Feeling the Pull:

Using Magnetic Modeling To Understand Emotions in Form

by

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ABSTRACT

Research in design, emotion, and product experience has focused on establishing a connection between the aesthetic qualities of products and emotions. Studies in product expression have demonstrated relevant patterns between aesthetics and spatial reasoning. In design research, fully understanding latent qualities of consumers assists in developing an immersive product experience which in turn can engender a lasting product relationship. This study evaluates how people interpret the emotionality of form in order to establish a veritable method for interpreting emotional variables in 3D objects.

This research assesses the emotional perception of aesthetic values in 2D and 3D teapots. A teapot image collection and taxonomy was constructed with 101 images of teapots across four centuries. Eighty-four participants completed a card sorting task of twenty randomly distributed teapot images (taken from the total 101 image collection) into Plutchik's eight emotion categories. Individual pieces of the teapots were coded according to the base, handle, lid, or spout that was presented in the image. The coded pieces from the card-sorting task were arranged per frequency in the overall set. Through the use of response data from the card sorting task, a network of the images was developed in Pathfinder. The content of these results were compared to images of models gathered during an interview with an interactive co-creation method referred to as Magnetic Modeling. Magnetic Modeling is a methodological tool that allowed participants to manipulate individualized pieces of 3D printed teapots into proposed emotional labels.

The findings of this research establish prototypical associations in aesthetic traits and teapot piece combinations for each emotion category. Participant responses were categorized into 4 personas representing the types of perceptual bias in the studies' participants. A discussion and comparison of the methods for academic and theoretical practice is provided.

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CHAPTER 1

INTRODUCTION

1.1. Background and Justification

1.1.1. Product Experience. Everyday occurrences elicit emotions from the smell of a well-used coffee maker, to the smooth yet powerful touch of a rumbling orbital sander, or the view of the sculptural tail fins of a 1959 Cadillac slicing through the boulevard; people experience emotion as a result of the environment (Lazarus 1991, p. 819). Products in particular are soaked with experiential qualities as each feature imbues facets of influence throughout a lifetime of use. Evidence of emotion induced product purchasing and attachment has a deep research base. (Chitturi, 2009; Schifferstein & Zwartkruis-Pelgrim, 2008). Creusen (1998) identified the experiential product qualities that attract individuals with specific personal characteristics and initiate purchasing decisions (p. 26). Despite the financial advantages, the domains of research within product experience strive to move products from economically dependent to leading the market with the enhancement of the user and product interaction.

Clarkson (2008) showed how products and the individual interact and communicate continuously influencing perception, memory, attention, and performance. However, the past fifteen years has had an influx of inquiry into more substantial elements of interaction with an emphasis on increasing pleasurable experiences (Green & Jordan, 2001). Designed and manufactured objects enrich one's every action; assisting them work more efficiently, play more effortlessly, and network more effectively. The new standard for product experience research is to continuously connect the multifaceted aspects of the user's intellect, senses, and emotions to the qualitative attributes of products (Desmet, van Erp, & Karlsson, 2008, p. 2). The user and product relationship is now recognized as engendering affective experiences. Their immersive ability is obvious as people and their products are inseparable. For many, the loss of a favored phone or the thrill of purchasing a particular pair of shoes warrants a strong emotional response.

1.1.2. Aesthetics. Products engage the senses of sight, touch, hearing, smell, and taste, with their material, texture, sounds, flavor, and images (Chang & Wu, 2007). However, no other sense is studied more than sight and no other quality of products is evaluated more than

aesthetics (Desmet & Hekkert, 2007, p.62). Aesthetics research spans across centuries, delving into philosophy and art history before the advent of design, marketing, or psychology (Kim, 2006). Through the "fine arts, sculpture and painting have long been thought to embody emotive qualities that designed objects do not" (Reavley, 2004, p.379). Towards the end of the twentieth century, these fields became intimately paired with the success or failure of products in the marketplace as "the ergonomic discipline increasingly began to focus on other subjective experiences arising from the use of products" (Schifferstein & Hekkert , 2008, p. 7). This includes the potential for aesthetics to be emotionally rich and offer more pleasure and satisfaction (Reavely, 2004, p.379). Despite the depth of knowledge provided in these areas, traditional forms of research and analysis have gathered information about aesthetics in tedious, incremental, and seemingly minute amounts (Hekkert & Leder, 2008, p.259). Nevertheless, aesthetic attributes are vastly regarded as the most important factor for attraction (Adams & van Gorp, 2012 p.88). Regarding product performance in the market, a survey of senior marketing managers done by Bruce and Whitehead (1988) revealed that 60% believed design was the most important indicator of success (as cited in Achiche & Ahmed, 2010, p. 93-107). The particular intersection of design and emotion consistently cries out for more knowledge regarding the affective qualities of aesthetics as the influence of design and emotions may elevate the product's positive attention in the marketplace (Hekkert & Leder, 2008, p. 260).

1.1.3. The Importance of Designing Emotional Experiences. Traditional Industrial design and human factors focused on manufacturing products with an emphasis on the function and physical elements of structure such as the stylistic shape or material choice (Schifferstein & Hekkert, 2008, xix). Although this bears significant importance, observing users with products has altered the consensus from the product and the individual as separate and elevated their interaction as the most compelling aspect of product design (DiSalvo, Hanington, & Forlizzi, 2004). Schifferstein and Hekkert describe in *Product Experience,* "To understand experience we need to go beyond shape and form, even beyond simple ergonomics. We need to understand how psychology, the social sciences, communication, and business shape a person's experience (2008, p. xix)." This concept has created a new set of core values and disciplines that redistribute

conservative business directives into a progressive exploratory design perspective (Cagen & Vogel, 2002).

There are several definitive fields that contribute to product experience research often spanning through extant and obscure regions of industrial and graphic design, the cognitive sciences as well as other technology related scholarships such as human factors, and engineering (Schifferstein & Hekkert, 2008, p. 6). Research techniques are gleaned from distant corners of each field to thoroughly comprehend the actions and choices of users in order to match every element of the product experience to their needs. In the book,

Do You Matter: how great design will make people love your company the authors explain,

> You can base all your boundary conditions on cost, timing, and market opportunity, and use the data to make a decision. Along the way, you'll likely throw out some ideas because they're too expensive or they'll take too long, so you'll end up with a mediocre product that no one buys. A perfect process doesn't matter unless the total design is right (pg.10).

Services are paired with innovative products through a user-centered approach to create an overall design experience embedded with branding and aesthetic integrated appeal (Zeithaml, Bitner, & Germier; 2009, p. 250). During the 1980s and 1990s, design became seen as a new creative edge for most companies (Cagen and Vogel, 2002, p.5). The new millennia proved that design is now more of a necessity for companies to stay alive in a struggling economy (Brunner & Emery, 2009). For those companies involved in either products or services "design or die is, in fact, the deal" as "business people must understand how to design the customer experience or be laid to rest in the graveyard of irrelevance" (Brunner& Emery, 2009, p. 9).

1.1.4. Design and Emotion. Consumers are no longer satisfied with half-cultured experiences lacking intimate premeditation guiding the ultimate development of the product. They expect mere perfection in all stages of the product experience as " virtually any emotional pebble in the customer's road can become magnified into a perceptual paradigm shift resulting in negative feelings about your company (Brunner & Emery, 2009, p. 30)." Thus, the future of design will continuously re-evaluate each aspect of the design process in order to uncover potential leverage for divining the particular emotional experience sought by potential consumers.

Accessing these emotive qualities of products is no small feat as it is difficult to register abstract conclusions about an inanimate object. Current trends in design research emphasize using consumers to assist in the design process, referred to as co-participation (Sanders, 2002). In doing so, the products resemble the imbedded and unexplored desires of the individual. Design research methods act as a preventive measure against negative experiences as well as an opportunistic creative valley (Kolko, 2011). Aesthetic styling is often seen as industrial design's staple recourse, but the field as a whole has advanced to higher levels of abstract problem solving and solutions (Boradkar, 2010). Integrating the fields of marketing, design, and psychology has created distinct sects with more insight into the affective experience.

One of these areas forms a bridge between psychology and industrial design, commonly known as "Emotional Design" which explores emotions through the lens of product influences and targets opportunities to advance affective qualities of all portions of the product (Norman, 2004). Norman's emotion processing theory, Desmet's product appraisal theory, and Jordan's pleasure principles are considered the three main ideologies for dissecting an emotional relationship, interpretation, or experiences with a product. Each of these theories is considered the most current and prominent leading approaches within the emotion and design sector. However, this is not an exhaustive list and other available theories provide specific insights for integrating or linguistically interpreting those emotions correlating with design literature. Nevertheless, the three aforementioned theories will be covered in the literature review as foundational knowledge provided on the topic.

1.1.5 Limitations in Pre-existing Research. Although designing for emotions has recently gathered momentum, there is still a vast amount of information that designers do not have access to and have yet to be investigated by researchers in the field. This pertains specifically to the abstract associations registered between variations of applied three-dimensional (3D) aesthetic attributes and their emotional perceptions as experienced or interpreted by the user.

This is primarily a consequence of the inability to efficiently test design imposed 3D formational languages that are controlled for particular emotive categories (Govers, Hekkert, &

Schoomans, 2004, p.348). The concept of examining combinations of features and testing for alterations in emotional perception is, for the majority, limited. Ultimately, the knowledge regarding the emotional attributes of 3D form aesthetics is consistently bound to 2D representations or amorphous forms with restricted applicability to a real world situation (Hekkert & Leder, 2008, p.282). As practicing designers are limited in both their time and willingness to explore new research methods, it is unlikely that that most methods currently used to distinguish aesthetic emotions are integrated into the design process (Cagen & Vogel, 2002, p.140). The use of graphic models remains to be the industry's current strategy for considering emotions in design. For both the academic and practicing realms of design, a new applied method for disentangling the malleable associations between 3D forms and aesthetic combinations is necessary for honest portraits of visual elements (Hekkert & Leder, 2008, p.282).

