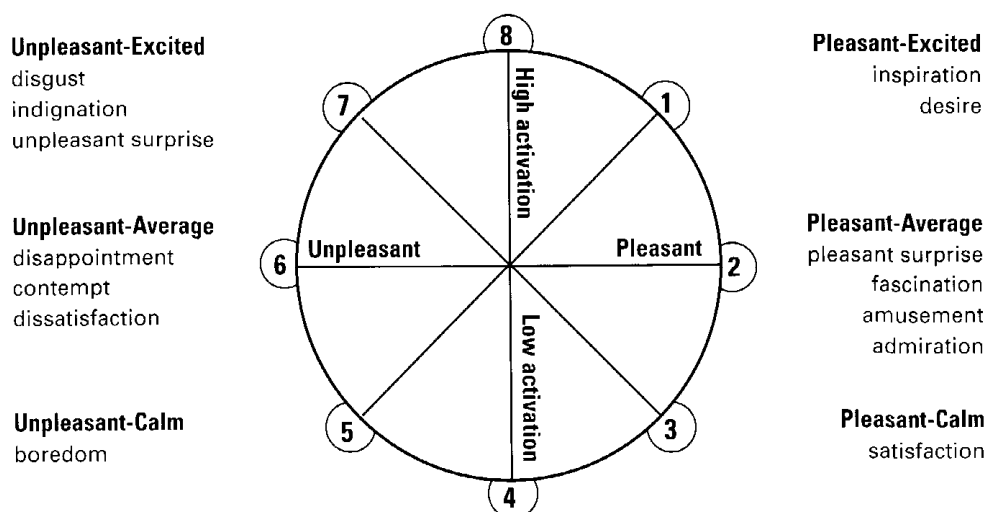


A person who feels dominant will be more evaluative and selective about where s/he wants to affiliate. Also, people who seek arousal such as excitement will tend to prefer arousing settings. Warm colors (Kueller & Mikellides, 1993), fast music tempo (Holbrook & Gardner, 1993; Kellaris & Kent, 1993), and complex environments (Berlyne 1960; Mehrabian & Russell, 1974) were found to increase arousal. Kaltcheva and Weitz (2006) summarized three visual elements of stimulus in shopping environment: complexity, color warmth, and color saturation. In addition to those findings, Kaltcheva and Weitz (2006) found out that a

consumer's motivational orientation moderates the effect of the arousal produced by a store environment on the pleasantness of the environment. When consumers have a recreational motivational orientation, high arousal has a positive effect on pleasantness but when consumers have a task-oriented motivational orientation, high arousal decreases pleasantness. Pleasantness mediates the effect of arousal on shopping behavior.

Circumplex model of emotions was developed by Russell (1980) and it derived from Mehrabian and Russell's (1974) study. Russell's (1980) circumplex model utilized Mehrabian and Russell's (1974) "semantic differential measures of emotional state or characteristic emotions" scale (pleasure, arousal). Russell (1980) found that pleasantness and arousal dimensions explained most of the variance and the dominance scale was not reliable enough in affect and behavior, and thus, research attention has been focused on these two variables; arousal and valance (Russell, 1978; Russell & Pratt, 1980; Russell et al., 1980; Bell et al., 1996). For this reason, Russell (1980) didn't transfer dominance dimension onto circumplex model of emotions; only semantic differential scales of pleasure and arousal dimensions were applied on Russell's (1980) circumplex model.

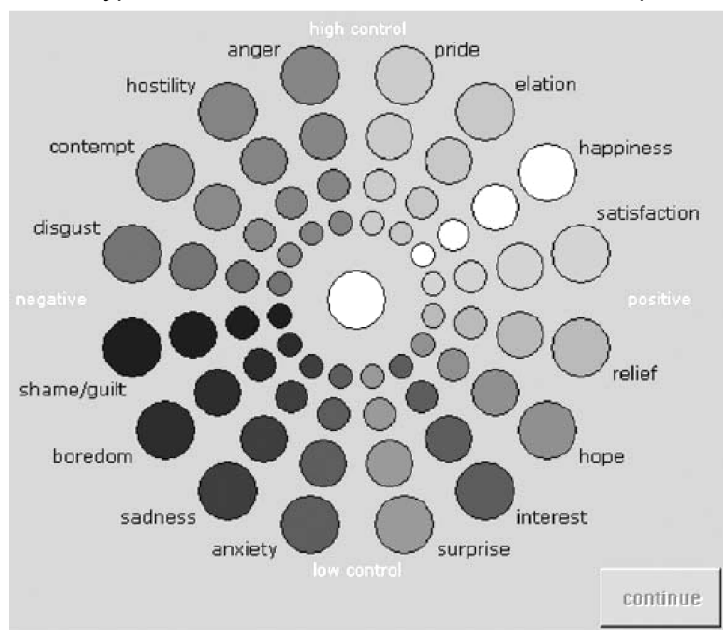
Figure 5: Fourteen PrEmo emotion words in eight categories (Desmet, 2002, p. 69).



Russell (1980) created the circumplex model of affective quality and Russell and Pratt (1980) tested this circumplex model applied to environment-human relationship. They (1980) conceptualized the affective meaning into a two-dimensional bipolar space that can be defined by eight variables falling in a circular order, positioned on every 45°. The points they

(1980) attained on this circular order are pleasant, exciting, arousing, distressing, unpleasant, gloomy, sleepy, and relaxing. See Figure 3 for the illustration of the bipolar space they (1980) designed to scale the affective quality of the environment. Placing affective states on such a circular order explains emotions' fuzzy borders with each other. For example, excitement falls at a point with high arousal and high pleasure (Russell, 1980). According to this model (see Figure 3), feeling relaxed includes low level of arousal but high level of pleasure. Note that this model includes affective states in general, not only emotions.

Figure 6: Prototype version of the Geneva Emotion Wheel (Scherer, 2005, p. 723).



The Circumplex model of emotions was used by many researchers during the last three decades (Bitner, 1992; Donovan & Rossiter, 1982; Donovan et al., 1994; Dube, Chebat, & Morin, 1995; Hui, Dube, & Chebat, 1997; Wirtz & Bateson, 1999; Wirtz, Mattila, & Tan, 2000; Kaltcheva & Weitz, 2006; Hull & Harvey, 1989) and it was tested many times with large sample sizes (Russell, 1980; Russell & Pratt, 1980; Russell et al., 1981; Wirtz et al., 2000; Barrett & Russell, 1998) through self reported scales via either simulated or the actual environments. Finally, the studies on human bodies validated circumplex model of affect and its utility in dissociating the roles of the amygdala, brainstem, cerebellum, thalamus, and association cortices in representing and modulating the affective evaluation of human faces (Gerber, Posner, Gorman, Colibazzi, Yu, Wang, Kangarlu, Zhu, Russell, & Petersen, 2008).

The order of the words or the wording on circumplex model of emotions can vary slightly (see Figure 4 for a newer version of the model – but note that this was not specifically developed for affective quality of environments. For other similar models see Figures 5 and 6). One of the disadvantages of using pleasure-arousal scale is that they might be limited to high target arousal situations (Wirtz et al., 2000).

Design for Emotion

With the advance of technology, with affordable and immense variety of consumer goods, and mass media influence consumers' expectations have changed. According to Demir (2005), consumer satisfaction used to base on needs however, with the competitive market and increased affordability at present, we can't expect consumers to know what they need all the time - there are so many alternatives in the market. Consumer studies also focused on the role of emotion in design. According to Creusen and Schoormans (2005), marketing researchers have become interested in pleasure to influence consumer behavior in purchase decisions.

Scholars (e.g. Norman, 2002; Jordan, 2000) claimed that users expect more than usability and functionality from a product. People are no longer pleasantly surprised when a product is usable; in contrast, they are unpleasantly surprised by difficulty in use (Jordan, 2000). Recent design trends show an inclination towards objects that inspire users, enhance their lives, and help in triggering emotions or even in evoking dreams (Jensen, 1999; Alessi, 2000). Velasquez (1999) explained that users are looking for fulfillment at a different level of appreciation. As a result, emotions and affect received increasing attention over the last few years.

Sweet (1999) reported Esslinger's (the founder of Frog Design) comments on product design: Even if a design is elegant and functional, it will not have a place in our lives unless it can appeal to a deeper level, to our emotions. Consumers do not just buy a product, but they buy a value in the form of entertainment, experience and self-identity. Along with his philosophy on form following emotion, Esslinger also believed that people will keep the product longer and take care of it, if it has built in the emotional value.

Forlizzi (1997) argued that the design of a product should yield not only a usable product, but an interaction which is a satisfying product that communicates to the user through its situation in an environment. Jordan (2000) explained the evolution of product user relationship as given below:

Once people had become used to having appropriate functionality, they then wanted products what were easy to use. Having become to usable products, it seems inevitable that people will soon want something more: products that offer extra; products that are not merely tools but living objects that people can relate to; products that not only bring functional benefits but also emotional ones. (p. 1)

Demirbilek and Sener (2003) also emphasized the importance of pleasure, happiness, and joy in design. Pleasure with products is defined by Jordan (2000) as the emotional, which is about how a product affects a person's mood (e.g. using a product can be exciting, interesting, fun, satisfying or confidence enhancing); hedonic, which is sensory and aesthetic pleasures associated with products (e.g. a person may recognize a product as an object of beauty or may enjoy the physical sensation of touching or holding a particular product); and practical benefits associated with products. Dewey (1980) also claimed that when a designed object not only performs a task but also evokes an immediate and vital experience, the product is not merely useful but aesthetic. There are four categories identified by Jordan (2000) in terms of product pleasure: (1) Physio-pleasure – related to touching and holding; (2) Social-pleasure – related to social relationships and communication that an artifact provides; (3) Psycho-pleasure – gained when a product helps the user to establish a task; (4) Ideo-pleasure – related to values that a product and its use represent or support.

For example, a physio-pleasure can be provided by texture of the furniture and wall coverings; social-pleasure can be provided when possession of a piece of furniture, price and quality of the interior decoration provides an association to a social group; psycho-pleasure can be provided with a functional and usable interior design; ideo-pleasure can be provided when the design of the interiors or the elements used in the interiors represent an ideology, personal aspirations or moral values. Note that the above literature suggests that there is more than aesthetic pleasure that derives from the physical attributes of the products or environments. However, this study aims to measure hedonic experience derived from visual appearance of environments and artifacts. Accordingly, this study does not include socio-pleasure or ideo-pleasure.

Aboulafia and Bannon (2004) explained that hedonic design gives pleasure and if the motive and goal of the user is pleasure, he or she may be satisfied with a hedonic design. "Meaning, emotions, and sentiments are highly inter-related. Without emotive attachment or 'bonds' to the outer world, sentiments, meaning or personal sense cannot emerge. "Life without feelings would be bland, empty, and meaningless" (Aboulafia & Bannon, 2004, p. 8).

Theories on Physical Characteristics of Environments

Physical attributes of the environment can affect mood, emotions, satisfaction, work performance, and meanings generated towards that environment. According to Rafaeli and Vilnai-Yavetz (2004), the precise relationship between emotions and the physical environment is complex and is insufficiently documented. According to the authors (2004), how a person evaluates an interior setting will depend on its functionality, its aesthetic qualities, and how we attach meanings to this place. For example, both visual and acoustic elements of physical environment produce reactions (Nasar, 1994; Takahashi, 1995; Bachorowski, 1999). Moreover, Baron (1994) proposed that environmental cues influence arousal and pleasantness of employees in workplace environment. For example, Scheiberg (1990) investigated the personal decoration of workspace and found out that employees design their spaces to express emotions; Bitner (1992) studied influence of physical environments on customer emotion; Wasserman, Rafaeli, and Kluger (2000) studied how physical qualities of bars and restaurants elicit behavioral scripts that contain distinct affective tones.

Lang (1992) categorized aesthetic experience between people and built environment as sensory, formal, and symbolic interaction. Sensory aesthetics is concerned with how pleasurable the sensations received from the environment are. Arousals as a result of colors, odors, sounds, and texture of the environment affect how people perceive environment. Lang (1992) defined formal aesthetics in architecture as the appreciation of shapes, rhythms, complexities, and sequences of the visual world. It is also concerned with concepts about sonic, olfactory, and haptic worlds. Finally, he (1992) identified symbolic aesthetics as the appreciation of the associational meanings of the environment that give people pleasure.

Lang (1992) identified five variables that carry symbolic meaning (related to physical attributes) in an enclosed environment. The first one is the building configuration, which is concerned with the meanings of shapes and patterns in an architectural style. Specific shapes (e. g. a particular pattern such as symmetry or a circle) may have associational meanings in certain cultures. For example, simple clear shapes represent modernism and complex shapes represent post-industrialism. The second one is spatial configurations, which is concerned with the meanings of volume, degree of enclosure, consumption of space, and proportions of enclosed space. For example, higher-status people inhabit larger physical settings than lower rank or open space may indicate more freedom and outward

movement. The third one is the materials, which can be chosen for their associations with visual character, sonic, haptic, and olfactory nature.

The fourth variable that carries symbolic meaning (related to physical attributes) is the nature of illumination, which is related to directionality, source, color, and level of illumination (Lang, 1992). There are correlations between types of light fittings, level, nature of illumination and certain behavior settings. Psychological effect of sunbeam shining through the stained glass window in cathedrals is an example to effect of lighting in built environment. Use of illumination may differ according to the purpose of the environment or even according to culture. The last variable Lang (1992) identified is the pigmentation. Colors of buildings, surfaces, and smaller artifacts may carry meanings in regard to social conventions. For example, color conventions differ from society to society. Apart from their semantic content, colors can also influence affective states. Use of pictures and color of the environment were found to influence mood and performance (Kwallek et al., 1988; Kwallek & Lewis, 1990). Colors have the ability to impact on the emotional well-being of human beings, either by stimulating or tranquilizing, exciting or depressing, or to provoking and antagonizing (Pavey, 1980; Fontana, 1993). There are contradicting results about how a specific color affects people in a specific way but majority of the findings in the literature suggests that warm colors such as red, orange, and yellow stimulate people more compared to the cool colors such as blue and green (Kwallek et al., 1988).

Delvin and Nasar (1989) found out that architects rated high style buildings as more clear, coherent, pleasant, relaxing, and meaningful. Both architects and non-architects favored novelty and clarity. Non-architects favored simplicity and popular attributes, while the architects favored complexity and high style attributes. Among the two types of “high” and “popular” residential houses that Delvin and Nasar (1989) tested preference was related to novelty within recognizable forms. Environmental complexity (Berlyne, 1960, 1974; Kaplan, Kaplan, & Wendt, 1972; Scott, 1993; Wohlwill, 1976; Madani Nejad, 2007) and mystery (Scott, 1993) also plays an important role on preference. Madani Nejad (2007) found that visual complexity and mystery increased significantly as levels of curvature were raised in the interior settings. Table 5 outlines studies found in the literature about physical attributes of environments and artifacts.

Table 5: Physical attributes of near environment that influence its evaluation.

Attribute	References
Building configuration	Lang, 1992; Rashid & Zimring, 2008.
Clarity	Delvin & Nasar, 1989.
Coherency	Delvin & Nasar, 1989.
Color	Fontana, 1993; Kwallek et al., 1988; Kwallek & Lewis, 1990; Pavey, 1980.
Curvature	Demirbilek & Sener, 2003; Hesselgren, 1987; Hopkins et al., 1976; Kuller, 1980; Madani Nejad, 2007; Papanek, 1995; Salingaros, 1998; Shepley, 1981.
High style attributes	Delvin & Nasar, 1989.
Materials / texture / haptic	Lang, 1992; Rashid & Zimring, 2008.
Mystery	Madani Nejad, 2007; Scott, 1993.
Nature of illumination	Heerwagen & Heerwagen, 1986; Lang, 1992.
Novelty (within recognizable forms)	Delvin & Nasar, 1989; Hekkert, 2006.
Odor	Lang, 1992.
Pictures or posters	Kaplan et al., 1972; Markus, 1967; Stone & English, 1998.
Popular attributes	Delvin & Nasar, 1989.
Rhythm	Lang, 1992.
Simplicity / complexity	Berlyne, 1974; Delvin & Nasar, 1989; Kaplan et al., 1972; Lang, 1992; Madani Nejad, 2007; Scott, 1993.
Sound	Lang, 1992.
Spatial configurations	Lang, 1992.
Windows	Butler & Biner, 1990; Jackson & Holmes, 1973; Markus, 1967; Stone & Irvine, 1994; Wells, 1965.