1.2. Purpose.

The function of this research is to explore the emotional values of 3D aesthetic combinations through the use of magnetic modeling; a methodological tool that allows participants to manipulate pieces of 3D forms into proposed emotional labels. Existing research supports the use of innovative methods in current experience design industries to quickly interpret the psychological and emotive perspectives of potential users (Sanders, 2000). In marketing and design research, fully understanding consumer latent perceptions aids in developing an immersive product experience which in turn can engender a lasting product relationship and lifespan through emotional attachment (Sanders, 2002).

This study will evaluate how people interpret the emotionality of a certain product in order to establish a veritable method for interpreting emotional variables and perceptions throughout the design development process. For clarity, teapots and teakettle forms were used to demonstrate the method. The current imperatives within the product experience fields of industrial design, psychology, and aesthetics are integrated into this design research tool with a particular emphasis on emotional perception. The goal of this tool is to allow any future or existing products to be evaluated for emotional values during the design process. However, the purpose of this tool is to provide further insight into how the totality of the product experience is formed through

aesthetic combinations and relationship with the user. Due to the use of a grounded theory approach, major themes that are connected to the purpose of the study provided a foundation to guide the remainder of the research.

1.3. Conceptual Framework

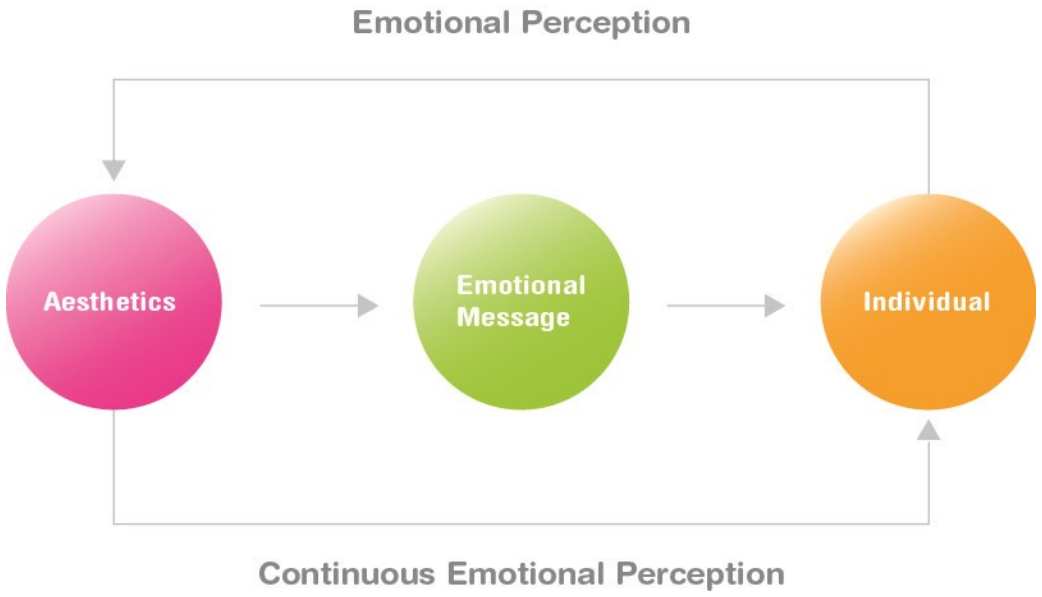

Figure1. Elements of the Emotional Aesthetic Experience

This model represents an exchanging relationship between the individual and the aesthetic attributes of the object or image. The interaction is initiated by the aesthetic attributes of the form. The affective messages from these aesthetics are then sent to the individual. This information is received and processed cognitively and affectively. It is then formulated into a cognitive impression and an affective state. The resulting relationship is cyclical as the message is continually sent to the individual, but it does not always have to go through a period of consideration. The aesthetics may simply reinforce the continuous emotional perception of the object. This repetitive rotation is symbolic of the layers as seen in existing experience, emotion, and perception models. Emotional experience extends from continuous attribution of affective qualities to aesthetic characteristics. This perception is also bidirectional as it takes place from the aesthetics to the individual and from the individual to the aesthetics.

Literature on 3D shapes suggests that forms which follow minimalistic or Gestalt ideology are often preferred by users (Chou, 2011). Aesthetics have been shown to reveal the most

intense initial response with users as well as communicate function and purpose effectively, and connect to memories and motivational responses (Norman, 2004). The level of form simplicity and other product semantics will generate an instantaneous psychological and affective response in the viewer. This emotional impression will then affect the behavior of the product user or potential consumer. Additionally, forms with positive emotional impressions often allow for better functionality and a more intuitive user experience overall.

1.4. Research Questions

As this research employs a grounded theory approach and an involved literature review, a more expansive list of questions was compiled prior to the study. After the literature review was completed and the methodology concept was developed, this list was then limited to the following questions that directly relate to the experimental portions of the study.

1. *Is there a difference between 2D and 3D emotional aesthetic perceptions?*

   Justification: As most current research on products, their aesthetics, and external visual messages is on 2D products or amorphous 3D shapes, this study discusses the differences and potential uses of evaluating both types of visual information.

2. *How do certain combinations of 2D and 3D aesthetic forms influence emotion perception?*

   Justification: Thus far, a majority of aesthetic research has focused on the entirety of products combined features rather than analyzing possible alterations of the individual characteristic pieces of the product. The method discussed in this study allows for the forms to be manipulated into groups and evaluated for a variety of particular features. Exploring canonical combinations of forms may reveal unknown variables in emotion perception that the forms may display individually in a group with like characteristics.

3. *What are the aesthetic elements that communicate particular emotions in form?*

   Justification: The majority of the body of research in aesthetics and emotional perception exists to produce a formula that explains the associations of particular characteristics with a particular emotion. It is only natural that this question is included as much of the

research in this area is concerned with favorable or unfavorable communication of emotion related variables.

4. *How do the perceptual biases of individuals alter the emotional perception of aesthetics?* Justification: Cognitive perception is built upon an individual's own perception of self which includes their personal style, gender, and likes or dislikes. Therefore, the addition of personal attributes should be acknowledged when emotional perception is taken into consideration.
5. *What is the process of interpreting and applying emotional qualities within aesthetics?* Justification: How people construct emotions out of forms offers extensive information into the value associated with certain variables. Shapes, sizes, and details can all be acknowledged independently or in groups which allow the analyses to go beyond basic Gestalt and aesthetic generalizations. How people form realizations distinguishes ranked perceptual preferences as well as encourages new webs of correlational similarities and differences within the information.

1.5. Scope and Limitations

1.5.1. Study. Emotional design principles can extend to all corners of design, marketing, and psychology fields with a special emphasis in Industrial Design. All services, products, and systems are operated and desired by human beings and they all feel emotions. Emotional responses can be evaluated in both instantaneous and delayed reflections on any particular topic or object. It should be noted that a stream of the design industry has the opinion that aesthetics themselves cannot be affective (Hekkert, 2008, p.260). However, this debate is on-going and there is a general understanding that product aesthetic attributes do influence the perception of the user and in this study's case, the participants' perception. Additionally, this study's aim does not limit the focus on the emotive quality itself, but rather on the perspective of the participant's understanding of the emotion in 3D forms. This is a fine, but meaningful distinction as the researcher does not imply that this research is an explicit representation of emotive feelings as this point is currently arguable.

The descriptions provided by the participants can be seen as general themes involved in the cross roads of emotions, design, and aesthetics. This research does not pretend to act as an exhaustive resource regarding the theories related to design or emotions, but to provide an adequate base of included sects for inspection. The intent is to explore the nature of emotional perception in 3D forms and their combinations in a particular product. As a graduate career is limited in both time and resources, it is impossible to presume that each relevant field is presented in its summation. Through the grounded theory approach, relevant information was collected and compiled for a supportive infrastructure on significant topics. Analogous themes and weaknesses lead to develop of the conceptual framework, research questions, and the resulting experiments.

1.5.2. Sample. Due to limited amounts of time and resources, two representative samples of the industry consumers will be included in our study. A large number of students attending Arizona State University have been included in one stage of the methods. However, participant sampling does not exclude individuals who do not attend the university. Participants will be limited between the ages of 18 and 90 in order to include a large variety of individuals. As both the age range and participant group may be impacted by the location of the study, this research is not representative of all product consumers. The participant sample was purposely kept broad as this study is one of the first of its kind. Demographic data was collected utilizing recordings from participant surveys including gender, age, and education level (among other topics). This minimal information was gathered regarding the participants, but was not incredibly extensive and is not correlated to the results.

1.5.3. Methods. An image analysis, a digital remote card sorting task, and an interactive study referred to as magnetic modeling comprised three distinct research phases. The following study is heavily steered by grounded theory as each stage informs the next. An ethnographic viewpoint was essential to the natural formation of generalized applicable motifs. Following a design research outlook, these stages were intentionally uninhibited as this let trends surface naturally throughout the process. Quantitative and qualitative analysis was performed on the data provided by the remote card sorting task. Qualitative research was conducted through an

extensive interview process following interactive methods. Due to the ethnographic nature of the research and interviews, the researchers own experience and personal outlook may alter the research. It is undeniable that the researcher's viewpoint as a designer and student helped frame the data collection, analysis, and conclusions. Great lengths were taken to ensure objectivity and convergence using multiple methods, and established design research tools and analysis strategies. One of these methods, referred to as magnetic modeling, is an alteration of the existing co-creation method Velcro-modeling. As some measures of emotional perception are relatively new in the field, future application of the research may be hindered. Nevertheless, the results of this study attempt to frame a untapped region of research.

1.5.4. Definitions. The following list of commonly used terms is provided to assist in offering the specific implied perspectives of the researcher.

Product—"A device that provides a service that enhances" or detracts from the "human experience." (Cagen & Vogel, 2002, p. 7). This definition suggests that a product is a physical object, and distinguishes itself from services in that services are ideological and intangible in comparison.

Aesthetics—"Is the branch of philosophy that deals with sensory judgments of beauty and good taste" (Zangwill, 2007 as quoted in Adams & van Gorp, p.86). This version of aesthetics suggests the expansive study of the field as a whole. Aesthetics can also apply to the product itself as in this definition: "aesthetics doesn't refer just to visual appearance, but also to judgments of what makes a sound, feeling, smell, or taste appealing" (Adams & van Gorp, p.86). This definition argues that aesthetics not only communicate visual properties such as form and surface, but also aid in the cognitive impression of more functional and interpretive properties.

Value—"In design and engineering, value is often treated as a goal to be achieved by corporations for the products they create for consumers (Boradkar,2010, p.46) ." Value in this case implies a sense of worth to be offered and received. This relationship extends beyond financial worth to multidimensional qualities such as social, aesthetic, functional, or emotional benefits that may be experienced.

Affect—(affective) A sense of what is good or bad based on low or high arousal. Affect is unattributed emotion. Affect is similar to emotions, but is considered more derived and basic in quality and depth. See Chapter 2 for further explanation.

Archetype--is the prototypical or expected shape of an object. In this study, this is referencing the main piece types established in the teapot taxonomy.

Emotion—is an attributed experience of affect, rather a subjective experience (Frijda, 1988, p. 1). In this sense, an emotion is affect that is attributed to the product, image, or aesthetic form. See Chapter 2 for further explanation.

Attachment— the degree of consumer-product attachment as the strength of the emotional bond a consumer experiences with a product. “Consumer-product attachment implies the existence of an emotional tie between a person and an object. An object to which a person is attached is considered to be special and typically means a lot to that person” (Schifferstein & Zwartkruis-Pelgrim, 2008, p. 1).

Taxonomy—is a classification of objects arranged in a hierarchy of importance or derivation. In this study, the teapot bases that are deemed most simplistic and aligning with standard mathematically derived 3D shapes are found at the core of the hierarchy. Those with similar aesthetic traits extend from these standard shapes.

Perception—The cognitive, affective, and sensory impression of a stimulus. This includes subconscious physical reactions and conscious evaluations.

Perceptual bias—is reflective of the attitudes, sentiments, and personality traits of the individual that frame how one perceives the affective nature of an object.

Primary aesthetic elements—these are the largest portion of an object in the visual field of an individual. In this study, the bases of the teapot are considered the primary aesthetic elements.

Secondary aesthetic elements- these are the smaller, functional pieces of an object. In this study, the teapot handles, spouts, and lids are secondary to the bases of the teapot.

Anthropomorphize—The action of making something or referring to something inanimate as human or alive.

Stimulus—Anything that may cause a physical, cognitive, or emotional reaction in an individual is considered a stimulus. More specifically, the distinct parts of an object (or teapot) and the object as a whole are both stimuli.

1.5.5. Definitions of Aesthetic Traits. The following is a list of definitions used to describe the specific aesthetic trait found within the context of a teapot.

Sharp—In teapots, this is the tendency for a steep, angular shift between surfaces and edges or the ability of pieces to project into a point.

Smooth—In this context, smooth is the ability for edges and details of surfaces to be rounded, non-textured/flat, and filleted.

Straight--Teapots that have straight qualities are rectilinear, oblong in length, or have flat surfaces.

Round—This is referencing forms that have a simplistic curvilinear shape without an excessive number of curves; they are simplistic yet curvilinear.

Robust—This is the ability of a teapot to present a large size or presence through the width of its base or the height of its frame.

Delicate—The teapot will appear smaller in size, more breakable, and less solid. The solidarity of the teapot is dependent on if the teapot's secondary elements flow directly into the base or if they appear to be separate attached pieces.

Down—This refers to have a downward visual pull usually extending from bottom-heavy bases or elements that point towards the surface on which the teapot is sitting.

Up—In teapots upward movement is seen from the sides of the base extending in an upward angle, the height of the object, and the height of the secondary elements. Upward is shown by the segments or edges of the object pointing toward an area above the base of the teapot.

Contained—This is synonymous with closure in product expression. In teapots it is displayed through the distance of the handle and spout to the base of the teapot.

Open—The secondary pieces in the "open" teapots extend away from the base and equals less closure.

Angular—This is determined by the amount of angles in the pieces, surface, and details of the object.

Curved—In teapots, this is based on how many elements and surfaces appear to be curvilinear over rectilinear.

Stimulating—This refers to the ability of the teapot to draw attention either through displaced or incongruent elements.

Unstimulating—In teapots this is seen when the teapots are very plain and lack variety in their overall appearance.

Symmetrical—This is depicted in teapots with even alignments and heights in the handle and spout relationship.

Unsymmetrical—This is shown by displaced and uneven alignments within the secondary elements of the form.

Simple—In teapots this is represented by forms with little variation in their aesthetic elements.

Complex—Forms with a significant amount of variation between the dominant and submissive traits, and/or a broad representation of both types of traits, are viewed as complex.

Static—Teapots that appear to be static do not have a strong direction of movement within their elements. This means that the eye is not quickly drawn through the form in one standard direction. These objects may also have elements of robustness, such as a larger base, that suggests the object may be difficult to move or heavy when lifting from a surface.

Dynamic—This is the ability for the teapot to have a strong directional flow in its visual elements that leads the viewpoint of the onlooker.

Unharmonious—Unharmonious teapots lack cohesion in their design elements. These teapots appear as if they are collections of pieces from different teapots combined into one form.

Harmonious—This is the tendency for the teapot to display a cohesive design language with similar aesthetic qualities and combinations throughout the form.

Unbalanced—The relationship of the visual “weight” of one side of the teapot appears larger or smaller than the other. The teapot appears unstable.

Balanced—The relationship of secondary elements attached to the base is evenly distributed and/or has the same visual presence (size, extension, etc.). The teapot appears stable.

1.6. Significance

Certain qualities of products are more desirable than others, but with an ever changing marketplace it can be confusing what elements are absolutely essential and what is just going to pass with the winds of popular culture. Harnessing the purity of product attraction still eludes researchers and designers alike. The intricacies of the formula for a truly successful product are highly sought after as companies seek to increase sales and customer satisfaction. Additionally, current trends regarding sustainability and ecological consciousness have brought social hurdles for designers to maneuver enforcing the need to make products that are long lasting in their functionality, use, and desirability. More than ever before, customers expect products to deliver a heightened sense of meaning and emotional drive. Products are not simply functional; they are emotional imprints in the consumer's life. "The ubiquity of things in everyday life, their role in shaping identity, their critical presence in economic systems, their existence in art, their function as markers of history, all are qualities that make them socially and culturally significant" (Boradkar, 2010, pg. 6).

Emotional design promotes an empathetic understanding regarding all aspects of products. This includes evaluating the emotional message exhibited by forms. Emotional messages may be the platform for positive experiences by the individual including, purchasing, use, and attachment (Desmet, 2012, p. 1). Singular emotional experiences generated by one form over time are seen to accumulate into a more permanent bond often referred to as product attachment (Demir, 2008, p. 140). These responses both affect and are affected by the initial attraction the viewer had to the product form (Clarkson, 2008). This continual cycle of positive emotional attraction is what leads to product attachment. Thus, the first impression of the product will create a conveyed emotion and a product aesthetic attraction that may lead to a more permanent bond. This bond not only improves the experience of use, but also aids in lengthening the life span of the product, the continued care of the object, and increasing the return purchase of the customer once the product is no longer desirable (Desmet, 2012, p.1).

This research is specifically investigating how manipulating 3D shape affects the emotional perception of that object. Theoretically, designing for certain emotions may provide a new outlet to identify attachment latent qualities. Products already display a range of emotions, narrowing these to prototypical visual traits relative to core emotions reframes the designing process of aesthetics. Furthermore, the use of a qualitative co-creation method as provided in this research, may access these latent desires of users more effectively (Sanders, 2002).

1.7. Outline of Report

The following report aims to sufficiently draw parallels within the relevant research fields through the use of a brief literature review, methodology, findings, and discussion chapter. Chapter two chronicles the pertinent portions from the bodies of literature within psychology, human factors, industrial design, and aesthetics. Each of these fields is connected to the overall scheme of product experience and is considered seminal in its foundation. Chapter 3 outlines the methodology process used to investigate, collect, and analyze data. Findings from the data are provided in Chapter 4. Conclusions and a summary regarding discoveries from the entire process are delivered in Chapter 5. Future implications and suggested research are also covered in the final chapter.

CHAPTER 2

LITERATURE REVIEW

2.1. Introduction

The literature review is divided into five sections. The first section will address the seminal theories of emotion in psychology covering affective states, experience theories, and action theories. Emotion theories in design encompass the second section including Jordan's pleasure principle, Norman's theory of emotion processing, and Desmet's product appraisal theory. The third section of the literature review will address related topics in the human and product interaction with emphasis on product experience and attachment. The fourth section will cover integrated concepts regarding visual perception and aesthetics with comparative current research. Finally, the last section discusses the design process and application of a co-creative method as support for the creation and use of magnetic modeling. The following sections on the literature are not meant to be entirely exhaustive as each topic is immense, but rather, they will reflect on areas relevant to the study. The intention of the literature review is to provide an understanding of product experience that is applicable to the study.

2.2. Emotions

As intuitive beings, humans are innately entwined with their affective experiences. Derived from evolutionary instincts, feelings, emotions, and other affective qualities guide us in our actions and choices from menial tasks to life altering decisions. What distinguishes what we experience from these interactions as emotions? What components make up an emotion? How can we differentiate emotions from other similar players of affect such as moods or feelings? Several models explaining various attributes of emotional experiences exist throughout various disciplines of science. These models range from describing the physical process to the psychological process in which emotions are both expressed through our external acts and internal modalities.

2.2.1. Affective States. When describing emotions it is first pertinent to distinguish what enacts an affective state. Throughout research on emotion, the two levels of categorizing core affect, and by extension emotions, exist on a bipolar scale (Plutchik, 1982). Affect or an affective

state, according to emotion theory, “is generally used to refer to all types of subjective experiences that are valenced, that is, experiences that involve a perceived goodness or badness, pleasantness or unpleasantness (Desmet, 2008b, pp 381).” At their “core is the experience of pleasure or pain” (Frijda, 1988). Thus, emotions are first, and most importantly, determined by how good or bad they are perceived by the individual. This also creates the first layer of how emotions are categorized. Sensing what is good or bad is referred to as our “core affect.” Each emotion is derived from a simple and raw core affect that distinguishes it from other emotions (Yik & Russel, 1980).