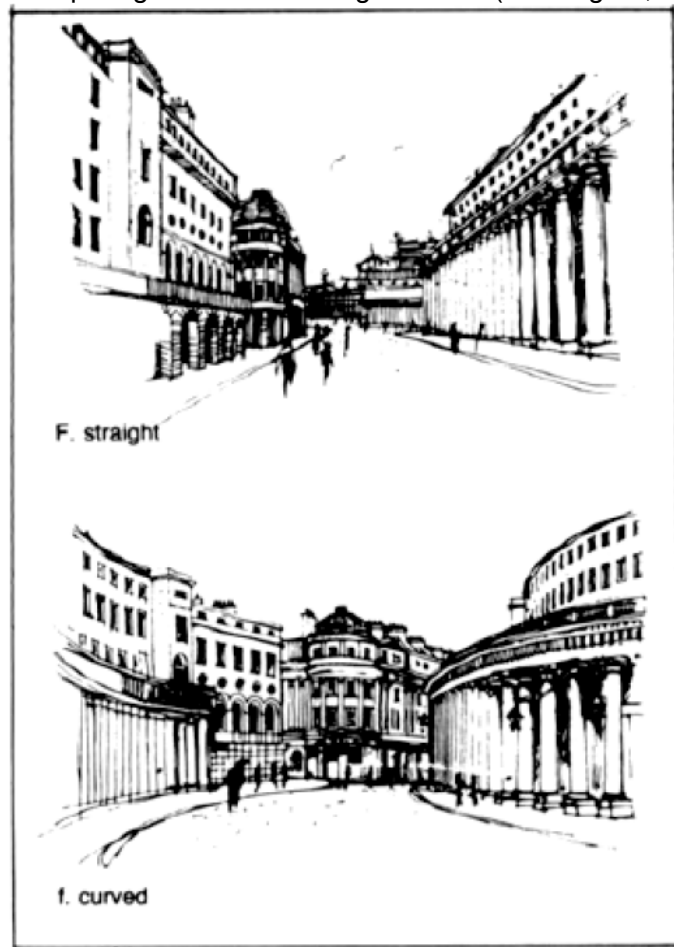
Theories on Form

Prak (1977, as cited in Madani Nejad, 2007) pointed out that environmental form holds both denotative and connotative meaning. Form of the setting generates a knowledge, recognition and subjective experience, which is related to aesthetic experience. There have been especially studies on curvature in design literature. For example, according to Papanek (1995), people are likely to find curved/rounded forms cuter because of their association with babies/infants. According to the author (1995), child physiognomy brings on feeling of

warmth and protectiveness in human. Dissanayake (1988) also reinforced the power of a baby smile offering us instant and unconditional "happiness," as well as the strength to go on in life.

Variations in proportions and roundness in forms contribute to the visual perceived "age" of products. "Cuteness" is the resulting attribute that seems to evoke "happiness" and the feeling of protection ... Therefore, the expressive aspects of human postures, gestures, and facial expressions may be used in equivalence as a semantic resource (e.g., facial expression, posture, and gesture). (Demirbilek & Sener, 2003, p. 1354)

Figure 7: Comparing curved and straight streets (Hesselgren, 1987).



Papanek (1995) also explained that curved shapes of internal spaces invoke feelings of "joy, harmony and well-being" (p.229). Similarly, Hesselgren (1987) evaluated the emotional loading of curved urban outdoor spaces versus rectilinear urban outdoor spaces. She found that a curved street was more positively evaluated than a straight one (See Figure 7).

Another theory is about the organic forms and their association with nature and human body (Pearson, 2001). Salingaros (1998) explained that buildings with natural and biological forms appear more psychologically comfortable. On the other hand, rectilinear forms of modern architecture may lack spatial sense in human terms (Alexander, 1977, as cited in Madani Nejad, 2007). Moreover, Shepley (1981) compared two different environments in regard to curvature and found out that old people tend to prefer object-orienting interior spaces (curved walls) more frequently than the spatially-orienting characteristics (squared off walls). Similarly Kuller (1980) found that pleasure is more often elicited by rounded-off architectural forms than by square-edged forms

Madani Nejad (2007) studied emotional responses towards curvature in architecture and compared non architects and architects' responses. He found out that non-architects showed significant positive response to curvilinear architectural forms and they found curvilinear forms to be pleasant, elevating and reducing stress. Finally, he also found out that there is a strong relationship between curvature and feminine qualities of architectural space, which was shared by both architects and non-architects. Madani Nejad (2007) also found that curvilinear form tends to make observers feel safer and perceive the space as more private. Hopkins et al. (1976) also studied curvature based on curve radii and found out that subjects had minimum attraction to the straight line. On the other hand, increase in the intersection of curved contours made the person feel confused and anxious (Roelfsema et al., 1999). Therefore, it could be anticipated that completely straight lines or too much curvature would be less preferred in an architectural interior setting.

One of the design principles is "unity in variety" (Koenig, 2006). Although there should be continuity and unity in settings, there should also be a reasonable amount of variation. Also, environments should provide a reasonable amount of stimulation (Stone & English, 1998), which could be interpreted as a variation of form in a reasonable amount would be preferred over monotony of same form type in an environment. Also, studies indicated that curvilinear line segments were perceived to be more complex than straight lines (Berlyne, 1960, 1974, 1971; Barrow & Tenenbaum, 1981). Madani Nejad (2007) further explained

...people prefer higher levels of environmental variety and richness (Scott, 1993), therefore it can be argued that by using curvilinear forms, one would expect an increase in perceived visual complexity and, consequently, visual preference. (p. 20)

On base of the findings in the literature, it would be interpreted that settings with only curvilinear lines or with only rectilinear lines would provide continuity of similar shapes and forms, which would provide unity. However, too much sameness would also create a monotonous environment with little variation. The settings with only curvilinear lines could overcome this problem because curvilinearity found to increase complexity (Hopkins et al., 1976; Madani Nejad, 2007) and the literature associated curvilinearity with pleasant emotions (Papanek, 1995; Madani Nejad, 2007; Hesselgren, 1987). As a result, it is possible to state that the settings with a combination of rectilinear and curvilinear lines would provide variety and would elicit more pleasant and more arousing emotions than the settings with only rectilinear lines. See Figure 10 for an illustration of findings in the literature about form and how those findings led to hypotheses of this study.

Summary

It is important to understand how physical environment affects people to design more efficient and pleasant settings. Study of near environment and artifacts has many interacting variables. Two of those interrelated variables are the influence of physical characteristics of places and emotions elicited by places. In the literature, there is confusion about emotion words and characteristics. For this reason, it is important to define emotions and their functions clearly, be aware about their limitations, and understand how they could be measured to study their influence on people-place relationship properly. One of the most reliable and validated method to measure emotional responses elicited by near environment is Mehrabian and Russell's (1974) verbal scales of emotions and Russell's (1980) circumplex model of emotions which utilized valance and arousal as two bipolar dimensions and placed emotion words in a circular order according to their similarities.

Studies showed that emotions play an important role on people's evaluation and interaction with their environments. Feelings triggered by a physical setting can determine affiliation and approach to that place. Also, designed environments and artifacts should not only function properly, they should also trigger emotions to provide a good user experience (See Figure 8). Designed environments and artifacts can elicit positive emotions such as joy, pleasure, and excitement through their appearances. Studies also showed that form as a design element plays an important role on how people react to their near environment. Finally, literature suggested that curvilinear lines might be preferred over rectilinear lines.

In short, emotions affect the interaction between people and their near environment, and a good interaction between the two would improve human well-being. An emotion triggered by physical attributes of artifacts and environments such as form should be studied in order to provide rich and positive interactions and positive emotional responses to near environment.

Figure 8: Relationship between emotion, visual appearance of artifacts or environments, and people.

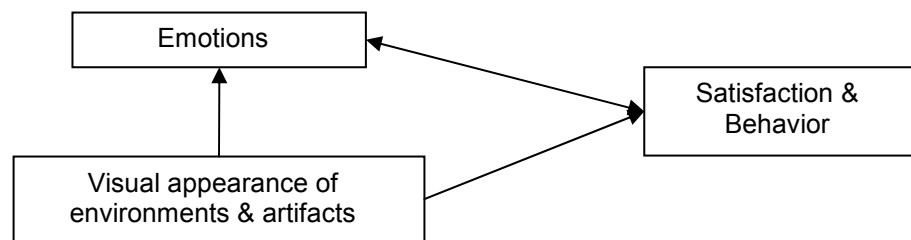
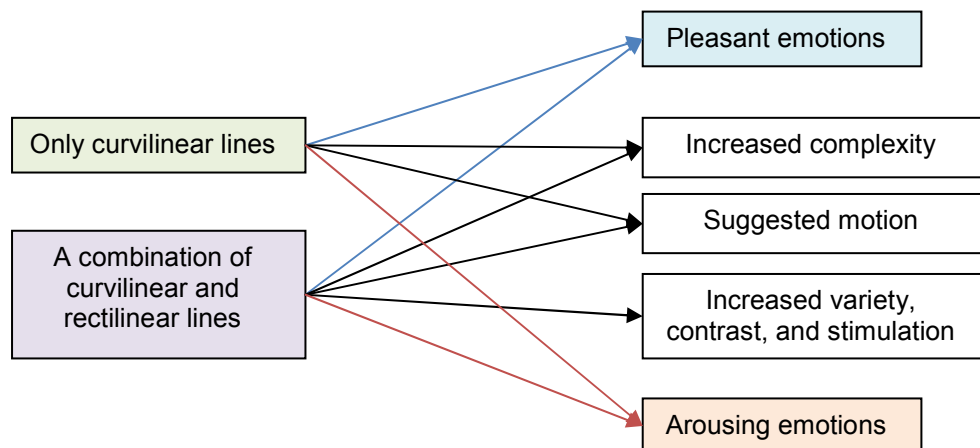


Figure 9: Emotions triggered by two types of forms.



CHAPTER 3: METHODS

The main purpose of this study was to compare emotional responses elicited by man-made interior settings with rectilinear versus curvilinear forms. In order to test this objective, an online survey was administered to a convenience sample. The following chapter discusses the model used for this study, sample selection, research design, and methods.

Model

Experience of emotions cannot be measured objectively (Barrett, 2006). However, self-report verbal scales were found reliable and easy ways to collect data (Desmet, 2002; Russell, 1980). This study utilized circumplex model of emotions (Russell, 1980), which derived from Mehrabian and Russell's (1974) "semantic differential measures of emotional state or characteristic emotions" scale (pleasure, arousal) (see Appendix A for scales and see chapter two for more information on circumplex model of emotions). These scales were validated and were found to provide reliable data by different researchers (Russell, 1980; Russell & Pratt, 1980; Russell et al., 1981; Wirtz et al., 2000; Barrett & Russell, 1998; Kaltcheva & Weitz, 2006; Holbrook et al., 1984). They were found successful for studying environment and its implications on behavior and emotions. Halvena and Holbrook (1986) found that Mehrabian and Russell's (1974) dimensions better described the experience in regard to consumption situations when they compared it with Plutchik's (1980) psycho-evolutionary emotional categories that suggest all emotions are combinations of eight emotions. Furthermore, Halvena and Holbrook (1986) found out that measurement scales of Russell's (1980) circumplex model of affect have no discriminant validity problems; this model is convenient to apply and its predictive and explanatory power seem to provide good external validity (Wirtz, 1994).

"Semantic Differential Measures of Emotions" scale is consisted of twelve items. Average score of six items in this scale determines arousal score and average score of the other six items determine the pleasure score for each respondent (See Appendix A for 12 items). The validity and reliability of this scale were tested by using the Kuder-Richardson reliability coefficient by Mehrabian and Russell (1974). The pleasure reliability was 0.81, with a retest value of 0.72 (Mehrabian & Russell, 1974). The arousal reliability was 0.50, with a retest value of 0.69 (Mehrabian & Russell, 1974). Russell (1980) also tested reliability of

Mehrabian and Russell's (1974) arousal and pleasure scales; he (1980) found an alpha level reliability of 0.84 for pleasure and an alpha level of reliability of 0.74 for arousal.

Sample Selection

The total number of participants were 142 undergraduate students enrolled at Oregon State University in the departments of Design and Human Environment (DHE majors: Interior Design, Housing, Merchandising Management, and Apparel Design) and Art (majors: Fine Arts, Graphic Design, Visual Arts, and Art History). The participants were predominantly white (88%) and female (83%). The students were between the ages of 18-51 years (average 22 years old; 85% of the sample was below the age of 23). See Table 6 for demographic information of the whole sample.

The participant students were assumed to have at least basic design understanding because they were recruited through advertisements sent via emails to specifically Design and Human Environment and Art undergraduate email lists. Data collection started after the Institutional Review Board (IRB) approved the survey. The emails were sent once in every month during June, July, August, and September 2009. The survey was closed at the end of September 2009 after three months of data collection.

Table 6: Whole sample demographics (N=142).

Variable	Item/#								
Age	18yrs 15	19yrs 19	20yrs 22	21yrs 35	22yrs 18	23 yrs and older 17		No Response 2	
Gender	Male 24		Female 118						
Race/Ethnicity	White A. 124	Asian A. 6	Hispanic A. 6	Native A. 2	Pacific Islander 1		Other 2	No Response 1	
Major	Int.D. 36	Mer.M. 22	App.D. 19	Hous.S. . 19	F.Arts 13	Gra. D. 25	Vis.A. 4	Art.H. 2	No Response 2
Department	DHE 96		Art 44	No Response 2					

Instrument Development

An online survey was created with the support of a commercial website that creates online surveys for distribution. Survey started with an informed consent document, which provided information about the research study and the survey. After reviewing the informed consent, the respondents had to approve that they were 18 years old or older, that they were either a DHE (Design and Human Environment) or an Art undergraduate student, and that they agreed with the consent information provided on the page. If they didn't approve any of the above terms, they were directed to exit the survey. Those who approved the above terms could proceed to the questionnaire and start with completing demographic information such as major, age, gender, and university webmail address. The webmail addresses of the participants were asked from those who wanted to participate in a drawing to earn money for completing the survey (Please see Appendix D). Participation in the drawing and participation in the study were completely voluntarily. The drawing was offered to encourage the students to complete the whole survey. The respondents were also asked: "How are you feeling right now?" just before they started answering the questions about the visual stimuli (See Appendix A for the survey questions). This question was designed to understand the overall emotional state of the participants before starting the survey because being in a good or bad emotional state that day might have influenced their responses provided during the survey and it might have created a bias in the results.

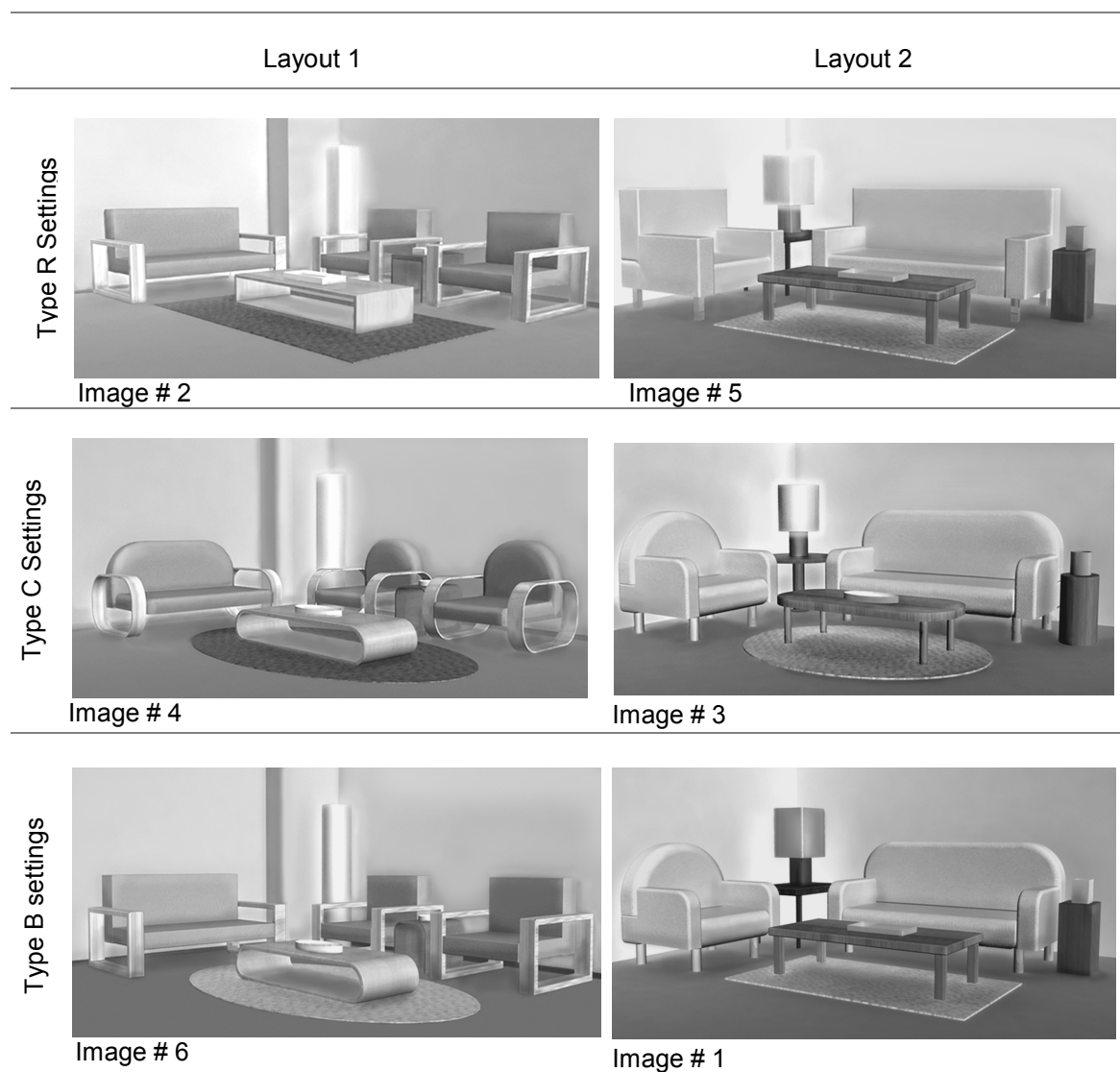
The rest of the survey included six different computer drafted grayscale visual stimuli. The visual stimuli depicted parts of interior settings with furniture such as a couch, armchairs, coffee tables, and a lighting fixture. The visuals were drafted with a 3-D modeling software (Rhinoceros 3.0) and then they were rendered by another software program (V-ray plus / 3DS Max 7), which provides photo-realistic renders of modeled environments and objects on computer (See Appendix B for visual stimuli used in the survey). Russell and Pratt (1980) explained that photographic slides provide valuable data for studying environments:

The use of photographic simulations rather than actual environments not only was convenient but insured that subjects were responding to exactly the same stimulus. Moreover, available evidence indicates that simulations especially if they include visual input provide a surprisingly good approximation to actual environments. (p. 320)

The respondents were instructed to provide their responses quickly, without thinking too much about the settings shown on the screen or about their answers. Many of the questions included rating emotion words. Accordingly, it was expected that their responses

would provide aesthetic/hedonic emotions via gut reactions, not pragmatic emotions or emotions through ownership. However, it was not possible to observe how long time the respondents spent for answering the questions or whether their pragmatic emotions influenced their answers or not.

Figure 10: Thumbnail views of the visual stimuli.



The computer drafted interior settings used as visual stimuli had the same or very similar point of views. The visuals depicted three different types of settings in regard to form: the Type C settings had only curvilinear furniture; the Type R settings had only rectilinear

furniture; and the Type B settings had both curvilinear and rectilinear furniture. There were two examples of each of the settings with a particular form type (e.g. there were two curvilinear settings with different layouts) because there were two types of design layouts applied throughout the survey. Each layout was applied twice to a setting with a specific form style. For example, stimuli with curvilinear forms were depicted twice; one with design layout 1 and the other with design layout 2 (See Figure 10 and Tables 7 & 8). The reason for using two different layouts for each form type was to examine the influence of different furniture layouts and styles on the results, and providing more settings for each form type to increase the reliability of the data by retesting.

Table 7: Form types, layouts, and image/visual stimulus numbers they refer to.

	Form type	Layout type	Image no.
Type C setting	Curvilinear	1 and 2	3, 4
Type R setting	Rectilinear	1 and 2	2, 5
Type B setting	Both curvilinear and rectilinear	1 and 2	1, 6

Table 8: Form and layout types, and response abbreviations for each visual stimulus.

	Form type	Layout type	Response abbreviations
Image 1	B	2	PL1, AR1, AA1
Image 2	R	1	PL2, AR2, AA2
Image 3	C	2	PL3, AR3, AA3
Image 4	C	1	PL4, AR4, AA4
Image 5	R	2	PL5, AR5, AA5
Image 6	B	1	PL6, AR6, AA6

PL=pleasure; AR= arousal; AA= approach-avoidance

The objective of the study was comparing different form styles and it was assumed that the other characteristics of the physical environment would be controlled by taking the following measures: Visual Stimuli with the same layouts displayed the same kind, amount, and placement of furniture; the furniture was designed simple and geometric for all six settings; diagonal lines, patterns, artwork, and any form of entertainment such as Television and reading materials were avoided in the setting; there were no implied/suggested activities

in the settings such as eating, reading, sleeping or studying. Also, the furniture, walls, floors, and carpets had the same texture and similar values; major difference was form (See Appendix B). For example, the forms were completely round and/or oval in a particular setting and they were only square or rectangular in another particular setting. Respondents answered the same questions for all six different simulated interior settings.

Each visual stimulus was displayed on a separate page/screen on the web. On each page, the respondent was asked to complete the same six questions: one question including “semantic differential measures of emotional state or characteristic emotions” scale, three questions including “verbal measures of approach avoidance” scale, and two open ended questions. The items in the scales were introduced in different and random order for each visual stimulus. The first question in the survey was “Please quickly mark your emotional responses elicited by this interior setting on each scale given below”. The aim of this question was to measure the emotional responses elicited by each visual stimulus using twelve semantic differential scales (e.g. a nine point rating scale from unhappy to happy). This question stayed as the first question throughout the survey because emotions are short term and it was assumed that it would be easier and faster for the students to see the visual stimulus and mark their emotional responses on rating scales if the scales were placed just below the stimulus. However, the order of twelve scales listed in this question changed randomly for each stimulus throughout the survey.

The order of the other five questions also changed for each visual stimulus. Those questions were two open ended questions and three likert scale questions to measure approach-avoidance behavior. The open ended questions were “Is there any other feelings/emotions that you'd like to describe about this interior setting?” and “What have you liked/disliked about this room? Please explain”. Those two questions aimed to provide a better understanding on emotional responses. Finally, “approach-avoidance” questions were: “To what extent does this place make you feel friendly and talkative to a stranger who happens to be near you?”, “Once in this room, how much would you enjoy exploring around?”, and “How much time would you like to spend in this room?” (See Appendix A for the complete list of survey questions).

Analysis

The aim was to compare emotional responses triggered by three different types of settings that differed in form. The data were analyzed using variables' mean scores and Wilcoxon signed rank test using "STATA/IC 11" statistical software. The survey questions were identical for each visual stimulus as discussed earlier. The first step was evaluation of semantic differential scales from the first question. This part included twelve scales, each ranking between "-4" to "4". Six of the items in this scale determined average pleasure (PL) score and the other six of the items in the scale determined average arousal (AR) score for each of the visual stimulus (See Mehrabian & Russell, 1974 for more information).

Note that there were three different form styles to be compared and there were two different furniture styles and layouts applied on the settings (See Figure 10, Tables 7 and 8 for a better understanding of the types of settings in the survey). There were:

- two Type C settings (settings with only curvilinear forms: image#3 and image#4),
- two Type R settings (settings with only rectilinear forms: image#2 and image#5),
- two Type B settings (settings with both curvilinear and rectilinear forms: image#1 and image#6).
- three settings with the first design layout: one Type C setting (Image#4), one Type R (Image#2) setting, and one Type B setting (Image#6),
- three settings with the second design layout: one Type C setting (Image#3), one Type R setting (Image#5), and one Type B setting (Image#1).

Once the mean PL (pleasure) and AR (arousal) scores were calculated for each setting, it was possible to compare whether or not there was a significant difference between the emotional responses triggered by each type of the setting. This could be achieved by using Wilcoxon signed rank test in order to compare the PL and AR scores of different visual stimuli. This test uses the sign and the magnitude of the rank of the differences between pairs of measurements and it provides an alternative to the paired t-test when the population distribution of the differences is not normal (Ott & Longnecker, 2006). Wilcoxon signed rank test only tests differences between paired responses. Using Wilcoxon signed rank test, it was possible to compare PL scores and AR scores between the settings in pairs. Accordingly, each test of comparison did not include missing responses into the test; if a respondent had failed to answer one of the questions in the pair, his/her response was not included in the analysis of that particular comparison of the two settings. Among the 142

respondents, only 105 of them completed the whole survey. The analysis method for comparing emotional responses triggered by two different settings excluded the missing answers. As a result, each pair of comparison had different number of respondents. The demographic characteristics of each group used for each test were very similar to the characteristics of the whole sample: Majority of the respondents in each group was younger than 24 years, white, female, and most of them were from the department of DHE (Design and Human Environment). Demographic characteristics of each group were reported separately in Appendix C.

Before comparing the responses collected for different form types, the first step of the analysis was comparing emotional responses to different furniture styles and layouts. The settings with layout #1 and the other settings with layout #2 were compared. In other words, the settings with the same form type were compared with each other in order to find out the influence of furniture style and layout on results. Wilcoxon signed rank tests were conducted for comparing the settings with the three pairs for settings with the same form but different layout. For example, image #3 and image #4 were compared in regard to their PL, AR, and AA responses. If the results indicate a significant difference between those two settings, it means the use of different furniture style and layout influenced the responses towards the settings with curvilinear lines. Once this analysis was completed, the next step was comparing PL and AR scores for the settings with different forms using Wilcoxon signed rank tests.

The next step of the analysis was calculating approach avoidance (AA) scores for each participant. AA scores were determined by three likert scale questions. The sum scores of those questions determined overall approach avoidance score (AA) for each respondent. AA scores for each setting were compared with each other using Wilcoxon signed rank tests. The relationships between PL and AA responses for each setting and the relationships between AR and AA responses for each setting were analyzed using non-parametric correlation (Spearman Correlation) in order to find out the degree of association between those variables. It was expected to find significant correlations between PL and AA values and between AR and AA values. Note that PL and AR values were independent of each other; a PL and an AR score formed an emotional response of a particular respondent together. For this reason, their relationship was not analyzed in this study. Spearman correlation is used for estimating the degree of association between ordinal variables with no normal distribution assumption. Spearman *rho* coefficient estimates the strength and

direction of association between two variables. *Rho* coefficient can range between -1.00 and 1.00. A positive coefficient indicates that the two variables vary in the same direction. Similarly, a negative coefficient indicates that the variables vary in opposite directions. Also, coefficient values ranging between $|0.5|$ and $|1|$ refer to a strong association and values ranging between $|0.3|$ and $|0.5|$ refer to a moderate strength of association between the two variables.

The AA scores were not transferred to the circumplex model (See Russell, 1980; Russell & Pratt, 1980). Each emotional response could be transferred on to the circumplex as a point on the coordinate system. An arousal (AR) score determined the (y) coordinate and a pleasure (PL) score determined the (x) coordinate of a response. Thus, each response could be marked on the circumplex of emotions with (PL, AR) coordinates. This method provided an overall view of how the responses/points were distributed on the circumplex layout. Finally, the qualitative data gathered by the open ended questions provided further discussion on the findings.

Circumplexes were used for analyzing the emotional responses. See Figure 3 for circumplex model of emotions applied to affective quality of places by Russell and Pratt (1980). Also, see Figure 4 for the most recent version of the circumplex model of emotions by Barrett and Russell (1998). The pleasure and the arousal scores on the circumplex varied between “-4” and “4”. A score of zero would mean a neutral emotional response on the circumplex. The PL scores ranging between zero and four refer to the pleasant emotions and the degree of pleasantness increases as the number value increases (e.g. 3 refers to a more pleasant emotion than 2). The PL scores ranging between zero and minus four refer to the unpleasant emotions and the degree of unpleasantness increases as the value of the number decreases (e.g. -3 refers to a more unpleasant emotion than -2). Similarly, the AR scores between zero and four refer to the activating/arousing emotions and the degree of arousal increases as the number value increases (e.g. 3 refers to a more arousing emotion than 2). The AR scores between zero and minus four refer to the unarousing emotions and the degree of arousal decreases as the value of the number decreases (e.g. -2 refers to a more arousing emotion than -3). An example of arousing - pleasant emotion is excitement; an example of unarousing - pleasant emotion is feeling calm; an arousing - unpleasant emotion would be feeling nervous; finally an example of unpleasant - unarousing emotion is feeling depressed.

Fortunato (2004) found that subjects who have tendency toward negative emotional responses also tend to report larger number of negative responses. This might cause a bias in the results. For this reason, respondents' emotional states (good vs. bad) just before they started the survey were asked and compared by looking at their mean values. The demographic characteristics of the sample were not analyzed in regard to their influences on responses due to the limitations on the sample characteristics. Finally, the open-ended questions were utilized for discussing the data analysis results. The qualitative data also provided a better understanding of the limitations of the study.

This chapter explained the survey design, sample selection, and the data analysis procedures. The next chapter will present the results for:

- examining PL, AR, and AA scores of each visual stimulus via their mean values,
- comparing PL, AR, and AA scores between the settings with the same form type but different furniture styles and layouts via Wilcoxon signed rank tests,
- comparing PL, AR, and AA scores between the visual stimuli with different form types via Wilcoxon signed rank tests,
- examining the relationships between PL and AA; and between AR and AA via Spearman correlation tests,
- examining the distribution of emotional responses of each setting on the circumplex layout to learn about the types of emotions elicited by each setting and by each form type,
- examining open ended questions for discussing the above results.

CHAPTER 4: RESULTS

The results were reported in three different sections: The first part included comparing the pleasure (PL), arousal (AR), and approach avoidance (AA) scores between each visual stimulus in regard to their form styles and layouts. This first part was broken into three different sections; pleasure, arousal, and approach avoidance. The second part examined the correlation between the approach avoidance behavior and the emotional responses (PL and AR scores). The third part included the circumplex of emotions for each setting and form type.

First of all, the majority of the respondents were in a good emotional state prior to taking the survey. On a five point scale, the respondents were asked about how they were feeling at that moment. Five represented a good emotional state, and one referred to a poor emotional state. The respondents scored an average of four as their level of positive emotional state. Only 4% of the respondents were in rather a negative affective state right before taking the survey. It was found that those who were in a better emotional state before starting the survey scored more positive responses on the survey. However, there were no consistent significant results suggesting this influenced the survey results significantly.

Comparing Pleasure, Arousal, and Approach-Avoidance Responses

Pleasure, arousal, and approach-avoidance scores were reported throughout the chapter using the first two letters of each measure and the number of the visual stimulus/setting they stood for. For example, PL3, AR3, and AA3 all reflected responses collected for the third visual stimulus / image #3 in the survey. PL1 means pleasure score of the first image in the survey; AR5 means arousal score of the fifth image in the survey; and AA6 means approach-avoidance score of the sixth image in the survey (See Figure 10 and Tables 7, 8). The PL, AR, and AA results were reported separately in this chapter due to large amount of statistical tests used for comparing visual stimuli in pairs.

PL, AR, and AA scores were first compared between the settings with the same form type in order to investigate how different furniture styles and layouts influenced emotional reactions to the same forms. Wilcoxon signed rank tests were used for this type of analysis. Next, the PL, AR, and AA scores were compared between; the Type C (with only curvilinear forms), the Type R (with only rectilinear forms), and the Type B (with both rectilinear and curvilinear forms) settings.

Tables 9, 11, and 13 show the mean and standard deviation values for the PL, AR, and AA responses. Wilcoxon signed rank tests compared the responses between the two Type C settings (setting #3 and setting #4): The PL responses for the two settings differed significantly ($z = -4.56$; $p < 0.01$); the AR scores differed significantly ($z = -7.33$; $p < 0.01$); and the AA scores also differed significantly ($z = -2.05$; $p < 0.05$). The responses for the two Type R settings (setting #2 and setting #5) were compared: The PL responses for the two settings differed significantly ($z = 4.85$; $p < 0.01$); the AR scores were not different significantly ($z = 0.44$; $p > 0.05$); and the AA scores differed significantly ($z = 2.82$; $p < 0.01$). The responses for the two Type B settings (setting #1 and setting #6) were compared: The PL responses for two settings differed significantly ($z = 3.70$; $p < 0.01$); the AR scores were different significantly ($z = -7.4$; $p < 0.01$); and the AA scores also differed significantly ($z = -5.85$; $p < 0.01$).

The findings indicated that except from the Type R settings' AR responses, all the responses differed significantly between the settings with the same form type. Again, except from the Type R settings' arousal responses, the settings with the Layout 1 received significantly higher PL, AR, and AA responses than the settings with Layout 2. As a result, it was found that use of different furniture styles and layouts influenced the responses towards the settings with the same form type. Accordingly, while comparing the responses towards different forms, the responses were compared between the settings with the same furniture style and layout meaning that they were compared separately for the two groups of settings: the settings with Layout 1 and the settings with Layout 2.

Pleasure

The PL scores were compared between the settings with the three different form types (Type C, Type R, and Type B) using their mean and standard deviation values, and the Wilcoxon signed rank tests. Table 9 shows the mean PL scores for each visual stimulus. The PL scores ranged between “-4” and “4” on the scales. The collected mean PL responses ranged between “-1.3” and “0.1” for the six visual stimuli.

According to the mean pleasure values shown in Table 9, all the PL scores were low and except from PL4 value, all of them were negative. The highest mean PL scores were obtained from the Type C settings in both groups of settings with different layout types. Mean PL3 value ($M = -0.66$) was the highest score among the settings with layout #2 and mean PL4 value ($M = 0.14$) was the highest value among the settings with the layout #1. Mean PL4

value was also the highest and the only positive value among all six mean values. The Type R settings received the lowest mean pleasure scores in each group: Mean PL5 value ($M = -1.29$) was the lowest score among the settings with the layout #1 and mean PL2 value ($M = -0.43$) was the lowest mean pleasure score of all. Settings with the curvilinear forms elicited the most pleasant emotions, and the settings with the rectilinear forms elicited the most unpleasant emotions in respondents within both groups of settings (layout #1 vs. layout #2). All of the scores were different from each other and none of them was “0”, in other words, none of the settings averaged a neutral pleasure response.

Table 9: Mean pleasure (PL) scores.

	Variable	Obs	Mean	Std. Dev.	Min	Max
Layout#2	PL1 (Type B)	142	-1.156	1.499	-4	3.2
	PL3 (Type C)	117	-.662	1.669	-4	3.7
	PL5 (Type R)	107	-1.289	1.739	-4	2.8
Layout#1	PL2 (Type R)	124	-.433	1.510	-4	3.2
	PL4 (Type C)	111	.135	1.696	-4	4
	PL6 (Type B)	106	-.389	1.730	-4	3.8

The bolded values show the highest mean PL scores in each group.

Table 10: Wilcoxon test results for comparing pleasure (PL) scores between different forms.