2.2.1.1. Core Affect. Once it is determined whether the core affect is good or bad, it is then distributed across a level of arousal. Yik and Russell (1980) organized core affect labels with their distinguishing level of arousal in the two-dimensional model below.

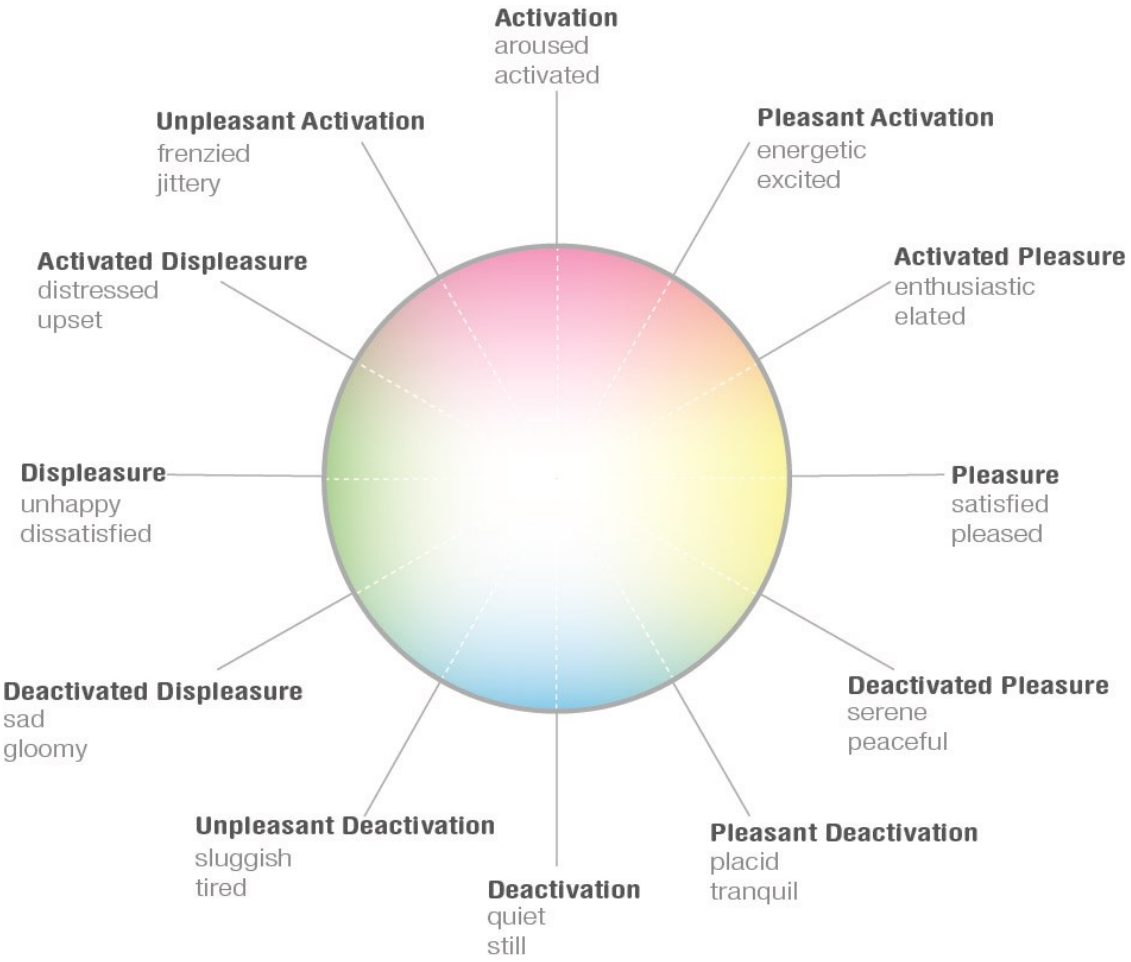

Figure 2. Core Affect (adapted from Yik & Russel, 1980)

The horizontal axis is representative of the goodness or badness and the vertical axis is representative of the level of activation. However, this model only signifies the emotive variable related to the experiential quality through core affect and neurophysiological activity generated as a result; this model does not display emotions (this is due to lack of attribution which is addressed in the sections on appraisal).

People experience core affect at all times; arousal determines the activation level of the particular core affect (Yik & Russel 1980). For example, anger and sadness are both considered negative responses, but sadness occurs at a state of lower arousal than anger. Arousal can be viewed as being most representative of one's physiological relationship with core affect (Frijda, 2009, p.268). Essentially, arousal amplifies the experience of core affect and the result is often associated with the amount of attention that is paid to that experience (Frijda, 2009, p. 268). Nevertheless, core affect and arousal are only two portions that determine the make-up of any emotion.

2.2.1.2. Emotion Components. In order to understand what attributes signify an emotion, a general understanding of the components of all varying emotional episodes is necessary. According to Moore (2010) of Ghent University, an emotional episode includes the interaction between a stimulus and the individual and any resulting consequences that occur in reaction to this exchange (p.6). Emotional episodes are comprised of "a cognitive component; a feeling component, referring to the emotional experience; a motivational component, consisting of action tendencies or states of action readiness; a somatic component, consisting of central and peripheral physiological responses; and a motor component, consisting of expressive behavior (Moore, 2010, pp. 1)." Thus far, descriptions of the feeling component and the physiological components have been addressed. However, these are attributes of all emotional episodes not merely emotions alone.

The level of arousal, the source of the response, and the length of time the core affect is experienced determines if the affect is a mood, emotion, feeling, or attitude (Moore, 2010). All emotions are triggered by some sort of emotion evoking stimulus such as an event, object, or person (Frijda, 1988; Desmet, 2002). A common example could be a teddy bear that one has

owned since their fifth Christmas. The teddy bear stimulates an emotional pleasantness if it is associated with good feelings from previous experiences. It is this exchange that is drawn between the individual and the stimulus that is especially significant when applying emotional concepts to design. Out of all affective states, emotions require a "one-to-one relationship between the affective state and a particular object; one is afraid of something, angry at someone, happy about something and so on (Frijda, 1994 as cited in Desmet, 2008a, p.62)."

It is pertinent to note that the object does not necessarily have to be a physical object or product. Other examples could include a brand, company, or policy to list a few (Press & Cooper, 2003, pg. 44). In addition, whereas all emotional episodes result from a stimulus, a stimulus is not necessarily an object. Emotions must result from an object, not simply a stimulus alone. For example, if one is mad at a remote for not working, but it is in fact the television signal not functioning properly, the remote is the object of the emotion and the faulty television signal is the stimulus that caused the event (Desmet, 2008b). Nevertheless, the individual is able to assess the object of their emotion in most cases (Ekman & Davidson, 1990; Desmet, 2002).

In order for an affective state or emotional episode to be considered an emotion this relationship between the object and the individual has to be present (Frijda, 1994; Desmet, 2002). However, emotions must also be considered intentional, are relatively brief in their length of time, and are characteristic of higher states of arousal (Carlson 1997 as cited in Disalvo 2004,p.251). This sudden increase of arousal is pronounced by the attention garnered either by the stimulus or the object. As Carl DiSalvo explains in *Design and Emotion* ,"Emotion is defined as short, sharp waves of feeling, arising without conscious effort or reflection, usually accompanied by increased activation of the autonomous nervous system—physiological changes in heart rate and respiration (2004, p.251)." Furthermore, the intentionality of the emotion is representative of the relationship that exists between the object and the individual. Additionally, the rise in arousal makes emotional states acute experientially with an undefined beginning or end (Campos,1984; Frijda, 2009; Plutchik, 1965). Thus, emotions are brief and intense in comparison to other affective states.

2.2.2. Other Affective States. Emotions are considered the most applicable affective state for product design because of the direct relationship existing between the individual and the stimulus. However, other affective states may intermingle with emotions or change the perception of a specific emotion or stimulus (Plutchik, 1965 pg. 2). Therefore, brief descriptions of other affective states are provided as follows:

Moods: As defined by Russel (1980), a mood "implies a prolonged experience, often relatively mild, with behavioral demeanor, thoughts, and motivation. For example, in everyday English, an anxious mood implies Core Affect of unpleasant arousal that endures for a long period with the likelihood of worried thoughts, vigilant behavior, and the motive to avoid risk." Moods are differentiated from emotions as they do not require a person-object relationship, but are rather a result of a culmination of experiences (Frijda, 1994; Desmet 2002).

Sentiments: Similar to emotions, sentiments relate to a person-object relationship. Also known as attitudes, this state represents our likes or dislikes, tastes or preferences. However, "although you might be afraid of dogs, actually being frightened by a dog is a different emotional state (Frijda,1994; Desmet 2002)." Nevertheless, an individual who prefers Nike shoes has a sentiment towards that brand.

Personality Traits: Also termed 'emotional traits,' they are specific and long-term affective dispositions of an individual. As Desmet states, "one can have a cheerful or gloomy character (2002)." These states are non-intentional as they do not involve a direct object.

Every affective state characterizes the entirety of experience at any given time. One's personality traits may adjust the sentiments one has and both of these may be altered by the mood one is in; affect is fluid and each layer blends together infusing perceptions. This comingling is reflective of the interplay between cognition and affect.

2.2.3. The Interplay: Cognition and Affect. As Donald Norman explains in his book *The Design of Everyday Things*, "Cognition interprets the world, leading to increased understanding and knowledge. Affect, which includes emotion, is a system of judging what's good or bad…it makes value judgments (20)." What Donald Norman is referring to is a point that all major

theories regarding affect and emotion agree upon; emotions are derived from our evolutionary behavior (Plutchik, 1982). Darwin first remarked on evolutionary evidence of emotions in animals such as the baring of fangs and the sneer of a human (Plutchik, 1982). Thus, emotions are extensions of the initial physiological responses animals require to survive. In Viktor Johnston's book *Why We Feel* he explains, "The attributes of the mind evolve to enhance discriminations when they are functionally useful…as a consequence, organisms have evolved subjective experiences…(and) the neural machinery that underlies this interpretation of reality" (1999, p. 19). Hence, these complex neural pathways are a result of the evolutionary need to guide our actions as subjective experiences can provide more information regarding the survival of genetic traits.

As the affective system is derived from evolutionary responses to stimuli in the environment, individual emotions are responses to specific situations as well. For example, a threat in the environment will communicate danger to the individual who will experience fear and respond with a flight sequence. Johnston continues by stating,

> "emergent properties evolved because they provided solutions to problems that were consistently present and posed habitual threats, or offered benefits, to biological survival in specific ancestral environments (1999, p. 17)."

As shown in Johnston's quote, certain experiences, or rather emotional episodes, provide needed information regarding the environment as desired through evolution. The affective system therefore informs the cognitive system in making analytical, rational, and reflective decisions.

The two systems are interdependent and intense cognitive thought relies heavily on the affective system (Khalid, 2006). Diversely, "emotional reactions typically involve extensive cognitive processing (Khalid, 2006). The field of psychology once viewed emotions as additive 'extras' where emotion rested like a residual layer of film atop more predominant cognitive functions such as learning, thinking, or language (Campos 1984, p. 148). However, extensive research by Oatley (1996) and Zajonc (1980) reveals that affect acts as an anchor to these functions, linking cognitions to associations registered in the surrounding environment (Desmet, 2008, p. 398; Campos, 1984, p. 149; Zajonc, 1980).

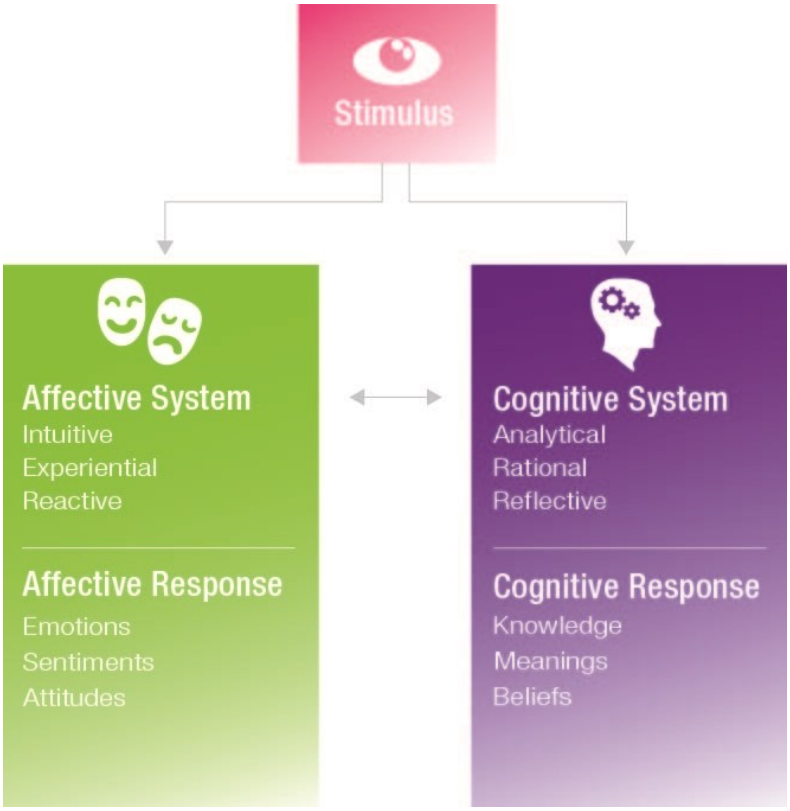

Figure 3. Cognition and Affect (adapted from Khalid, 2006)

The diagram depicts that the affective system (regarded as emotions) is intuitive and occurs quickly; whereas the cognitive system is responsible for most decisions, but is slow. Cognition helps the individual both engage in emotional experiences and also interpret them either in the moment or at a later time. The affective and cognitive systems both vary in the affective states that they access and yet are dependent on each other to create all of these responses (Khalid, 2006).

These are relatively general characteristics and some theorists question the readied involvement of cognition occurring with affect (Moore, 2010). However, one thing remains clear; you cannot have one without the other as rationality implies the use of feelings and emotions simply "motivate a passionate concern for objectivity (Khalid, 2006). " The traditional assumption that emotions contaminate rational thought is not accurate as cognitions and emotions intermingle to create impressions on our behavior (Zajonc, 1980). The interaction between

cognition and emotion as derived from our evolved bodily responses creates impressions of our environment and thus influences our behavior in that environment.

2.2.4. Emotion Theories: How Do Emotions Function? Gerald Cupchik (2004) recalls in his article *The Design of Emotion*, that emotions serve as a conduit to process messages from external stimuli fostered in either the physical or social realms. Our internal interpretation is derived through a degree of consciousness (p.4). This repeats the theme of emotions as a way to describe the interactions occurring between the body and the mind as a result from an external stimulus. Thus far, emotions have been described from an evolutionary standpoint as all emotion theories agree in its integral part of emotion development. However, throughout history the order and possible consequential layering of this interaction has been problematically convoluted and inconclusive despite the extensive knowledge base provided by the fields of psychology and neuroscience (Moore, 2010). Nevertheless, Cupchik (2004) recounts that historically there are two streams of emotion theories either action oriented or experience oriented.

2.2.4.1. Action or Experience Driven; Body and Mind. As presented previously, emotions are thought of being composed of affect, cognition, motivation or a somatic component, and a behavioral or motor reaction. The order and significance of these components defines which emotion theory is being utilized. The difference between action oriented and experience oriented theories depends on whether cognition or affect drives the interaction between the individual and the stimulus, and whether the content of the mind or the reaction from the body takes initiative or precedence (Cupchik, 2004, p.4). Most theorists believe the key is in determining the mechanism responsible for eliciting the emotion (Moore, 2010).

Action oriented theories focus on creating a formula to describe the interaction between the body and mind that are often "reduced to levels of activation or arousal." Schachter (1966) presented the equation Emotion=Arousal+Cognition (as cited in Cupchik, 2004). This equation simplifies emotion to a level of arousal and thought that facilitates goal acquisition. As Cupchik states (2004), "the content of the mind takes priority over a body, which is treated as the mere vehicle of goal attainment (p.4)." Moreover, action theories are then considered top-down as the mind (the top) controls the reactions of the body (the ground or bottom). This concept was

initiated by the James (1884) theory of emotion which proposed a stimulus led to a physiological response in the body that was then interpreted by the mind (Moore, 2010, p. 12). Once attributed to an object, this interpretation would create an emotional experience. However, this theory is viewed as devaluing affective responses and placing too much responsibility on cognition (Lazarus, 1991).

As a result of these weaknesses, these theories that once depended so heavily on physiological responses and conscious cognitive interpretation of affect then began to place more weight on appraising affective conditions. Still in the stream of action theories, the concept of appraisal relayed that cognitions are seen as more responsive and unconscious than deliberate (Lazarus, 1991, p. 357). The process of appraisal still relies on a physiological response, but the stimulus is first appraised or considered prior to an action tendency that activates this physiological response (Moore, 2010, p. 12). Once the behavior occurs, one attributes their feeling or experience to the stimulus that is presented. As Frijda (1988) provides, "grief is elicited by personal loss, anger by insults or frustrations and so forth (p. 272)." The entirety of this interaction composes the experience or emotion. Modern appraisal theorists also propose that the components may intermingle and are not necessarily sequential as one can begin shaking and feel the urge to flee at the same time (Moore, 2010). Still, appraisal is considered action oriented as it is a top-down process and is held in high regard as an accurate modern interpretation of the process of emotions.

2.2.4.2. Experience: the Ontogeny of Basic Emotions. As appraisal theories tend to weigh more heavily on the interpretation of the mind, experience theories tend to place more emphasis on the body. This is embodied first through our physical experience of emotion and then through our social experience of emotion. Moreover, experience theories proposed that "social episodes" or "meaningful characters" frame our interactions with the world (Cupchik, 2004, p. 4). Therefore, emotional experiences are "an organismic response to meaningful life events (Cupchik, 2004, p.4)." Experience theories were initially presented through theories emphasizing Basic Emotions or Affect Programs using a set group of emotions as a representation of innate and evolutionarily derived reactions to stimuli. For example, when presented with an enemy or

foe, one is programmed to fear and the goal attainment is to flee (Plutchik 1965, p. 2). Basic emotions were derived from Tomkins (1962) interpretation of Darwin's evolutionary theory on emotion promoting learned reactions that have been imbedded through evolution (as cited in Campos, 1984). Below is a chart constructed by Drews (2007) which depicts the affective responses as derived through evolutionary responses:

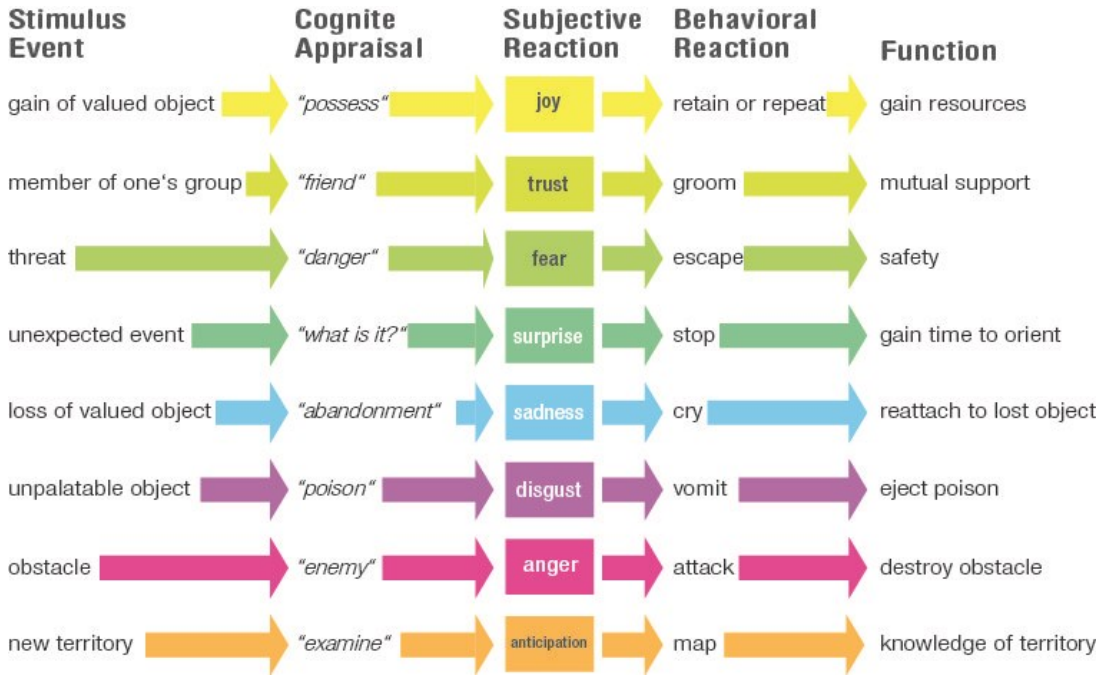

Figure 4. Emotions Derived from Survival and Evolution (adapted from Drews, 2007)

Through the evolutionary study of both humans and animals, there are prototypical patterns of behavior that are enacted during specified situations involving goal attainment. Essentially, "Emotions represent proximate methods to achieve evolutionary fitness (Plutchik 2001, p.348)." Furthermore, Plutchick (1982) proposed that there are "eight patterns of adaptive behavior (which) represent the basic dimensions of emotion applicable to all organismic levels." These emotions result from one of an organism's basic needs such as protection (fear) or reproduction (happiness) (Plutchik, 1965).