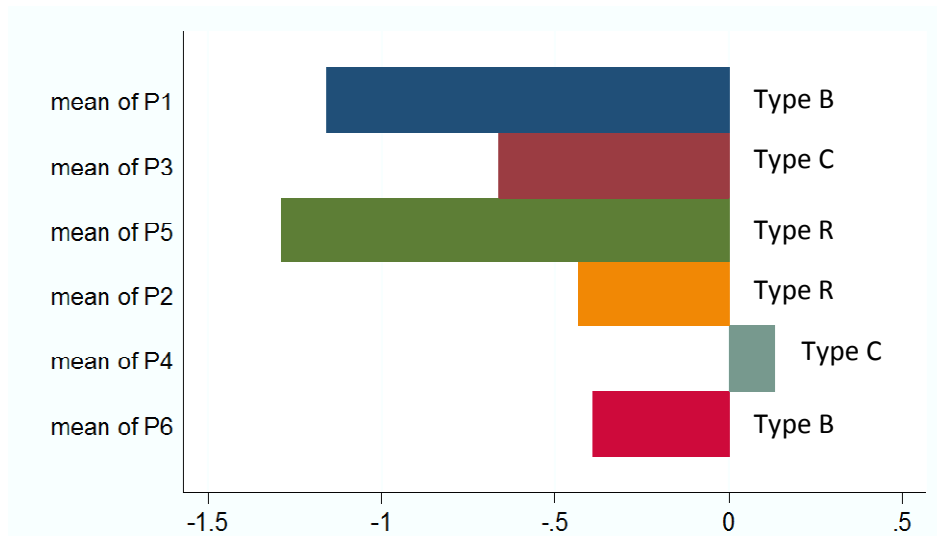
	PL variables	Forms	Relationship btw their mean values	N	Z score	P value
Layout #1	PL2 - PL4	R vs. C	PL2 < PL4	111	-3.2	0.0013**
	PL2 - PL6	R vs. B	PL2 < PL6	106	-1.1	0.268
	PL4 - PL6	C vs. B	PL4 > PL6	105	2.52	0.012*
Layout # 2	PL1 - PL3	B vs. C	PL1 < PL3	117	-2.73	0.0064**
	PL1 - PL5	B vs. R	PL1 < PL5	107	3.63	0.0214**
	PL3 - PL5	C vs. R	PL3 > PL5	107	-1.24	0.0008**

* p value < 0.05; ** p -value < 0.01 ; N=number of observations

Total six Wilcoxon signed rank tests were run for comparing the PL scores between the different visual stimuli (See Table 10). Each test compared pairs of responses from two different settings with the same layout and with the different form types. Each comparison was tested using different number of observations because not all participants completed the

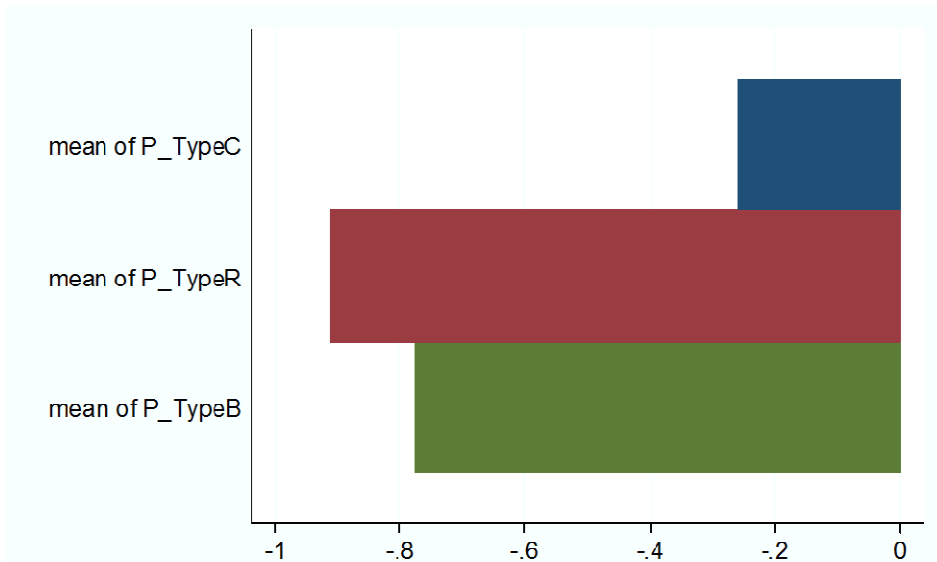
survey for all visual stimuli. See Appendix C for sample demographics for each focus group. The groups included mostly white, female, DHE students. The ages of the participants ranged between 18 years and 51 years and majority of the respondents (85%) in each group were younger than 25 years old.

Figure 11: Mean pleasure scores for each visual stimulus.



P stands for pleasure score in the figure.

Figure 12: Combined mean pleasure scores for Type C, Type R, and Type B settings.



P stands for pleasure score in this figure.

Test results revealed that among the visual stimuli with the first design layout, the PL4 scores were significantly higher than the PL2 ($z = -3.2$; $p < 0.01$) and PL6 scores ($z = 2.52$; $p < 0.05$). As expected, the Type C setting received significantly the highest pleasure score within the settings with layout #1. There was no significant difference ($z = -1.1$; $p > 0.1$) between the PL2 (Type R setting) and the PL6 (Type B setting) scores. Further statistical analysis showed that among the visual stimuli with the second design layout, the PL3 scores were significantly higher than the PL1 ($z = -2.73$; $p < 0.01$) and PL5 scores ($z = 3.63$; $p < 0.01$). As expected, the Type C setting received significantly the highest pleasure score within the settings with layout #2. There was no significant difference ($z = -1.24$; $p > 0.1$) between the PL1 (Type B setting) and PL5 (Type R setting) scores. (See Table 10 for Wilcoxon signed rank test results). Also, the Type C setting with the first design layout significantly received the highest and the only positive PL score among the all six visual stimuli. See Figure 11 and 12 for comparison of the PL scores.

To sum up, the only consistent significant difference between the settings with the three different forms and the participants' pleasure responses was observed only for the settings with curvilinear lines (Type C settings). Among the settings with layout #1, the Type B setting received a higher PL mean value compared to the Type R setting. However, this difference was not significant. In contrast, among the settings with layout #2, the Type R setting received a significantly higher mean PL value compared to the Type B setting.

Arousal

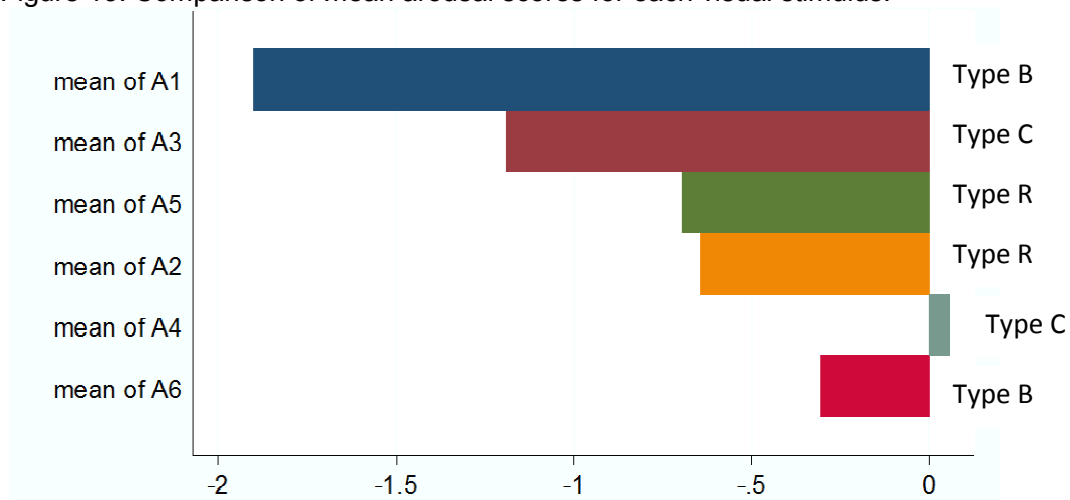
The Arousal (AR) scores were compared between the three types of settings with three different form types (Type C, Type R, and Type B) using mean and standard deviation values, and Wilcoxon signed rank tests. Table 11 shows the mean AR values for each visual stimulus. The AR scores ranged between “-4” and “4” on the scales. The collected mean AR responses ranged between “-1.9” and “0.06” for all six visual stimuli. As shown in Table 11, the AR mean and standard deviation scores were different for each visual stimulus. The AR scores were all negative except from the AR4 mean value. Also, only the AR4 value was very close to zero. In other words, it was close to a neutral mean arousal response. Settings with the second design layout received lower AR scores than did the settings with the first design layout.

Table 11: Mean arousal (AR) scores.

	Variable	Obs	Mean	Std. Dev.	Min	Max
Layout#2	AR1 (Type B)	141	-1.901	1.129	-4	2.3
	AR3 (Type C)	117	-1.188	1.252	-4	3
	AR5 (Type R)	107	-.695	1.623	-4	2.7
Layout#1	AR2 (Type R)	122	-.643	1.353	-4	2.7
	AR4 (Type C)	111	.056	1.511	-4	3
	AR6 (Type B)	106	-.303	1.513	-4	3.6

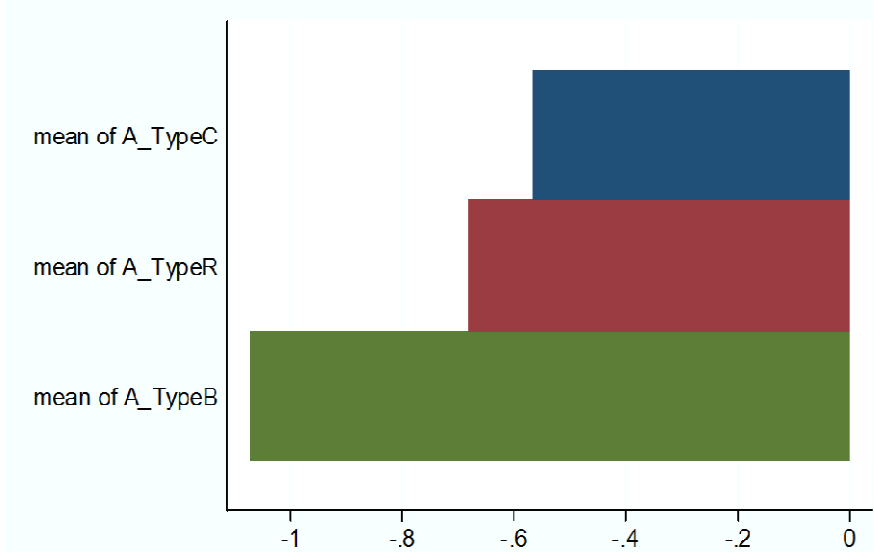
Note: The bolded values show the highest mean AR scores in each category.

Figure 13: Comparison of mean arousal scores for each visual stimulus.



A stands for arousal.

Figure 14: Combined mean arousal scores for Type C, Type R, and Type B settings.



A stands for arousal.

The highest AR scores obtained in each group were as following: the Type C setting in the group with design layout #1 and the Type R setting in the group with layout #2. The AR5 ($M = -0.7$) and AR4 ($M = 0.06$) were the highest mean arousal scores among all six mean values. AR4 was the highest and the only positive value of all. The Type R setting received the lowest arousal score (AR2, $M = -0.64$) among the settings with layout #1, and the Type B setting received the lowest arousal score (AR1, $M = -1.9$) among the settings with layout #2. The mean AR1 value was the lowest arousal score of all six mean AR scores. As expected, the Type C setting (AR4) received a higher arousal score than the Type R setting, and the Type B setting received a higher arousal score (AR6) than the Type R setting among all three settings with design layout #1. However, the same pattern wasn't observed among the settings with layout #2: the Type R setting (AR5) elicited the most arousing emotions, and the Type B setting (AR1) elicited the least arousing emotions in this group of settings.

Six Wilcoxon signed rank tests were run for comparing the arousal scores between the six visual stimuli in two groups; the settings with layout #1 and the settings with layout #2. The three settings with the first design layout (AR2, AR4, AR6 scores) were compared, and the three settings with the second layout were compared with each other (AR1, AR3, AR5 scores). Each comparison was tested using different number of observations because not all participants completed the survey for all visual stimuli. Different respondents left the survey at different levels. See Appendix C for each group's demographic information. The groups included mostly white, female participants from the department of DHE. The ages of the participants ranged between 18 years and 51 years, and majority of the respondents in each group (85%) were younger than 25 years old.

Table 12: Wilcoxon test results for comparing arousal (AR) scores between different forms.

	AR variables	Forms	Relationship btw their mean values	N	Z score	P value
Layout #1	AR2 - AR4	R vs. C	AR2 < AR4	111	-4.33	0.0000**
	AR2 - AR6	R vs. B	AR2 < AR6	106	-2.66	0.008**
	AR4 - AR6	C vs. B	AR4 > AR6	105	1.96	0.051
Layout #2	AR1 - AR3	B vs. C	AR1 < AR3	117	-5.38	0.0000**
	AR1 - AR5	B vs. R	AR1 < AR5	107	-6.42	0.0000**
	AR3 - AR5	C vs. R	AR3 < AR5	107	-3.01	0.0027**

* p value < 0.05; ** p -value < 0.01 ; N=number of observations

The Wilcoxon signed rank tests revealed that among the visual stimuli with the first design layout, the AR4 scores were significantly higher than the AR2 ($z = -4.3$; $p < 0.01$) scores. The Type C setting received significantly higher arousal scores than the Type R setting in this group. The Type B setting also received significantly higher AR scores (AR6) than the Type R setting (AR2) ($z = -2.66$; $p < 0.01$). Finally, there was no significant differences between the Type C and the Type B arousal scores ($z = 1.96$; $p > 0.05$). The Type C and the Type B settings triggered significantly more arousing emotions than the Type R setting in this group of settings with the first design layout. The Type R setting significantly elicited the least arousing emotions among all three settings (AR2, AR4, AR6 scores). See Table 12 for the summary test results.

Among the three settings with the second design layout the Type R setting received the highest mean AR score (AR5, $M = -0.67$). The Type C setting had the second highest mean AR score (AR3, $M = -1.12$), and the Type B setting had the lowest mean AR score (AR1, $M = -1.9$). The Type R setting received significantly higher AR scores than the Type B setting ($z = -6.42$; $p < 0.001$) and the Type C setting ($z = -3.00$; $p < 0.01$). The Type C setting significantly elicited more arousing emotions than the Type B setting ($z = -5.38$; $p < 0.001$). In contrast to expectations, the rectilinear setting with the second design layout significantly provided the highest arousal values in this group. The Type B setting with the second design layout significantly triggered the least arousing emotions in respondents.

To sum up, the arousal responses were inconsistent in the data. The Type C setting was significantly more arousing than the Type R setting with layout 1, and it was vice versa for the settings with layout 2. Curvilinearity didn't provide higher amounts of arousal as expected in both groups of settings. Similarly, the results between the Type B and the Type R settings were inconsistent between the two groups of settings with the different layouts. The former with layout 1 was significantly more arousing than the latter as expected. However, the latter with layout 2 was significantly more arousing than the latter. The hypotheses about the rectilinear lines eliciting the least arousing emotions among all types of forms were not supported consistently in both groups of settings. It is believed that the furniture style and layout, and limitations of the instrument influenced the results.

Approach – avoidance behavior

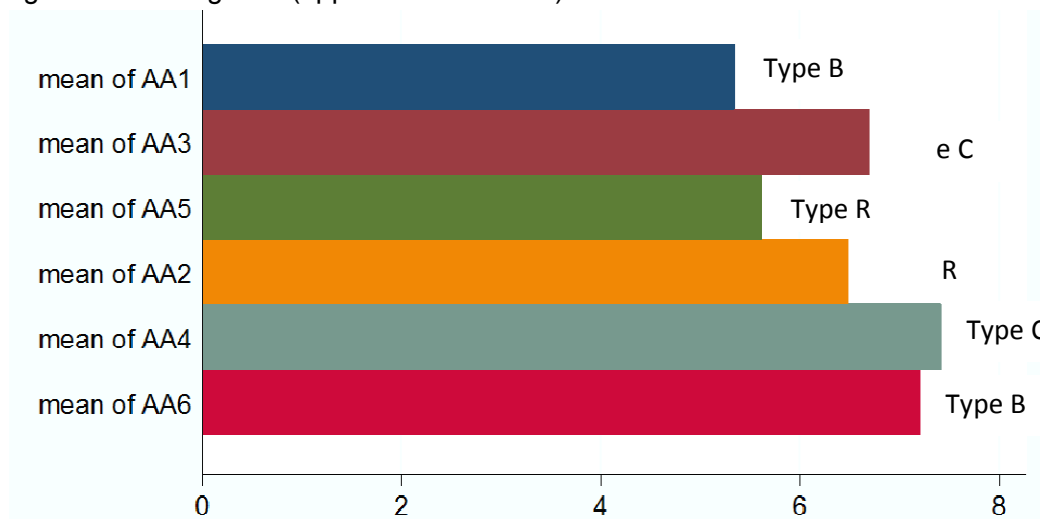
The approach-avoidance (AA) scores were compared between the three types of settings with the three different form types (Type C, Type R, and Type B settings) using mean and standard deviation values, and Wilcoxon signed rank tests. Table 13 shows the mean AA scores for each visual stimulus. The AA scores ranged between “3” and “15” on the scales. The collected mean AA responses ranged between “3” and “14” among the six visual stimuli. All of the AA mean and standard deviation values differed from each other. The highest AA scores were obtained from the Type C settings regardless of their layouts. AA3 ($M = 6.7$) and AA4 ($M = 7.4$) were the highest approach-avoidance scores among all six mean AA scores, AA4 being the highest value. Settings with layout #1 received higher AA scores than the settings with layout #2.