These building blocks can be reorganized and combined to identify new emotional experiences so that mixed emotions can be created (Plutchick, 1965, p.2). He claims that, "all other emotions are combinations of these few primary ones, just as all colors are mixtures of a

few primary colors (2001).” Plutchik organized these eight core emotive patterns into an emotion wheel as displayed in the diagram below.

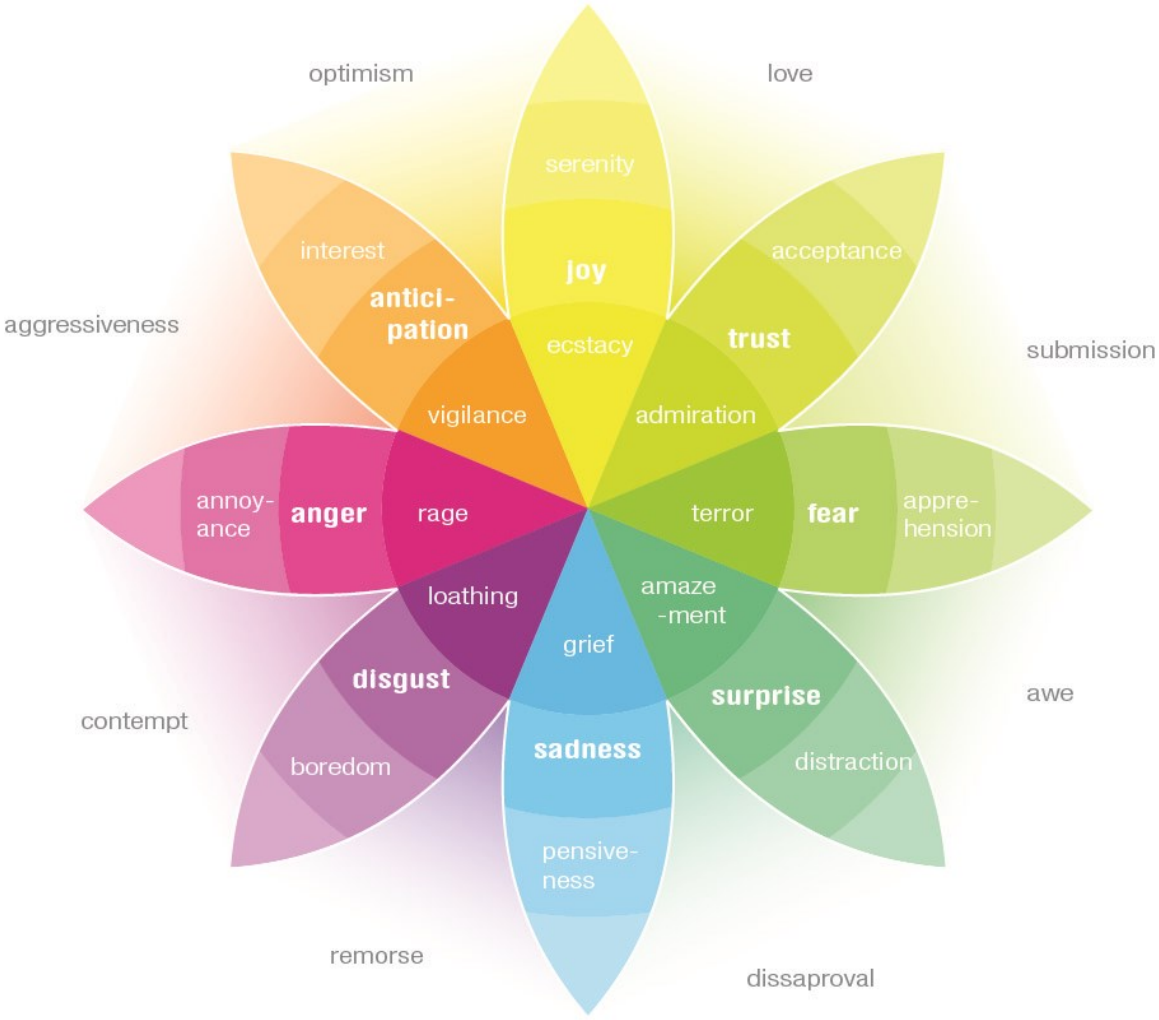

Figure 5. Plutchik’s Emotion Wheel (adapted from Plutchik, 1982)

Similar emotions are placed next to one another, and dissimilar emotions are placed 180° across from each other like in a color wheel. After three decades of confirming his psychoanalytic roots of each core emotion, Plutchik expanded his wheel into a cone to depict changes in arousal across the same emotions. As arousal increases, the intensity of the emotion increases and is thus located more central to the diagram.

It is important to note that other versions of emotion wheels have been contrived throughout history (Plutchik, 2001). Furthermore, Plutchik himself stated that from "Descartes to the present, philosophers or psychologists have proposed anywhere from 3 to 11 emotions as primary or basic (Plutchik , 2001, p. 344)." Pluchik's particular model was chosen as a foundation for this research as it is readily accepted as valid across both the fields of psychology and design.

As provided by the previous research, each basic emotion has a definitive set of evolutionarily derived response, behaviors, and function. For further comparison, the basic emotions are presented below with similar emotional labels and a distinction of negativity or positivity (Markus, 2007).

Joy- Positive. Delight, serenity, cheerfulness, elation, ecstasy.

Trust- Positive. Acceptance, tolerance, admiration.

Fear- Negative. Terror, panic, fright, apprehension, dismay, timidity.

Surprise-Positive/negative. Amazement, astonishment, uncertainty, distraction.

Sadness- Negative. Grief, sorrow, dejection, gloominess, pensiveness.

Disgust- Negative. Loathing, revulsion, aversion, dislike, boredom.

Anger- Negative. Fury, rage, hostility, annoyance.

Anticipation- Positive. Vigilance, attentiveness, expectancy, curiosity, interest.

The singular basic emotion also has an existing relationship to the other emotions as described by Plutchik's wheel. Extensive research exists exploring the qualities of various emotions, but these similar emotions provide foundations for comparison.

2.2.4.3. Simplifying Theories. Cognitively, basic emotions, and ultimately experience theories in general, are considered bottom-up processes as the body leads the mind. The theory is that each basic emotion is representative of a specific neural signature and set of motor reactions. For this theory to be considered applicable as an evolutionarily derived function, the reactions of these basic emotions would be the same across all individuals and arguably across several species (Lazarus, 1991; Plutchik, 2001). More current experience theorists Ekman (1992) and Izzard (1994) have been able to prove cross cultural similarities in physical motor

reactions and thus provided more support for this theory. Thus, similar cross-cultural facial expressions have been found for each core emotion.

Like any other event the human body can interpret, emotions serve a purpose to help understand our experience and make accurate predictions. These two types of theories describe two streams of emotion research as they have been presented throughout time. In truth, they theoretically work together to represent the totality of experience. The following simplified definitions have been provided to help distinguish important characteristics:

> *Experience Theories:* Includes Plutchik's theory of basic emotions. These theories propose "species specific packages of genetic programs, appraisal by goal-relevance and coherence with physiological expressions (van der Veen & Illman, p. 398)." Goal relevance refers to needs driven by evolutionary behavior. The body guides the mind.
>
> *Action Theories*: Includes Componential Theory of Emotions and Appraisal theories. These theories dictate that "emotions are less structured and act on a social dynamic system, where appraisal is based on features where there is a low physical correlation with other aspects of emotion (van der Veen & Illman, p. 398)." The mind guides the body.

In summary, the relationship between the body and the mind can be seen as bi-directional depending on the approach and perspective of the individual. These two streams of emotion theories simply portray the possibility for flexibility in emotion activation. As Cupchick states, "when the mind is dominant, then the body functions in terms of feelings, whereas when the body is dominant, it awakens the mind's eye with memories and symbolically meaningful experience (5)." As a result of applying emotion theories and sensitivities, design can take into consideration both perspectives of emotion theory and use them interchangeably to assist in cultivating both bodily and mentally triggered emotions.

2.3. Design and Emotion

Emotions act as the conduit of human experience; our perceptions, memories, behavior, and motivation are all influenced by emotions. To experience is to be human and emotions are essential to that experience. As previously covered, emotions exist as innate reactions to our

world and there is no exception to material objects. In fact, one might argue that material objects are treated with some level of regard similar to other humans (Jordan, 2002, pg. 7). People develop affective relationships with their products as shown by the love and care tendered to a family heirloom.

Products emotions gathered interest once the reality of their potent interpersonal agency commanded attention. However, emotion and design remains vastly differentiated and intangible as many products may elicit various types of emotions, a majority of experiences lead to a mixed combination of emotions, and individual subjectivity influences emotional perception.

2.3.1. Design and Emotion Theory Standards. In his summary of product emotion theories in *Product Experience*, Pieter Desmet suggests that there are three basic requirements for product emotion theory. First, product emotions must take into account possible variances among individual's and the ability for emotions to change over time (2008, p. 386). Secondly, the theory must acknowledge that emotions contain both vast and minute distinctions that alter the perception of the emotion from surprise to fear or joy to sadness. Thirdly, and possibly most importantly for industrial design, the theory must recognize that the product acts as a stimulus rather than simply focusing on the reaction of the user and alienating the product's initial ignition of attention. It is noted in *Product Experience* that this may be the most troubling goal to achieve as it is often left by the wayside (2008). This is unfortunate as the interplay between the product and user is most assuredly a relationship, and one half of this interaction cannot exist without involvement from the other partner. Thus, products and their users are co-dependent in creating any length of an emotional bond.

2.3.2. Fulfilling Needs. Mel Fruitman, Vice president of the Retail Council of Canada remarked, "The art of marketing is to encourage people to want something, to get them to say, 'I need it so much that I want to have it. I'll forgo something else if need be" (Giard, 2005, pg. 53). The unspoken purpose behind design is to make a product more desirable either through aesthetics, usability/functionality, or an emotional connection. However, the role of design is to create a product that suitably fulfills a need. In Maslow's Pyramid of Needs (figure 6), once the basic needs of food, shelter, protection, and stability are met, individuals will seek higher

standards of needs (Giard, 2005, p. 56; Maslow, 1954). These include but are not limited to the need for friendship, respect, beauty and truth.

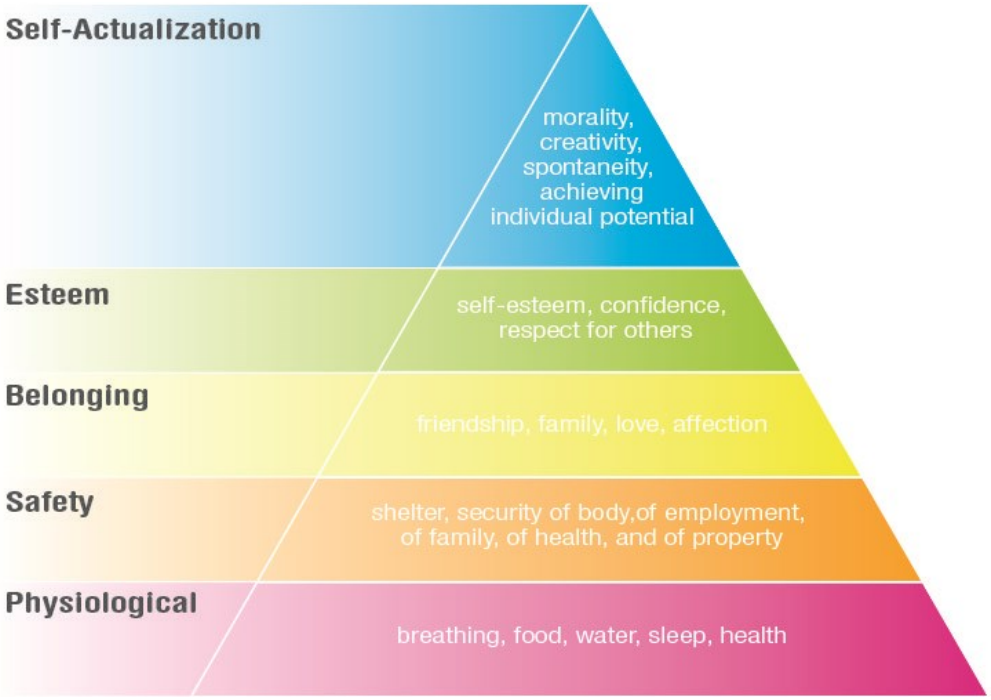

Figure 6. Maslow's Hierarchy of Needs (adapted from Maslow, 1954)

These values reveal that humans are emotional creatures in need of higher levels of connection with their world around them. In addition, each aspect of the human experience is first connected to survival and reproduction before other higher level needs are addressed.

2.3.3. The Pleasure Principle. In response to the emotionally detached outlook of human-factors literature present in the 90's, Patrick Jordan proposed a more holistic viewpoint which extended beyond mere functional usability. Initially, the *Hierarchy of Consumer Needs* (figure 7) was developed by Jordan in 1997 with Maslow's hierarchy of needs as its infrastructure in order to present the potential for a "New Human Factors (Jordan 2001 pg. 4)." Maslow's hierarchy was previously displayed in figure # for comparison, but it is not a subject for debate for this particular research. The point to be taken from Maslow's work according to Jordan is "the idea that as soon as people have fulfilled the needs lower down the hierarchy, they will then want to fulfill the needs higher up (Jordan, 2001, pg.5)." This is nearly synonymous to people getting

used to a particular product as their experiences becomes saturated and therefore they look for something more fulfilling.

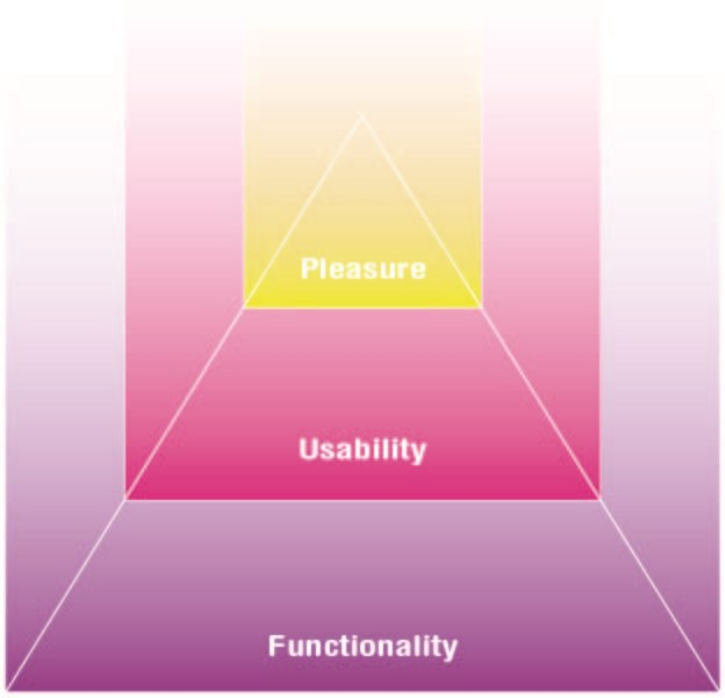

Figure 7. Hierarchy of Consumer Needs (adapted from Jordon 2001)

Jordan argued that consumer's had similar needs as Maslow's hierarchy in relation to the products that they would like to see on the market. For example, functionality is seen as the base of the pyramid and the most basic required element of a product. Without basic functionality, the product will be unusable and will lead an unsatisfactory experience. Proper functionality is only applied when the appropriate limitations within environment and context of use are identified and met (Jordan, 2001, p. 5). Functionality then allows for usability which in turn leads to ease of use in the product context. However, modern human factors practitioners are proficient at providing usability and "it seems evident that people will soon want something more…products that are not merely tools but 'living objects' that people can relate to; products that bring not only functional benefits but also emotional ones (Jordan, 2001, p. 6)." Thus, functionality and usability have created an opportunistic platform for the highest level of satisfaction—pleasure.

Pleasure is currently the ultimate, highest need a product can fulfill for a potential user (Jordan, 2001, p.6). Although these pleasures that may be derived are initially seen as successive, Jordan claims that "it has been shown that consumers can choose products based on pleasure, while compromising functionality and usability (Jordan, 2001, p. 6)." Therefore, it is concluded that products created for emotional connections and more extensively pleasure while maintaining other basic requirements of use, may garner more support in the market than other products as they provide a flourishing emotional presence.

Jordan expanded his pleasure theory when he divided pleasure into four groups: physio, socio, psycho, and ideo pleasures. Physio-pleasure is engendered by "sensory organs" which include touch, smell, and sensual excitation. Feeling the smooth texture of a surface or the smell of a new car are both examples of Physio-induced pleasure. Socio-pleasures are based off of "interaction with others (Desmet & Karlsson, 2008b, p. 326)," or rather a need thereof. For example, creating the social identity of a yuppie wearing a polo shirt and driving a Porsches may represent the socio-pleasure obtained through a higher sense of status. Psycho-pleasure is the act of satisfaction from the completion of a successful function from the product. A successful psycho-pleasure might occur after using an app that successfully and easily appropriates the tip amount while visiting a restaurant. The final level, ideo-pleasure, is considered the most "abstract," is based off of the values presented such as being eco-friendly or inspirational. This type of pleasure is most applicable to the aesthetics of a product and would categorize "products as art forms (Jordan, 2001, p.14)."

Particular limitations regarding the pleasure principle should note that the theory is provided as a way to categorize and address pleasure potential in products, not to suggest that all products must contain all four types of pleasure. This is merely a tool for designers and similar practitioners to understand the rationale behind types of possible pleasure that may be created or controlled. Further, pleasure "can be thought of both as the elimination of, or absence of, pain and also the provision of positive, joyful feelings (Jordan, 2000, p.15)." This suggests wide range of possible applications for the theory.

2.3.4. Norman's Emotion Processing. In Donald Norman's book *Emotional Design: Why We Hate or Love Everyday Things*, he describes three levels of processing that are performed when an object is observed, used, and considered. Norman based this conclusion off of the research done by Norman, Ortany, and Revelle which recognized three levels of processing in the brain (Norman, 2004). Norman reaffirmed these processes in the product experience of emotions as shown in figure 8.