Table 13: Mean approach-avoidance (AA) scores.

	Variable	Obs	Mean	Std. Dev.	Min	Max
Layout#2	AA1 (Type B)	140	5.343	1.896	3	11
	AA3 (Type C)	116	6.690	2.733	3	13
	AA5 (Type R)	107	5.617	2.557	3	13
Layout#1	AA2 (Type R)	120	6.475	2.188	3	12
	AA4 (Type C)	111	7.414	2.940	3	14
	AA6 (Type B)	106	7.198	2.631	3	14

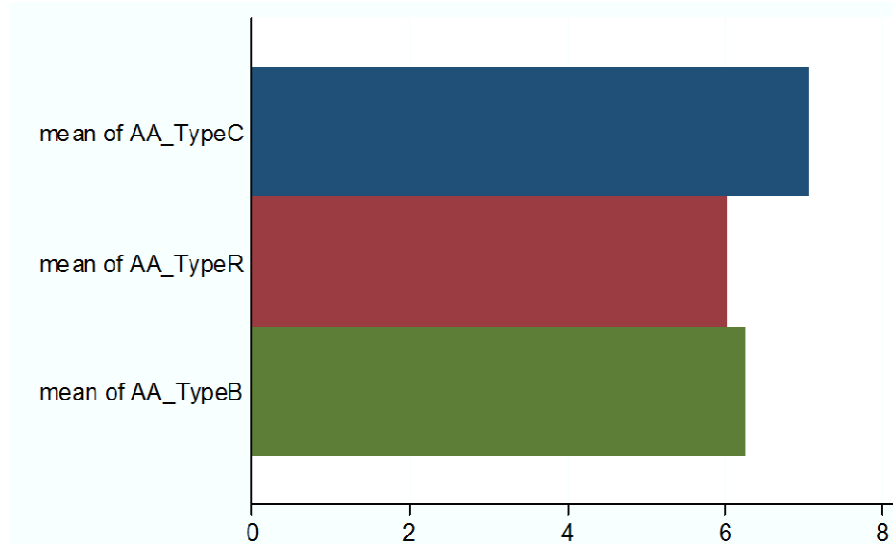
Note: The bolded values show the highest mean AA scores in each category.

Figure 15: Average AA (approach-avoidance) scores for each visual stimulus.



The Type R setting received the lowest AA value (AA2, $M = 6.5$) among the settings with layout #1, and the Type B setting received the lowest AA value (AA1, $M = 5.3$) among the settings with layout #2. AA1 was the lowest AA score among all six mean values. As expected, in both groups of settings with different layouts the Type C settings (AA3, AA4) received higher AA scores than the Type R settings. This supported the hypotheses that people approach curvilinear lines more than they approach rectilinear lines. On the other hand, the results were inconsistent for the relationship between Type B and Type R settings' AA scores. The Type B setting (AA6) with the layout #1 received higher AA scores than did the Type R setting. The same pattern wasn't observed among the settings with layout #2: the Type B setting (AA1) received a lower AA score than the Type R setting (AA5).

Figure 16: Combined approach-avoidance (AA) scores for Type C, Type R, and Type B settings.



Six Wilcoxon signed rank tests were run for comparing AA scores between the six visual stimuli in two groups; settings with layout #1 and settings with layout #2. Three settings with the first design layout (AA2, AA4, AA6) were contrasted and three settings with the second layout were contrasted (AA1, AA3, AA5). Each comparison was tested using different number of observations because not all participants completed the survey for all visual stimuli. See Appendix C for each group's demographic information. The groups included mostly white, female participants. The ages of the participants ranged between 18 years and 51 years and majority of the respondents in each group (85%) were younger than 25 years old.

In regard to three different types of settings with the first design layout, test results revealed that the AA4 scores were significantly higher than the AA2 scores ($z = -3.60$, $p < 0.001$); the AA6 scores were significantly higher than the AA2 scores ($z = -3.7$; $p < 0.001$); and the AA4 scores were not significantly higher than the AA6 scores ($z = 0.88$; $p > 0.05$). In regard to the three different types of settings with the second design layout, the AA3 scores were significantly higher than the AA5 scores ($z = 2.97$; $p < 0.01$). The AA5 scores were not significantly different than the AA5 scores ($z = -1.19$; $p > 0.05$). Finally, the AA3 scores were significantly higher than the AA1 scores ($z = -5.68$; $p < 0.001$). See Table 14 for summary test results.

Table 14: Wilcoxon test results for comparing each setting's approach-avoidance (AA) scores.

	AA Variables	Forms	Relationship btw their mean values	N	Z score	P value
Layout #1	AA2 - AA4	R vs. C	AA2 < AA4	109	-3.59	0.0003**
	AA2 - AA6	R vs. B	AA2 < AA6	104	-3.69	0.0002**
	AA4 - AA6	C vs. B	AA4 > AA6	105-	0.88	0.3808
Layout # 2	AA1 - AA3	B vs. C	AA1 < AA3	116	-5.68	0.0000**
	AA1 - AA5	B vs. R	AA1 < AA5	107	-1.19	0.2344
	AA3 - AA5	C vs. R	AA3 > AA5	106	2.97	0.0030**

* p value < 0.05; ** p -value < 0.01 ; N=number of observations

To sum up, the results only supported that people desired to approach the settings with only curvilinear lines more compared to the settings with only rectilinear lines. There were no consistent results about the relationship between the settings with a combination of rectilinear and curvilinear lines and the settings with only rectilinear lines. However, the results corresponded with the findings from pleasure and arousal responses. The C settings were the only settings that consistently received higher pleasure scores than the Type R settings. Accordingly, they also received higher AA scores compared to the Type R settings.

Relationship between Approach-Avoidance Behavior and Emotional Responses

Literature suggests emotional responses influence approach-avoidance behavior towards that setting (Mehrabian & Russell, 1977). Pleasure and arousal are independent of each other. They determine overall emotional response towards a setting. Thus, Spearman correlation tests were run to examine the relationship between approach – avoidance (AA)

responses and pleasure (PL) responses, and the relationship between AA and arousal (AR) responses. See Table 15 for summary of correlation test results.

According to Table 15, all pleasure scores, regardless of form type and design layout, have positive relationships with approach avoidance scores. Similarly, all arousal scores, regardless of their form type and design layout, have positive relationships with approach avoidance scores. All of the arousal and pleasure scores are significantly correlated with approach avoidance scores. The more the respondents felt pleasant about the settings, the more they intended to approach that setting. Similarly, the more the respondents experienced arousing emotions towards the settings, the more they intended to approach that setting. Among all the correlations, settings #4 (Type C) and #6 (Type B) had strong PL and AR correlations with AA. Settings #2, #3, and #5 had only strong pleasure correlations with AA (See Table 13). The findings support the literature that pleasure and arousal influence the approach avoidance behavior. The findings also support the results from approach-avoidance tests run for this study.

Table 15: Spearman correlations between each setting's approach-avoidance (AA) scores, pleasure (PL), and arousal (AR) scores.

	Variables	Form	N	<i>Rho</i> coefficient	<i>p</i> -value
Layout 1	PL2 – AA2	R	120	0.70	0.0000**
	PL4 – AA4	C	111	0.726	0.0000**
	PL6 - AA6	B	106	0.726	0.0000**
	AR2 - AA2	R	120	0.459	0.0000**
	AR4 - AA4	C	111	0.614	0.0000**
	AR6-AA6	B	106	0.522	0.0000**
Layout 2	PL1 – AA1	B	140	0.446	0.0000**
	PL3- AA3	C	116	0.801	0.0000**
	PL5 - AA5	R	107	0.694	0.0000**
	AR1 - AA1	B	140	0.338	0.0000**
	AR3 - AA3	C	116	0.472	0.0000**
	AR5 - AA5	R	107	0.377	0.0001**

* *p* value < 0.05; ***p*-value < 0.01 ; N=number of observations

The bolded *rho* coefficients refer to the strong relationships between the variables

Circumplex of Emotions

Figure 17 illustrates Russell and Pratt's (1980) circumplex model of emotions applied on environments. Note that there could be slight changes on the placement of the emotion words on the circumplex but the idea that emotions can be categorized according to their level of arousal and pleasantness is fixed in this model. Pleasure (PL) and arousal (AR) scores of a respondent determines (x, y) coordinates of his/her response. Circumplex of emotions showed how each response was marked on the circumplex and how the responses scattered on the circumplex plane. Also overall distributions of the dots on the circumplexes were useful for interpreting the types of emotions each setting or a particular type of setting elicited. There are four basic categories of emotions on the circumplex: pleasant-arousing emotions, pleasant-unarousing emotions, unpleasant-arousing emotions, and unpleasant-unarousing emotions.

Figure 17: Circumplex model of emotions with eight basic axes.

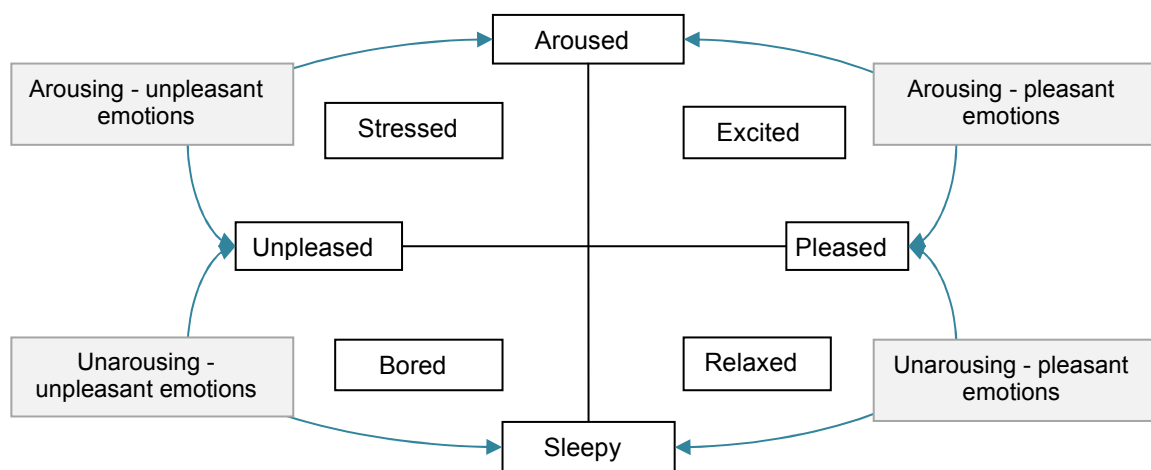


Figure 18 shows circumplexes of emotions applied for each visual stimulus. Although the circumplexes showed that each setting received all varieties of emotional responses scattered on the valance-arousal coordinates, majority of the responses for all of the six settings accumulated on the unpleasant-unarousing emotions. Settings with the layout #1 (settings #1, #3, and #5) had more unpleasant-unarousing emotions compared to the settings with the layout #2 (settings #2, #4, and #6). This indicates that the furniture style and layout influenced the respondents' emotional reactions to the settings.

Among all of the six settings, setting #1 (a Type B setting) had the highest percentage of responses scattered on unpleasant-unarousing emotions. Settings #4 (a Type C setting) and #6 (a Type B setting) had the highest percentage of responses scattered on pleasant-arousing (e.g. excited) emotions. Also, it seems like only setting #4 had slightly more pleasant emotions than unpleasant emotions scattered on circumplex layout. Moreover, setting #5 (a Type R setting) had the highest percentage of responses scattered on unpleasant-arousing (e.g. stressed) emotions. Settings #1 (Type B), #2 (Type R), and #3 (Type C) had the largest percentage of responses scattered on pleasant-unarousing (e.g. relaxed) emotions. Furthermore, settings #1 and #3 had very few emotional responses located on arousing emotions. Finally, setting #4 and setting #6 had more strong pleasant and stronger arousing emotions (scores above 2) compared to the others.

Only 105 out of 142 respondents completed the whole survey and answered all of the questions for all six visual stimuli. Using those 105 responses Figure 19 compared their emotional responses scattered on circumplexes of emotions for combined Type C, Type B, and Type R settings. The Type C emotional responses were calculated by taking average of the two Type C settings' (settings #3 and #4) PL and AR scores. The Type R emotional responses were calculated by taking average of the two Type R settings' (settings #2 and #5) PL and AR scores. Similarly, the Type B emotional responses were calculated by taking average of the two Type B settings' (settings #1 and #6) PL and AR scores.

For all three settings with different forms the emotional responses scattered on the circumplexes on all four areas representing all different types of emotions. The Type C settings elicited the highest amount of pleasant emotions such as exciting and relaxed emotions, and they elicited very few unpleasant-arousing (stressful) emotions. The Type R settings elicited the highest amount of unpleasant-arousing (stressful) emotions, although it was a small percentage. Moreover, the Type B settings received the lowest amount of arousing emotions. Also, the Type C and the Type B settings received the highest amount of pleasant-unarousing (relaxed) emotions. Lastly, the Type R settings had the highest number of average pleasure and arousal responses that were lower than "-2". In other words, the Type R settings triggered the strongest unpleasant and strongest unarousing emotions in people in average. In contrast, the Type C settings had the lowest number of arousal and pleasure responses that were lower than "-2".

Figure 18: Circumplexes of emotions for each visual stimulus.

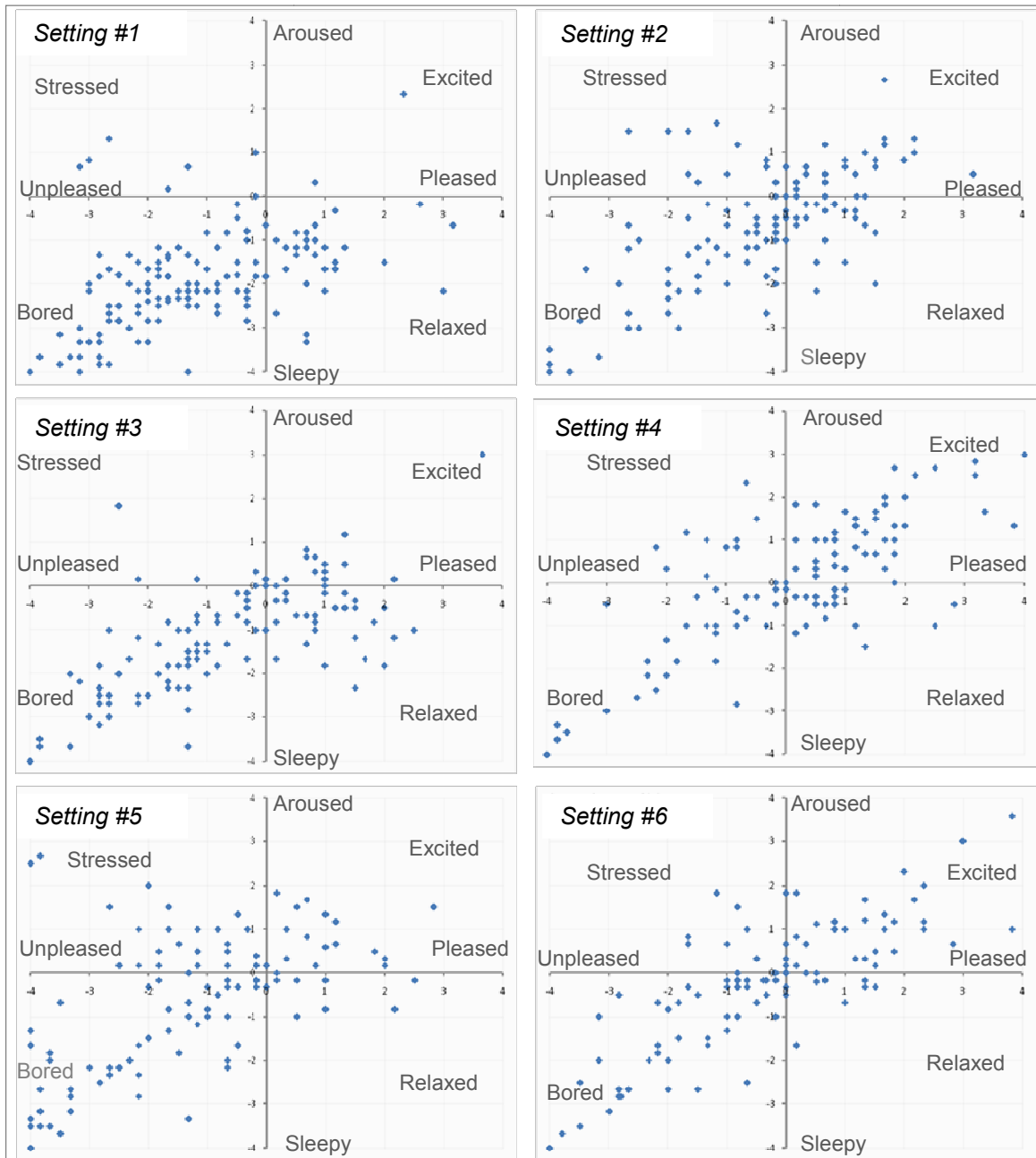
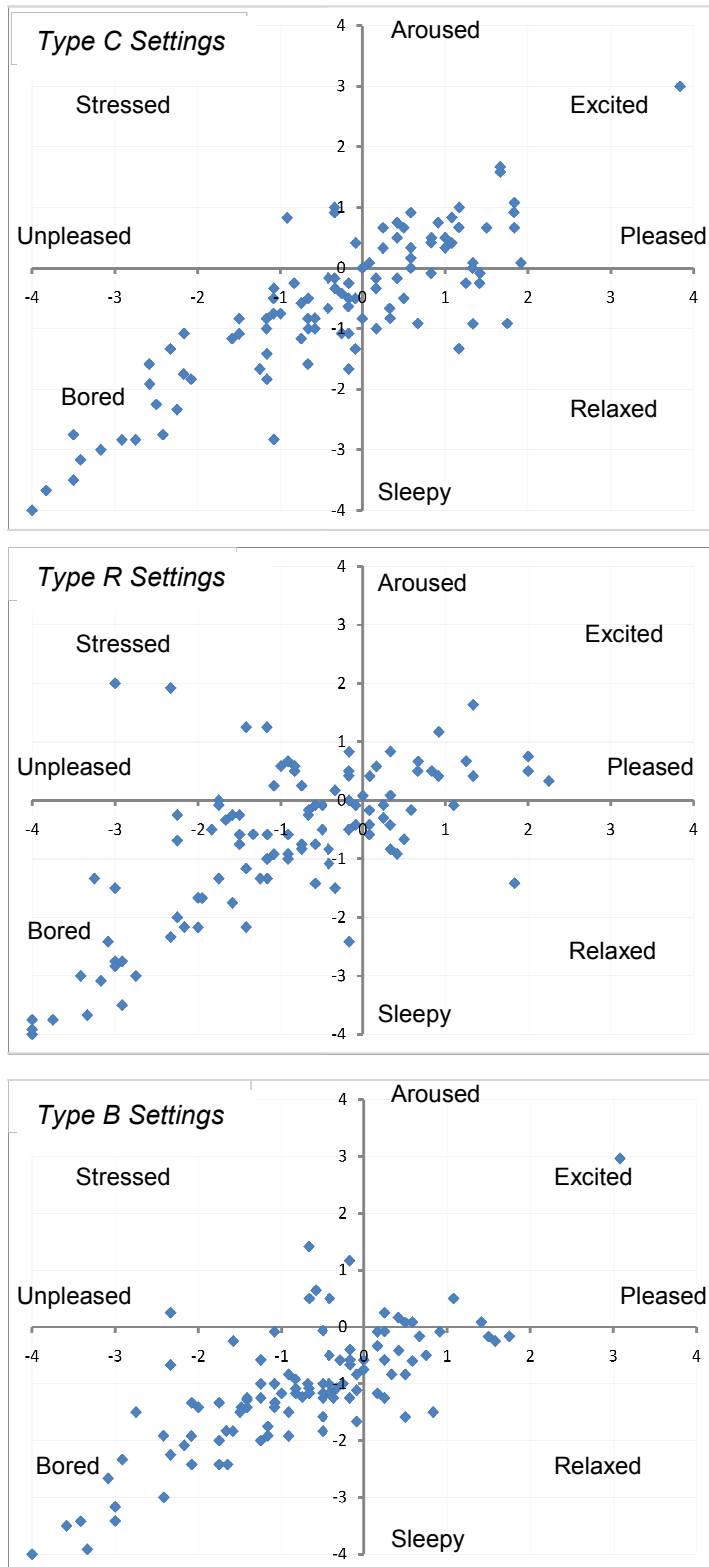


Figure 19: Circumplexes of emotions for combined Type C, Type R, and Type B settings.



Qualitative Responses

Each visual stimulus had two open-ended questions. The open ended questions were optional, and 116 (82%) out of 142 respondents answered those optional open-ended questions for at least one of the visual stimulus. The settings used as visual stimuli for this study received low mean pleasure (PL) and (AR) scores, and the distribution of the responses on circumplexes mostly scattered on unpleasant-unarousing emotions. Qualitative responses provided insight to explain the possible reasons for the negative emotional responses elicited by the settings. Many of the respondents mentioned their dislikes of the setting due to their grayscale and plain characteristics. Table 16 includes some of the responses provided for the two open-ended questions.

Table 16: Qualitative responses about general negative attributes of the settings.

Question: Is there any other feelings/emotions that you'd like to describe about this interior setting?

- “I think I would feel a little trapped in such plain surroundings”
 - “Uninspired to accomplish any tasks in the room however, I feel inspired to change it.”
 - “Very Plain”
 - “This seems like a very traditional setting, icon 1950/60/s household. I do think it's pretty boring overall.”
 - “I noticed that I tried to visualize it in color.”
 - “feels like a doctor's office”
 - “Very clean and minimalistic. It doesn't really inspire any emotion on either end. Keeps me feeling neutral”.
-

Question: What have you liked/disliked about this room? Please explain.

- “I dislike the bland atmosphere. It is not merely simplistic; it is devoid of character or charisma.”
- “There isn't much to the room. It's just very basic and uninteresting.
- “Disliked -- It looks like a waiting room for a doctor or dentist. Liked -- If bright colors and goofy knickknacks were used it would make a nice retro sitting room.”
- “The layout is nice and standard, but I think the lack of color in the drawing is making me disinterested...”
- “I like how it's clean and simple but don't like how it's got next to nothing in it...”
- “The room is very plain and uninteresting. There is no artwork on the walls to give the room any character or individuality. However, the room does seem open and spacious with the furniture shown.”
- “I disliked the fact that the walls and furnishings are bare...provide no topic for conversations. The room is only about function for sitting and nothing else.”
- “I like how sleek it is however, it's boring because of the color. It doesn't interest me at all other then, "oh, that's nice.”

The negative responses towards the simulated settings were expected due to their lack of ornamentation and decoration such as absence of artwork and context. There was no suggested activity in the room such as reading, watching TV or eating. The settings were designed in this way in order to control the influence of above variables on results. Even though the reactions to settings were negative, it was still possible to compare their emotional responses and find significant results. For example, the Type C settings were rated significantly and consistently as more pleasant than the Type R settings.

The qualitative responses also provided some insight on how specifically the respondents reacted to different form styles and furniture layouts or why they reacted toward the Type C settings positively. Table 17 lists some of the qualitative responses that explain how furniture style and layout influenced the results. Also, Table 18 lists some of the responses that explain how students reacted towards different form types.

Table 17: Qualitative responses about the furniture styles.

ID98: "Again I enjoy the open feeling of the furniture created through the hollow ends."
ID81: "This seems like a very traditional setting, icon 1950/60/s household. I do think it's pretty boring overall."
ID95: "...I dislike that the sofa and chair look hard and uncomfortable. However, the rounded furniture edges seem to make up for the hard surfaces, giving the illusion of comfort."
ID99: "furniture is too tall...overpowering, makes me feel meek."
ID11: "...I like the tall lamp in the corner as well."
ID15: "I liked the open areas in the furniture."
ID20: "The contemporary furniture is more appealing than the previous room."
ID30: "I like the furniture. It looks interesting."
ID94: "I really like the furniture. It looks new wave which means it looks trendy. It looks like a fun place to hang out."

Table 18: Qualitative responses categorized under different form types.

Comments about the Type C settings

Positive comments

ID35: "I initially felt intrigued at the continuous shapes"
ID56: "I like how the furniture is oval-ish... I find it a lot more playful. ..."
ID51: "I like the rounded shapes. They make the furniture look comfortable and inviting like I could lay on the couch and read for several hours."
ID94: "...The furniture looks more inviting. ...rather than boxy and boring looking."
ID95: "I like the rounded... The space is both calming and interesting...However, the rounded furniture edges seem to make up for the hard surfaces, giving the illusion of comfort."
ID11: "The calming affect it has. The rounded furniture seems to give off that feel."

(Table 18 Continued)

Negative comments

ID101: "I disliked that all the furniture shared the basic round shape."

ID108: "I like the shape better than the same furniture that was more round"

Comments about the Type R settings

Positive comments

ID90: "I like how the furniture is all squared."

ID95: "I like that the furniture line types are all angular. This makes the room cohesive."

Negative comments

ID35: "I don't like the rigid, jagged nature of the furniture ...All of the corners suggest many moments of pain as people bumped elbows, toes and shins."

ID98: "...I don't like the way everything is still square."

ID101: "Disliked the box shaped feel of the furniture."

ID109: "I dislike the square designs of the furniture."

ID30: "The seating furniture looks very uncomfortable..."

ID32: "The squariness & corners on the furniture are very disagreeable."

Comments about the Type B settings

Positive comments

ID 46: "I like the combination of rounded and angular shapes. Makes it interesting even though the room is plain and simple..."

ID101: "I liked that the furniture varied in style/shape."

ID98: "I like the combination of circular and square shapes."

ID15: "I like the contradiction between the sharp angles of the couch and chairs contrasted with the roundness of the table and rug."

ID20: "I like the contrast between the rounded furniture and the square furnishings."

Negative comments

ID98: "I like ... how there is a little differentiation in shapes. I still do not enjoy the similarity of every object in the room."

ID94: "I don't like the mixture between square and round. I think it looks like the decorator tried to make the room look new wave, but failed. The furniture doesn't blend well together."

ID109: "I dislike the circular table mixed with the rectangular furniture."

ID111: "Dislike the mixture of circular and squared off furniture"

According to those qualitative responses, the Type C settings triggered feelings of calmness, comfort, fun, excitement, and being welcomed; the Type R settings evoked dislike, discomfort, and feeling of danger (possibility of injuring one's self with sharp edges); the Type B settings were interesting, modern, and they had a nice contrast or lacked continuity in the setting. Continuity or repetition of form was also mentioned for the Type C and the Type R settings as both negative and positive remarks.

In conclusion, there were variety of negative and positive comments about each particular setting. Some of them were related to the form of the furniture in the simulated settings. There were contrasting comments by different respondents on the very same form types. This showed the subjectivity of aesthetic emotions or aesthetic appraisal. However, the majority of the comments on form favored the Type C settings, and this corresponded with the data findings of this study and the previous research found in the literature.

This chapter reported the data analyses results. The results were reported in different sections in regard to their content and aims of analysis. The next chapter discussed the results, limitations of the study, and implications on further research.

CHAPTER 5: DISCUSSION AND CONCLUSION

In this chapter, the results of the study are summarized and interpreted for the pleasure, arousal, and approach-avoidance scales. This is followed by a summary and interpretation of the findings for the circumplex of emotions. Additionally, limitations, implications, and recommendations for further study are presented.

Discussion and Summary of the Results

Pleasure, arousal, and approach avoidance responses were compared between the settings with three different form types: the settings with only curvilinear lines, the settings with only rectilinear lines, and the settings with both curvilinear and rectilinear lines. Six visual stimuli were used for measuring emotional responses triggered by those three form types. Two different furniture styles and layouts were depicted on the simulated interior settings in order to increase the reliability of the results. Except from the arousal responses collected for the settings with rectilinear lines, the significant p -values obtained by Wilcoxon signed rank tests revealed that the results significantly differed between the two groups of settings with different furniture styles and layouts. For this reason, responses were compared separately for the settings with the different layouts. This provided testing the below hypotheses twice and seek consistent results in order to make conclusions.

The hypotheses for this study were:

1. The settings with only curvilinear lines/forms would elicit more pleasant emotions than would the settings with only rectilinear lines.
2. The settings with only curvilinear lines would elicit more arousing emotions than would the settings with only rectilinear forms.
3. People would approach the settings with only curvilinear forms more compared to the settings with only rectilinear forms.
4. The settings with a combination of curvilinear and rectilinear forms would evoke more pleasant emotions in people than would the settings with only rectilinear forms.
5. The settings with a combination of curvilinear and rectilinear forms would elicit more arousing emotions than would the settings with only rectilinear forms.
6. People would approach the settings with a combination of curvilinear and rectilinear lines more compared to the settings with only rectilinear lines.

Pleasure

Pleasure responses were compared between the settings with different form types. Hypotheses 1 was supported based on the significant p -values from the Wilcoxon signed rank tests: In both groups of settings (settings with the same furniture style and layout were grouped together), the settings with only curvilinear lines elicited more pleasant emotions than did the settings with only rectilinear lines. The settings with only curvilinear forms were also found more pleasant than were the settings with a combination of curvilinear and rectilinear forms. In other words, curvilinear forms triggered the most pleasant emotion in this study. Different furniture styles and layouts didn't influence the pleasure responses triggered by the curvilinear lines.

Those findings supported the literature about curvilinearity and its positive emotional effects on people. The responses shown on circumplexes for each setting also supported hypothesis 1: Settings with only curvilinear lines elicited the highest amount of pleasant-arousing emotions such as excitement, elation, and happiness compared to the rest of the settings. Furthermore, qualitative responses supported that the respondents liked the furniture with the curvilinear lines more compared to the furniture with rectilinear lines. Those findings indicated that designing settings with curvilinear lines would evoke pleasant emotions in its inhabitants.

Such findings could be applied on a variety of settings. For example, curvilinear lines can be used in design of commercial settings to promote pleasant emotions. Health care and work environments, where the inhabitants would be suffering from feelings of depression, desperation or stress, can be designed with curvilinear lines in order to evoke pleasant emotions such as happiness and elation. Moreover, the customers could be attracted to the retail stores or restaurants where they feel happy.

Curvilinearity would also evoke positive emotions through architecture, landscaping, product design, and graphic design. Curvilinear forms in building design or in landscape design would promote feelings of happiness and relaxation. Various types of consumer products (e.g. household appliances, cars, lighting fixtures, purses, kitchenware, cellular phones, cameras, and etc.) with curvilinear lines could also generate positive emotions in users. Use of curvilinear lines in graphic design can be utilized for successful advertisement posters or banners and web designs, and this would result in web users to spend more time

at specific web sites or consumers who remember a specific advertisement due to its pleasant emotions triggered by its curvilinear graphics.

Hypothesis 4 was not supported based on the insignificant p -values from the Wilcoxon signed rank tests. Although there was no direct support for this hypothesis in the literature, it was assumed that the settings with a combination of curvilinear and rectilinear lines would elicit more pleasant emotions than would the settings with only rectilinear lines. In contrast to the expectations, the existence of curvilinearity in the former settings didn't trigger more pleasant emotions compared to the latter settings; the emotions triggered by the two were either not significantly different from each other or the setting with rectilinear lines triggered more pleasant emotions than the setting with a combination of rectilinear and curvilinear lines.

There could be two reasons that caused the insignificant and inconsistent results in regard to the test of hypothesis 4. First, limitations of the study might have caused bias in the data. The technical incapability of the instrument to provide random order of appearances for the visual stimuli might have influenced the results. Pleasure, arousal, approach avoidance, qualitative responses, and circumplexes all support that the first setting, a setting with both curvilinear and rectilinear lines received a greater amount of negative responses compared to the rest of the stimuli because of its first order of appearance in the survey. Further study is needed in order to examine this. Secondly, some respondents preferred continuity of form in the settings independent of their form types; this might have caused inconsistent results and needs further study as well. If it is assumed that the limitations of the study discussed above didn't influence the results, it could be interpreted that the existence of some curvilinearity in a setting didn't necessarily influence emotional responses; only if the whole setting consistently had curvilinear lines, then it promoted significantly more pleasing emotions than the rectilinear lines did. Therefore, there will likely be more pleasant emotions in spaces if only curvilinear lines used, and use of purely rectilinear lines in spaces should be avoided.

Arousal

When the two settings with the same form type were compared, it was found that the arousal responses elicited by the settings with only curvilinear lines significantly differed from each other. It also differed between the two settings with a combination of curvilinear and rectilinear lines. Different furniture styles and layouts influenced the arousal responses

towards the curvilinear lines. On the contrary, furniture style and layout didn't significantly influence the arousing emotions evoked by the settings with only rectilinear lines. No explanation was found in the literature about those findings. It could be interpreted that the relationship between curvilinearity and arousal was influenced by the furniture style and layout unlike the relationship between arousal and rectilinear lines. As a result, it was not possible to interpret how curvilinearity of furniture would influence stimulating feelings in interiors, and it was not possible to suggest that the use of curvilinear lines would promote high or low levels of stimulating emotions in people based on the study findings.

Arousal responses were compared between the settings with different form types. Hypothesis 2 was not supported based on the insignificant *p*-values from the Wilcoxon signed rank tests. The settings with only curvilinear lines were not found consistently more arousing than the settings with only rectilinear lines. It was assumed that those two types of settings had similar amount of variety in regard to their design attributes such as with their furniture count and style, colors, texture, amount and type of decoration, and etc. There were indirect implications in the literature about curvilinearity and arousal. The literature suggested that increase in curvilinearity caused increase in complexity (Hopkins et al., 1976; Madani Nejad, 2007) and suggested motion (Koenig, 2006). For this reason, it was theorized that the settings with only curvilinear lines would provide more stimulation, and evoke more arousing emotions in people compared to the settings with only rectilinear lines. However, there was no consistent evidence in the data to support this proposition. Inconsistent results were found between the groups of settings that had different furniture layouts and styles. Accordingly, layout and furniture style might have influenced the arousal responses towards curvilinear versus rectilinear lines, and this needs further investigation.

The findings also indicated that it is not possible to make suggestions about how one of the two (curvilinear versus rectilinear) form types should be applied to the settings to create stimulation in the environment. It was hypothesized that settings that people engage in high levels of activity such as the children's play grounds, sports centers, and dance halls could use curvilinear lines because curvilinear lines would stimulate them by eliciting arousing emotions in those environments. However, the inconsistent findings in the data indicated that it was not possible to make such suggestions about how one of the two (curvilinear versus rectilinear) form types should be applied to the settings to increase arousing emotions.

Hypothesis 5 was also not supported based on the insignificant p -values from the Wilcoxon signed rank tests. The settings with a combination of rectilinear and curvilinear lines were not found consistently more arousing than the settings with only rectilinear lines. Based on the same literature findings discussed about the hypothesis 2, it was expected that the existence of curvilinear forms would evoke more arousing or stimulating emotions towards the settings with both rectilinear and curvilinear lines compared to the settings with only rectilinear lines. Apart from the existence or absence of curvilinearity in the two types of settings, it was also proposed that the former would provide more stimulation through variation of form. The latter had the same repeating type of lines (straight) throughout the settings (Note that the simulated settings used in this study had plain, grayscale environments with no patterns, no organic forms, and no diagonal lines). As a result, it was expected that this great amount of sameness due to lack of variety of form and lack of curvilinearity in “the settings with only rectilinear lines” would evoke a greater amount of unpleasant emotions in people compared to the settings with a combination of rectilinear and curvilinear forms. However, findings of the study didn’t support this hypothesis. There were inconsistent results in the data. Hypothesis 5 was also only supported for the settings with a specific type of layout and furniture style.

One of the reasons for inconsistent results would be that the first setting, a setting with both curvilinear and rectilinear lines, received a greater amount of negative responses compared to the rest of the stimuli because of its first order of appearance in the survey. Further study is needed in order to examine this. If it is assumed that the limitations of the study discussed above didn’t cause bias in the data, it could be interpreted that the variety of form in a setting didn’t necessarily influence emotional responses.

Approach - avoidance behavior

Approach-avoidance scores were compared between the settings with three different form types. The responses were also compared between the pairs of settings with the same form type. It was found that different furniture styles and layouts didn’t significantly affect approach avoidance responses towards the same form type.

Hypothesis 3 was supported based on the significant p -values obtained from the Wilcoxon signed rank tests. People desired to approach to the settings with only curvilinear lines more compared to the settings with only rectilinear lines. These findings also corresponded with hypothesis 1 and supported the literature (Russell & Mehrabian, 1977)

that people approach pleasant settings more. Such findings can be utilized to design various interior and exterior environments. For example, design of retail stores or restaurants with curvilinear lines would attract customers, and possibly influence them to spend more time in the settings compared to the settings with rectilinear lines. Also, common areas in assisted living facilities or dormitories can be designed with curvilinear lines so, people would be encouraged to spend more time together, and feel comfortable engaging with others.

Hypothesis 6 was not supported based on the insignificant p -values obtained by the Wilcoxon signed rank tests. The respondents didn't consistently desire to approach the settings with a combination of curvilinear and rectilinear lines more compared to the settings with only rectilinear lines. The reason for the inconsistent findings could be due to the influence of different furniture style and layout applied to the settings with the same form type. Accordingly, based on the findings it is not possible to suggest that a combination of curvilinear and rectilinear lines would attract more people to a specific setting, make them feel friendlier, and make them spend more time in the setting compared to the rectilinear lines.

Those findings corresponded with hypotheses 4 and 5; the settings with a combination of curvilinear and rectilinear lines were not consistently more pleasant and arousing compared to the setting with only rectilinear lines. As a result, people did not desire to approach or avoid the former more compared to the latter. The results also supported the literature (Russell & Mehrabian, 1977); if those settings didn't trigger different emotional responses in people, it is not possible to say people would approach one of them more compared to the other because people approach the pleasant settings more.

The relationships between approach avoidance and two components of emotional response (pleasure and arousal) were analyzed using spearman correlation tests. The results indicated that there were consistently significant associations between pleasure and approach avoidance. Similarly, there were consistently significant associations between arousal and approach avoidance. Those findings supported Russell and Mehrabian's (1977) study on approach avoidance behavior and emotional reactions towards places. People approach pleasant and arousing places. Pleasant and stimulating settings would attract people and make them spend much time in those settings; they would feel welcomed and friendly in such places. As discussed earlier, such finding can be applied on a variety of settings, and it would also be applied in architecture, landscape design, product design, and graphic design fields.

In summary, the pleasure, arousal, and approach-avoidance results discussed above only supported hypotheses 1 and 3: the settings with only curvilinear lines significantly elicited the most pleasant emotions among all settings. As expected, people desired to approach those settings the most in all cases. However, those settings didn't evoke more arousing emotions in people compared to the settings with only rectilinear lines. Also, the difference between pleasure, arousal, and approach avoidance responses were not found consistent between the settings with only rectilinear lines and the settings with both curvilinear and rectilinear lines. The results were inconsistent in data. The latter settings didn't evoke more pleasant and more arousing emotions in people compared to the former settings as expected. As a result, the latter settings also didn't receive higher approach avoidance scores than did the former settings.

Circumplex of Emotions

The circumplexes of emotions helped predict the type of emotions a particular setting evoked in people in more detail. The circumplexes also supported that the responses for each setting were generally negative. The negative responses were expected due to the plain and grayscale nature of the visual stimuli. Despite the general negative reactions towards the simulated settings, it was still possible to compare the settings with different form types. The circumplexes also supported that the settings with a specific furniture style and layout received more negative responses compared to the other type. Those findings supported that furniture design and layout influenced how people react to different form types.

The distribution of emotional responses on circumplexes also showed that setting #1 had dominantly negative responses accumulated on unarousing-unpleasant emotions such as feelings of depression, boredom, and sadness. This supported that either this setting was very unarousing and unpleasant due to its qualities that separated it from the rest of the settings or its order of appearance as the first image in the survey caused a high amount of negative responses towards it. The analysis of qualitative responses supported that the first visual stimulus had the highest amount of negative comments, and the majority of the comments referred to the plain and grayscale nature of the setting, which were common characteristics of all settings used in the study. Thus, it can be interpreted that the participants showed their first and greatest amount of negative reactions to the first setting they encountered in the survey, and as they proceeded to the other simulated settings they

became familiar with the plain and grayscale characteristics of the settings. Use of a dummy visual stimulus as the first one could have avoided such bias.

The layout on the circumplexes clearly supported that the settings with only curvilinear lines received the highest amount of pleasant and arousing emotional responses such as excitement, elation, happiness, feeling calm or relaxed. This corresponded with the hypotheses 1 and 2, and supported the literature on curvilinearity and emotions. Those findings also supported Papanek's (1995) statements that curved shapes of internal spaces invoke feelings of "joy ... and well-being" (p.229). Circumplexes didn't support hypotheses 4 and 5. The settings with a combination of rectilinear and curvilinear lines received higher numbers of depressing and boring emotions than did the settings with only rectilinear lines.

Limitations

It was not possible to measure emotions objectively and in full context because emotions are very short term and subjective states, and emotion is a complex multidimensional concept. Also, use of verbal scales might have caused bias in the results. Respondents' immediate emotional responses might have disappeared until they marked their responses on the scales, and they might not have remembered their first emotional responses correctly. The participants were encouraged to provide their gut reactions towards the visual stimuli with the use of instructions but the open-ended responses revealed that the respondents were highly influenced by their cognitions in regard to judging the settings in terms of their functionality, design characteristics, and purpose of use.

Another important limitation of this study was the absence of a context while evaluating the settings. Many of the respondents expressed their effort to evaluate the function of the place as an office, as a waiting room or as a living room. The purpose of not assigning a context of use for the settings was avoiding pragmatic emotional responses and gathering hedonic and aesthetics related emotional responses, which mostly depend on gut reactions.

There were limitations on sample characteristics. The majority of the respondents were females and between the ages of 18 and 24. This limits the generalizability of the findings. Participation of more male respondents would have been preferred. Youngstrom and Green (2003) explained that women tend to express higher or more positive levels of emotional responses compared to men. However, the statistical analysis between men and women indicated no significant differences in this study in regard to their emotional responses.

The fact that the respondents were design and art students might have also encouraged them to evaluate the success of the designed settings using their design knowledge rather than using their gut reactions. Studies between people and their near environments are complex. The researcher tried to control as many variables as possible in this study by using grayscale and plain environments with no suggested activity in the settings. The negative attributes of the settings resulted in low pleasure, arousal, and approach avoidance scores for all visual stimuli but it was still possible to compare the settings with each other because they all shared the same negative attributes mentioned above.

It was not possible to control under which conditions or in what type of environments the respondents completed the survey. Their surroundings might have influenced their emotional reactions throughout the survey. People might have had specific tendencies to report their emotions. It was not possible to control participants' mood during the survey, and mood affects emotional states. Fortunato (2004) found that respondents who have a tendency toward negative emotional responses also tend to report a larger number of negative responses. In order to examine such a bias the subjects were asked about their emotional states before taking the survey. Although the majority of the respondents identified their emotional states before starting the survey as "good", some significant differences were found in regard to emotional responses between the participants who felt good versus bad. Students who felt "good" scored higher or more positive emotional responses compared to the students with poor emotional states. However, such influences were not found consistently between the two groups in the data.

Implications on Further Research

Additional studies can be conducted on this topic in various ways. This study can be repeated with a sample of students from different majors rather than only design and art students, and the results for the two samples can be compared. More male respondents could be added in the sample, and the results can be compared between males and females. This study can also be repeated for different age groups. For example, seniors' emotional reactions would be measured towards different form types, and the findings can be applied on assisted living facilities.

As the grayscale and computer modeled settings used in this study didn't provide realistic impressions of actual settings according to some of the participants, pictures of

actual settings would provide more accurate results in a simulation study because the actual settings would provide a more realistic impression of the environment. If a simulation method is to be used, the use of online surveys should be avoided. If the surveys are completed under researcher's supervision, the researcher can make sure that the respondents only looked at the pictures of the settings for a limited and equal amount of time. This would be helpful for collecting gut reactions via survey rather than the pragmatic emotional responses that utilizes mainly cognitive processes. Also, environmental effects on responses could be controlled if all the respondents complete the survey in the same room assigned by the researcher.

This study can be repeated by assigning context to the visual stimuli. For example, various commercial settings can be tested including retail stores, restaurants, cafes, dormitories, assisted living facilities, office environments, schools, museums, hospitals, hotels, and etc. The study can also be conducted for residential settings. Thus, the relationship between form, emotions, and approach-avoidance behavior can be investigated for different environments and the findings can be used for designing pleasant and welcoming settings.

This study can also be conducted in different design fields such as architecture, graphic design, landscape design, apparel design, and product design. The relationship between curvilinearity and pleasant emotions can be tested in those fields as well. However, a different instrument needs to be developed for such studies because the current instrument was designed specifically for interiors. The influence of curvilinearity on human-environment relationship can also be investigated in other contexts rather than emotions. For example, other affective states or behavior patterns could be examined. The influence of different form types on mental illnesses, way finding, work efficiency, place meaning, and etc. can be investigated.

Finally, this study utilized geometric forms, and avoided the use of diagonal lines and organic forms in the simulated settings. The relationship between other form types that were not included in this study and their emotional influences can also be investigated in future studies. Furthermore, influence of other physical attributes of the artifacts or environments such as their colors, spatial configurations, textures, and decoration on emotions can be studied. How those other physical attributes influence the relationship between forms and emotions can also be investigated.

Concluding Remarks

Emotions influence the way people react to, affiliate, approach and avoid their near environments. Russell's circumplex of emotions model (1980) and Mehrabian and Russell's (1974, 1977) study on emotional responses toward places and approach avoidance behavior were applied in this study in a more specific context: Emotional effect of curvilinear vs. rectilinear forms of furniture in enclosed simulated settings were compared and discussed. Findings from this study supported the literature on form and human emotions; curvilinear forms elicited more positive emotions than did rectilinear forms. Participant responses reflected a tendency or desire to approach the pleasant settings more compared to the unpleasant settings. The greater the pleasantness was, the longer participants wanted to stay in those settings and the more they affiliated with others in those settings. Accordingly, participants desired to spend more time in the settings with only curvilinear lines, and they affiliated with others more in those settings compared to the settings with only rectilinear lines.

No consistent results were found in regard to arousal responses and the responses elicited towards the settings with a combination of curvilinear and rectilinear lines. Further study is needed to re-test them because the results might have been influenced by the limitations of this study. As a result, it was not possible to suggest whether a specific type of form would create more arousing or stimulating emotions in people compared to another type of form.

The findings of this study can guide designers to design more welcoming and pleasant environments with the use of curvilinear lines in their designs. The use of curvilinear lines creates positive emotions in people, and they approach those settings more and engage with other people in those settings more. For those reasons, curvilinear forms would especially work in environments where social interactions between the inhabitants are desired or where people are desired to spend much time. This could be a more welcoming retail store where the customers feel pleasant and welcomed and spend more time shopping. This could also be an office environment where the employers are required to spend long work hours because curvilinear lines can possibly reduce work related stress by promoting pleasant feelings in the space. In conclusion, this study has demonstrated that the curvilinear forms/lines in the environment do influence people's feelings of pleasure in that space. Further research could focus on exterior environments, landscape design, graphic design,

and product design. This study supported the literature and provided foundation for further research on the relationship between people and different form types. Although curvilinear lines evoked more pleasing emotions in people compared to rectilinear lines in this study, other form types should also be investigated in order to learn more about their influences on people.

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APPENDICES

APPENDIX A
QUESTIONNAIRE

Format of the questions as they were shown on the Web are shown below. The first step was the informed consent. Please see Appendix D for the informed consent. The examples below show the sections about the demographic information and the questions about picture #1.

DHE Thesis Survey [Exit](#)

2. Demographic Information

20%

Your name (This is only required if you want to participate in the lottery to win \$50 or if your instructor offers extra credits for completing this survey)

Your ONID email address (This is only required if you want to participate in the lottery to win \$50)

1. What is your major? (e.g. apparel design, interior design, graphic design, etc.)

2. How old are you?

3. Sex

	Male	Female	Other
Gender	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

4. Race

	White	Asian	African American	Hispanic	American Indian	Alaska Native	Native Hawaiian or Other Pacific Islander
Race	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (please specify)							
<input type="text"/>							

5. Please answer the question below.

bad good

How are you feeling right now? ☐ ☐ ☐ ☐ ☐

Other (please specify)

DHE Thesis Survey Exit

3. Image 1

30%

Please answer the following six questions according to the image shown below. The images are in grayscale and computer drafted portraying simple sections of interior settings.

You should respond quickly, without thinking too much about your answers/emotional states. Your gut reactions are important for this survey.

You won't be able to turn back once you proceed to the next page.

After completing this page, you will be shown 5 more pictures like this one and you will be asked to answer the same 6 questions for each of them.

1. There are 12 scales below this grayscale computer drafted image. Please quickly mark your emotional responses elicited by this interior setting on each scale.



1.1

Annoyed

Pleased

emotional state

**1.2**

Unaroused

Aroused

emotional state

**1.3**

Unhappy

Happy

emotional state

**1.4**

Bored

Relaxed

emotional state

**1.5**

Unsatisfied

Satisfied

emotional state

**1.6**

Calm

Excited

emotional state

**1.7**

Sluggish

Frenzied

emotional state

**1.8**

Dull

Jittery

emotional state

**1.9**

Sleepy

Wide-
awake

emotional state

**1.10**

Melancholic

Contented

emotional state



1.11**1.12**

2. Is there any other feelings / emotions that you'd like to describe about this interior setting?

3. How much time would you like to spend in this room?

- ☐ None
- ☐ A few minutes
- ☐ An hour
- ☐ A few hours

4. Once in this room, how much would you enjoy exploring around?

- ☐ Not at all
- ☐ Slightly
- ☐ Moderate
- ☐ Much
- ☐ Very much

5. To what extent does this place make you feel friendly and talkative to a stranger who happens to be near you?

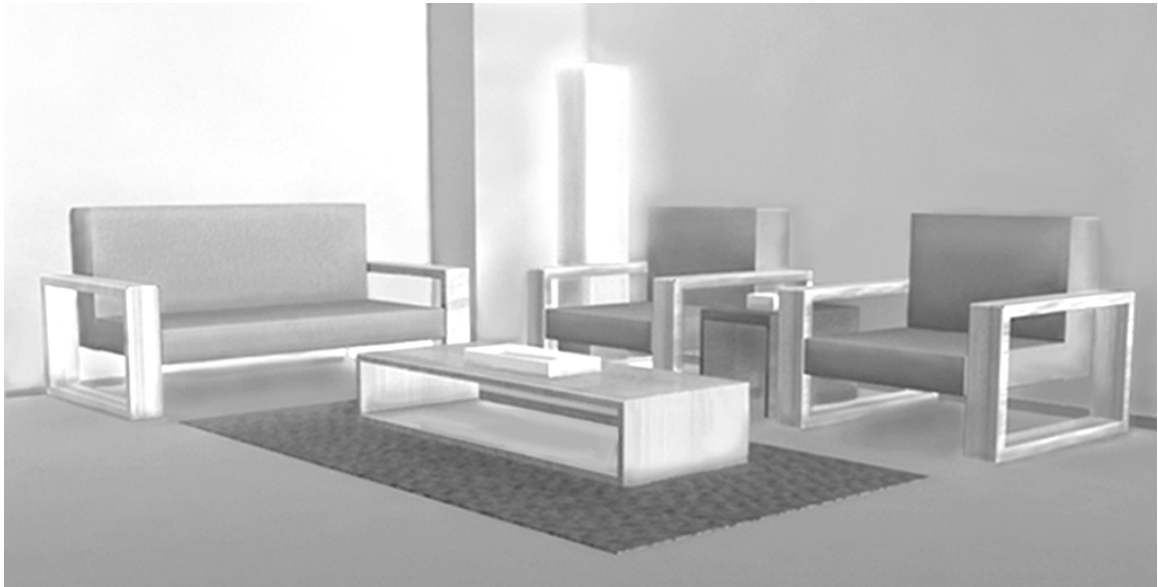
- ☐ Not at all
- ☐ Slightly
- ☐ Moderate
- ☐ Much
- ☐ Very much

6. What have you liked/disliked about this room? Please explain.

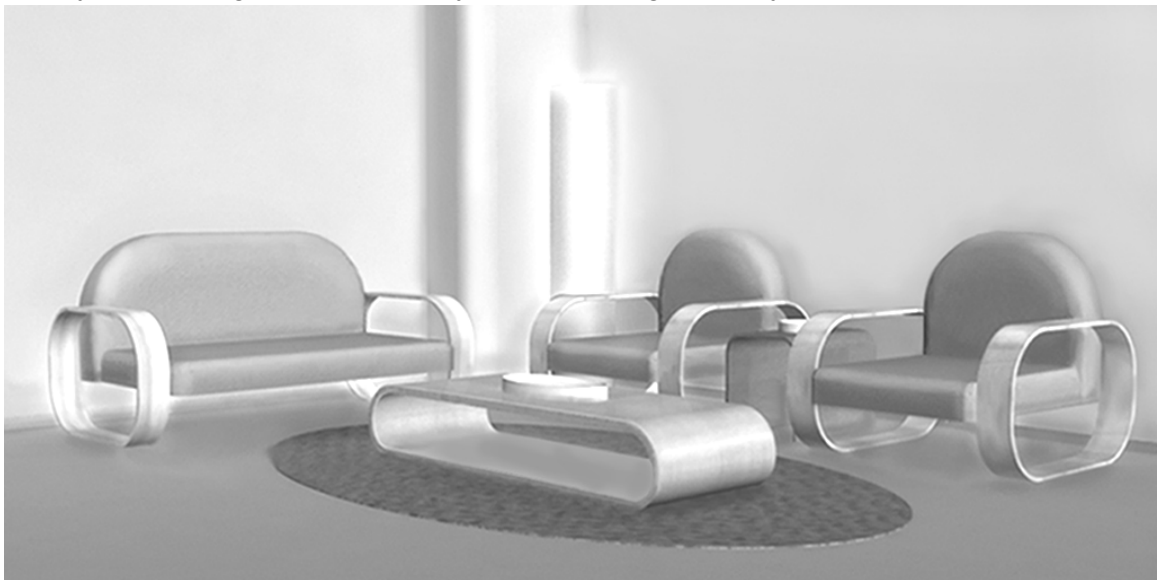
APPENDIX B

VISUAL STIMULI

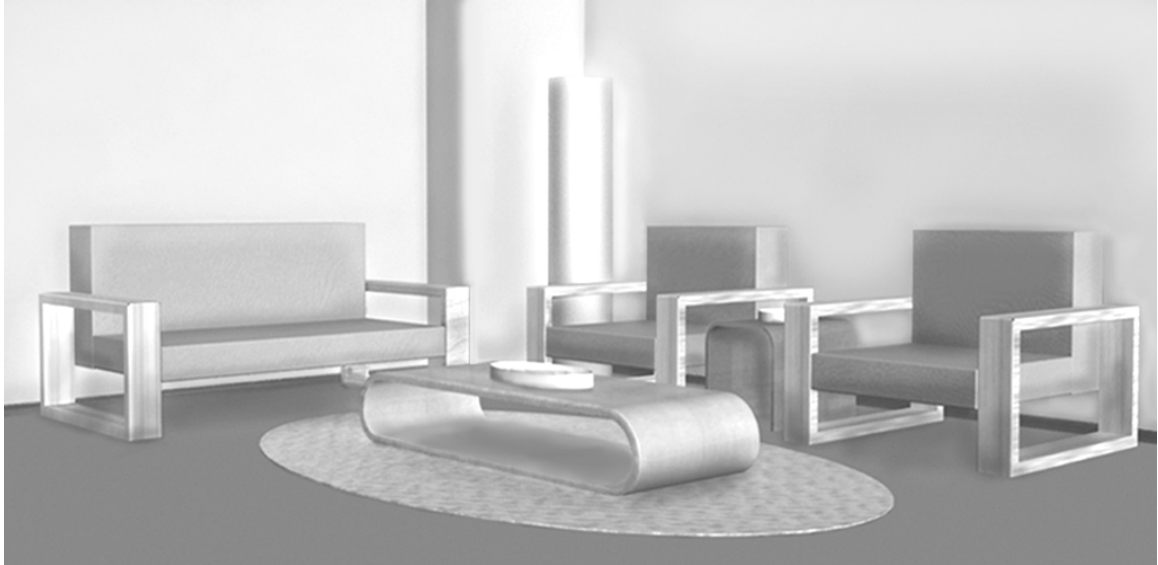
The Type R setting with furniture layout 1: a setting with only rectilinear lines.



The Type C setting with furniture layout 1: a setting with only curvilinear lines.



The Type B setting with furniture layout 1: a setting with both curvilinear and rectilinear lines.



The Type R setting with furniture layout 2: a setting with only rectilinear lines.



The Type C setting with furniture layout 2: a setting with only curvilinear lines.

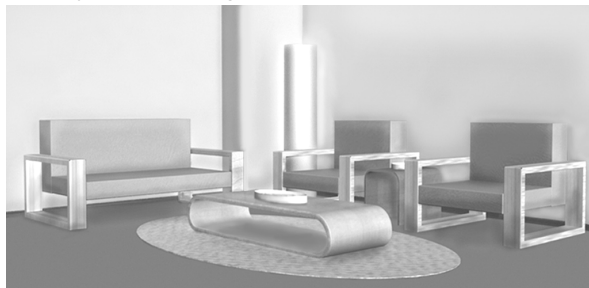


The Type B setting with furniture layout 2: a setting with both curvilinear and rectilinear lines.

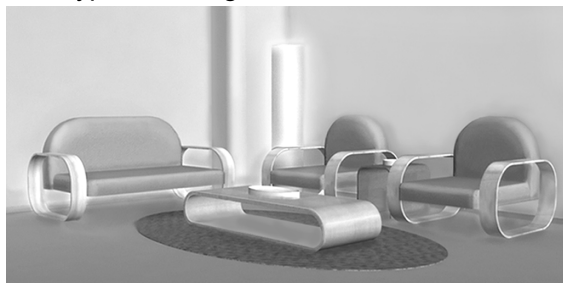


AN OVERALL VIEW OF ALL VISUAL STIMULI

The Type R settings



The Type C settings



The Type B settings



APPENDIX C

GROUP DEMOGRAPHICS

Group demographics for comparing setting #1 (Type B) and setting #5 (Type R) pleasure and arousal responses, and for comparing setting #3 (Type C) and setting #5 arousal and pleasure responses, N=107.

Variable	Item/#								
Age	18yrs 10	19yrs 20	20yrs 18	21yrs 28	22yrs 12	23 yrs and older 19			
Gender	Male 14		Female 93						
Race/Ethnicity	White A. 94	Asian A. 5	Hispanic A. 4	Native A. 1	Pacific Islander 1	Other 2	No Response -		
Major	Int.D. 30	Mer.M. 17	App.D. 13	Hous.S. 17	F.Arts 7	Gra. D. 16	Vis.A. 3	Art.H. 2	No Response 2

Group demographics for comparing setting #2 (Type R) and setting #6 (Type B) pleasure and arousal responses, N=106.

Variable	Item/#								
Age	18yrs 10	19yrs 20	20yrs 18	21yrs 28	22yrs 12	23 yrs and older 18			
Gender	Male 14		Female 92						
Race/Ethnicity	White A. 93	Asian A. 5	Hispanic A. 4	Native A. 1	Pacific Islander 1	Other 2	No Response -		
Major	Int.D. 29	Mer.M. 17	App.D. 13	Hous.S. 17	F.Arts 8	Gra. D. 15	Vis.A. 3	Art.H. 2	No Response 2

Group demographics for comparing setting #2 (Type R) and setting #4 (Type C) pleasure and arousal responses, N=111.

Variable	Item/#								
Age	18yrs 11	19yrs 21	20yrs 18	21yrs 29	22yrs 13	23 yrs and older 19			
Gender	Male 15		Female 96						
Race/Ethnicity	White A. 98	Asian A. 5	Hispanic A. 4	Native A. 1	Pacific Islander 1	Other 2	No Response -		
Major	Int.D. 31	Mer.M. 17	App.D. 14	Hous.S. 17	F.Arts 8	Gra. D. 17	Vis.A. 3	Art.H. 2	No Response 2
Department	DHE 76		Art 27	No Response 2					

Group demographics for comparing approach-avoidance scores between setting #1 and setting #3, N=116.

Variable	Item/#								
Age	18yrs 11	19yrs 24	20yrs 18	21yrs 31	22yrs 13	23 yrs and older 19			
Gender	Male 16		Female 100						
Race/Ethnicity	White A. 102	Asian A. 5	Hispanic A. 5	Native A. 1	Pacific Islander 1	Other 2	No Response -		
Major	Int.D. 31	Mer.M. 17	App.D. 14	Hous.S . 17	F.Arts 10	Gra. D. 19	Vis.A. 4	Art.H. 2	No Response 2

Group demographics for comparing approach-avoidance scores between setting #1 and setting #5, N=107.

Variable	Item/#								
Age	18yrs 10	19yrs 20	20yrs 18	21yrs 28	22yrs 12	23 yrs and older 19			
Gender	Male 14		Female 93						
Race/Ethnicity	White A. 94	Asian A. 5	Hispanic A. 4	Native A. 1	Pacific Islander 1	Other 2	No Response -		
Major	Int.D. 30	Mer.M. 17	App.D. 13	Hous.S . 17	F.Arts 7	Gra. D. 16	Vis.A. 3	Art.H. 2	No Response 2

Group demographics for comparing approach-avoidance scores between setting #3 and setting #5 (N=106).

Variable	Item/#								
Age	18yrs 10	19yrs 20	20yrs 18	21yrs 28	22yrs 11	23 yrs and older 19			
Gender	Male 14		Female 92						
Race/Ethnicity	White A. 93	Asian A. 5	Hispanic A. 4	Native A. 1	Pacific Islander 1	Other 2	No Response -		
Major	Int.D. 30	Mer.M. 16	App.D. 13	Hous.S . 17	F.Arts 7	Gra. D. 16	Vis.A. 3	Art.H. 2	No Response 2

Group demographics for comparing approach-avoidance scores between setting #4 and setting #6, N=10.

Variable	Item/#								
Age	18yrs 10	19yrs 19	20yrs 18	21yrs 28	22yrs 12	23 yrs and older 18			
Gender	Male 14	Female 91							
Race/Ethnicity	White A. 92	Asian A. 5	Hispanic A. 4	Native A. 1	Pacific Islander 1	Other 2	No Response -		
Major	Int.D. 29	Mer.M. 17	App.D. 13	Hous.S . 17	F.Arts 7	Gra. D. 15	Vis.A. 3	Art.H. 2	No Response 2

Group demographics for comparing approach-avoidance scores between setting #2 and setting #4, N=109.

Variable	Item/#								
Age	18yrs 11	19yrs 21	20yrs 18	21yrs 29	22yrs 13	23 yrs and older 17			
Gender	Male 14		Female 95						
Race/Ethnicity	White A. 96	Asian A. 5	Hispanic A. 4	Native A. 1	Pacific Islander 1	Other 2	No Response -		
Major	Int.D. 31	Mer.M. 17	App.D. 14	Hous.S . 15	F.Arts 8	Gra. D. 17	Vis.A. 3	Art.H. 2	No Response 2

Group demographics for comparing approach-avoidance scores between setting #2 and setting #6, N=104.

Variable	Item/#								
Age	18yrs 10	19yrs 20	20yrs 18	21yrs 28	22yrs 12	23 yrs and older 16			
Gender	Male 14	Female 90							
Race/Ethnicity	White A. 91	Asian A. 5	Hispanic A. 4	Native A. 1	Pacific Islander 1	Other 2	No Response -		
Major	Int.D. 29	Mer.M. 17	App.D. 13	Hous.S . 15	F.Arts 8	Gra. D. 15	Vis.A. 3	Art.H. 2	No Response 2

APPENDIX D

INSTITUTIONAL REVIEW BOARD (IRB) PAPERWORK


Institutional Review Board • Office of Research Integrity

Oregon State University, 308 Kerr Administration Building, Corvallis, Oregon 97331-2140

 Tel 541-737-8008 | Fax 541-737-3093 | IRB@oregonstate.edu
<http://oregonstate.edu/research/ori/humansubjects.htm>
Date: June 17, 2009

NOTIFICATION OF EXEMPTION
To: Marilyn Read
Design and Human Environment

From: Wayne A. Kradjan, Chair
Institutional Review Board

Re: 4345 – Emotional Effect of Curvilinear vs. Rectilinear Forms of Furniture in Interior Settings

The above referenced proposal was reviewed by the Oregon State University Institutional Review Board (IRB). The IRB has determined that your research project qualifies for an exemption under 45CFR46.101(b)

(2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, UNLESS:

- (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; AND
- (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

Further review of this research is not required and you may proceed with the research described in the protocol.

Please note that amendments to this protocol that impact the requirements for review must be reviewed prior to initiating the change. Please contact the IRB Office if you have questions about planned amendments.

To ensure that changes to this research project have not altered the review category¹, you will receive a brief annual inquiry regarding the status of this project.

¹ Review categories include exempt, expedited, and full board.

INFORMED CONSENT DOCUMENT

You should be a DHE or ART student to participate in this study. This survey is designed to measure emotions elicited by interior settings also known as the near environment. The responses gathered by this survey will be used in partial fulfillment of the student researcher's Master's thesis.

You won't be identified from your answers and you can quit the survey anytime you want to.

You can become eligible to participate in a lottery and win \$50 for completing this survey only if you answer all of the questions.

You will be shown 6 computer drafted, grayscale, plain interior environments and you will be asked to answer 6 questions about each picture.

See below for more information. The survey closes on September 30, 2009. During the survey, you will be shown computer drafted grayscale 7 pictures, and you will be asked to answer 6 questions for each of them. We ask that you complete the survey where you'll be asked to provide your emotional responses towards the pictures shown on the screen.

The survey also asks for basic demographic information. The survey will take approximately 15 minutes to complete.

WILL I BE PAID FOR PARTICIPATING?

You will not be paid for completing the survey. However, you will be eligible to participate in a lottery and possibly win \$50 just for doing this survey.

LOTTERY: One participant will win \$50. To participate in the lottery, you should provide your name and ONID email address on the next page. You have to complete the survey and answer all of the questions to be able to participate in the lottery. After the online survey closes in Fall 2009, one name will be drawn from those participants who wish to be included in the lottery, and the winners will be notified via their email addresses. The check will be provided by the student-researcher and can be picked up from DHE office (only if you win the lottery). We estimate that 60 students will participate in this study.

WHO WILL SEE THE INFORMATION I GIVE?

Your name/identity will not be shared with the public. The anonymous aggregate results may be used in a manuscript or presented at a professional symposium. If the results of this project are published, your identity will not be made public.

DO I HAVE A CHOICE TO BE IN THE STUDY?

Participation in this study is completely voluntary. You are free to refuse to answer any question or to withdraw from the study at any time.

WHAT ARE THE RISKS OF THIS STUDY?

There are no foreseeable risks involved in participating in this study.

WHAT ARE THE BENEFITS OF THIS STUDY?

You will not benefit from being in this study. However, we hope that, in the future, other people might benefit from the results of this study, because understanding the relationship between people and their near environment is important.

WHAT IF I HAVE QUESTIONS?

If you have any questions about this research project, please contact the student researcher S. Seda Dazkir at dazkirs@onid.orst.edu or at 541-737-4766. You can also contact the principal investigator Dr. Marilyn Read at Marilyn.Read@oregonstate.edu or at 541-737-0982

If you have questions about your rights as a participant, please contact the Oregon State University Institutional Review Board (IRB) Human Protections Administrator, at (541) 737-4933 or by email at IRB@oregonstate.edu.

Checking the boxes below and continuing this survey indicates that this research study has been explained to you, that your questions have been answered, and that you agree to take part in this study. If you wish to keep a copy of this form for your records, please print this page before continuing the study.

Are you 18 years old or older and an enrolled undergraduate student in either DHE or ART department?

- ☐ Yes, I am over 18, and I am an undergraduate DHE or ART student
- ☐ No, I am under 18 or/and I am not an undergraduate DHE or ART student

Do you agree to the consent information listed on this page?

- ☐ YES, I agree to the above consent form
- ☐ NO, I don't agree to the above consent form

SCRIPT FOR EMAIL ADVERTISEMENTS

Attention: DHE and ART students

Please take your time to participate in an online survey.

You will be eligible to participate in a lottery to win \$50 check for participating in this study (only if you answer all of the questions). Your answers will be anonymous and will be part of Master's thesis comparing people's emotional reactions to physical characteristics of different types of settings.

Please follow the link given below to reach the survey:

http://www.surveymonkey.com/s.aspx?sm=28eGQxToaNsLPliJlwy2NQ_3d_3d

Thank you, in advance, for your participation.

S. Seda Dazkir, Graduate Student.

Department of Design and Human Environment, OSU