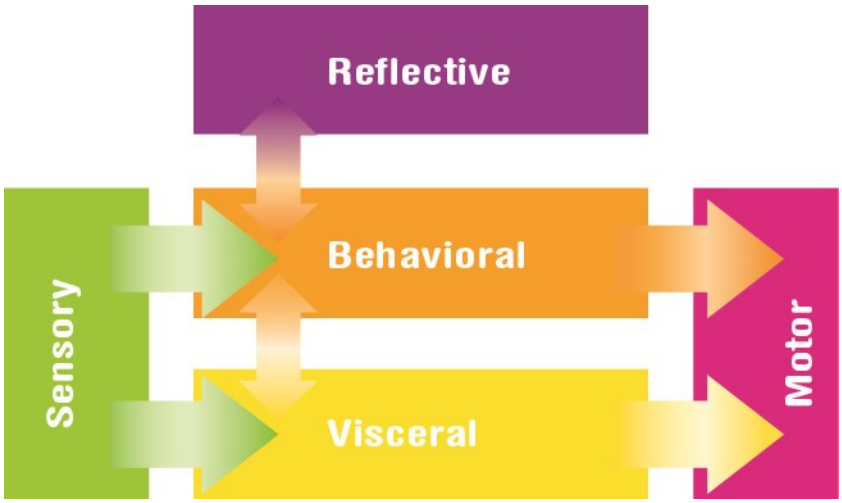

Figure 8. Norman's Three Levels of Processing (adapted from Norman, 2004)

The initial level of processing is referred to as the visceral level. This level occurs within seconds as it is the automatic and prewired response based in biological functioning. He describes the visceral level as "fast: it makes rapid judgments of what is good or bad, safe or dangerous, and sends appropriate signals to the muscles (the motor system) and alerts the rest of the brain (Norman, 2004, p.22)."

The visceral level is in charge of the first impressions of a product and the initial emotional response an individual has as well. As Donald Norman explains "What does it do....and how much does it cost....this is the reaction the visceral designer strives for, and it can work (2004, p.68)." Designers have a matter of seconds to make an impression on the purchasing actions of potential users. The visceral level of product design attempts to reach the user through the physical features of the product; the aesthetics, materials, and sound of the product play an important role in creating an affective stimulus.

The next level, called the behavioral level, frames the use or the function and performance of the product. While in this mindset, one can "visualize a situation and alter their behavior accordingly (Norman, 2004, p. 3)." In animals, this level of functioning is seen in dogs with territorial tracking behaviors. Repetitive performances in humans, such as skilled labor, are examples of this level at work. The behavioral level is responsible while physical and behavioral actions are being performed. These "actions can be enhanced or inhibited by the reflective layer and, in turn, (they) can enhance or inhibit the visceral layer (Norman, 2004, p. 2)." Thus, each layer's responsibilities and impression can negatively or positively determine the success of the other levels.

The topmost reflective level focuses mainly on the highest levels of feeling, emotions, and cognition. Although the reflective level of a product provides the most extensive thought processes to occur, it is limited as the sensorial input and motor control related to behavior cannot be accessed through this level. Moreover, the reflective level "watches over, reflects upon, and tries to bias the behavioral level (Norman, 2004, pg. 3)." While the other two levels are considered subconscious biological or physiological reactions, the reflective involves conscious thought and attributed attention. Moreover, Norman concludes that full emotions are achieved in this phase, while more basic stimulus activity and core affect are experienced in the visceral and behavioral levels respectively. While Norman's theory determined that emotions occur only in the reflective level, current appraisal theory suggests that types of emotion appraisal can occur in all three stages of processing (Desmet, 2008, p. 388).

2.3.5. Desmet's Product Appraisal Theory. Changes in our environment, whether great or small, are prone to evoking an emotional response (Fridja, 1986). As covered in previous sections, emotions are initial responses where a stimulus is first evaluated as good or bad. Although this is just one portion of emotion attribution, this evaluated pleasantness or unpleasantness is also where value within an object is initially identified. "Value judgments can be conscious or unconscious," but it is the point at which the evaluation becomes conscious that this process is considered appraisal (Adams & van Gorp, 2012, p. 32). There are two types of

appraisal: primary and secondary. Primary appraisal is marked by identifying a concern; the individual must have a conscious need to fill.

Secondary appraisal is more complex as it occurs when “an individual has the necessary internal and external resources to address the event, object, or experience (Adams & van Gorp, 2012, p. 32).” The potential for goal acquisition is identified in this stage as the product has been compared to a concern and the resulting emotion is then determined. In Pieter Desmet’s pinnacle dissertation (2002), he constructed an appraisal model relevant to product design as shown in figure 9.

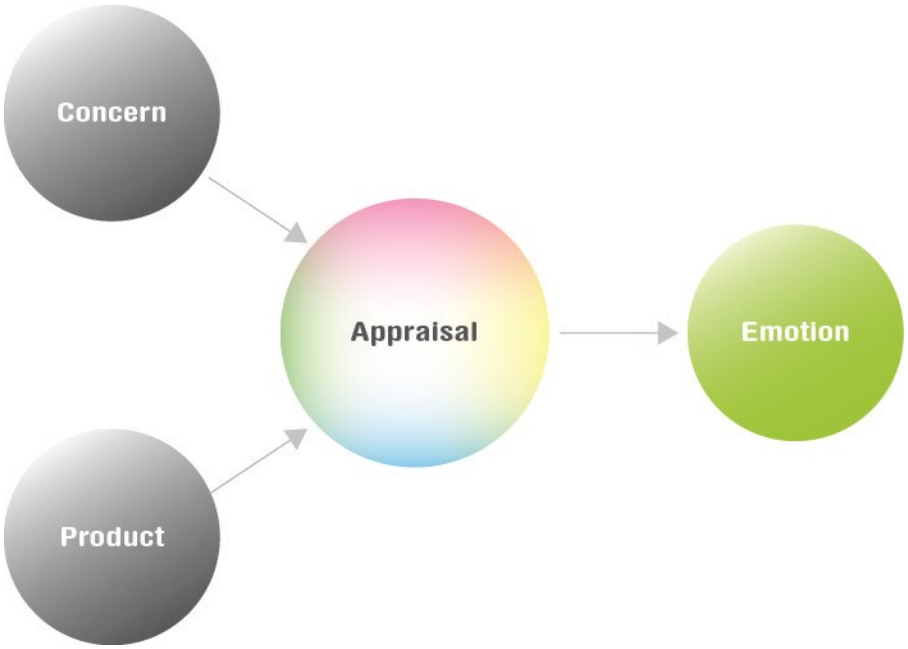

Figure 9. Desmet’s Appraisal Model (adapted from Desmet 2002)

If the object or product is seen as coinciding with our concern, then the resulting emotion is positive. If the object and concern are mismatched, then the resulting emotion is negative. As discussed previously, appraisals developed from recognizing adaptive advantages and disadvantages in the environment (Lazarus, 1991). Similarly, products can be associated with our needs and desires (Jordon, 2002).

Desmet (2002) provided an example of a girl Anna who purchased an alarm clock specifically designed to awaken her with light. The clock acts as the object which promises to wake Anna with light alone. Anna’s concern is that she wants a clock that wakes her successfully

without a loud obnoxious noise. Once Anna wakes successfully, she appraises her purchase of the alarm clock as positive and admiration for the alarm clock's creator is her resulting emotion. Thus, through the perceived potential for a product to meet the concern of the individual, a positive reaction may ensue.

The important distinction of Desmet's model is that he claims that products can evoke specific emotions in the user such as anger, disgust, surprise, or inspiration. His model goes beyond simply acknowledging that these processes occur, and reveals how emotional conclusions are consciously registered by the individual. A significant point should be clear; Desmet promotes emotion elicitation in the individual.

2.3.6. Product Emotion Elicitation. Jordan, Norman, and Desmet exemplify how products can create an emotional response from a product. Each one of these theories shows that we meet basic needs and experience physiological responses to products at the initial onset of interaction. Once these emotional ties are drawn, our experiences tighten this emotional connection with the product. As a result, a pleasurable and reflective emotional bond to the product is sown.

2.4. The Human and Product Relationship

The relationship between an individual and a product can be seen as an exchange of information or purpose fulfillment, but theorists believe this is simply the bare minimum required for any product. As barren as it sounds, product functionality has long been deemed as the most relevant of product attributes (Jordon, 2000). The belief that products can have a much deeper impact in the lives of people has become more evident through time. One area of interest has focused on prolonging the human and product relationship through attachment.

2.4.1. Attachment. Attachment between humans is defined as an "emotion-laden target specific bond between two persons" (Mugge, Schoormans,& Schifferstein, 2008, p.425). When this occurs, "a lasting emotional tie between people" will be established and "the individual strives to maintain closeness to the object of attachment and acts to ensure that the relationship continues" (Fogel, p. 310). Due to our innate attachment strategies, people seek similar bonds with products. Products are not limited to basic tools we can acquire; rather they have become

“living objects with which people have relationships” (Jordan, 2000, p. 7). Similar to human-to-human relationships, attachment with products defines the “strength of the emotional bond that can occur between a person and a specific product” (Schifferstein, Mugge and Hekkert, 2004). Current research on product attachment states there are three parts to the definition (Mugge,Schoormans,& Schifferstein, 2008, p. 426).

First, product attachment suggests a complete relationship with an object that exhibits ties extending from both the individual and the product. Character attributes of the individual including preferences, personality, and current mood can all frame the context in which a human-to-product relationship is both established and maintained (Savas, 2004, p. 317). The ability of the product to fulfill its function, have inviting aesthetic characteristics, and create an enjoyable experience encourages attachment emotions (Mugge,Schoormans,& Schifferstein, 2008, p. 427-428). Other influences such as memories, the consistency of product use, or the period of ownership, can continue to either hinder or assist in maintaining this bond (Savas, 2004, p. 319). Essentially, product attachment is derived from the interaction of two contributing parties: the product and the user.

Second, relationships with products can occur with varying degree, from an intensely bonded relationship to a more meaningless detachment (Savas, 2004, p. 319). The strength of an emotional attachment is characterized by its ability to obtain extra-ordinary meaning. It was initially thought that time must pass for attachment to take place, but recent research suggests that’s not necessarily the case. New products are associated with achieving more enjoyment as old products are associated with positive memory recall (Schifferstein, Hekkert, 2004, p. 329). Thus, even new products can obtain attachment qualities as long as they can “provide a special meaning and, therefore, exceed their merely utilitarian meaning to the owner” (Mugge,Schoormans,& Schifferstein, 2008, p. 427).

Third, product attachment implies that the interaction with the object occurs during an emotional state (Jordan, 2000). Products can display a range of emotions, but positive emotions are most often regarded as the source for sustained attachments (Desmet, 2012). Little or no emotions are exhibited if there is no attachment (Mugge, Schoormans & Schifferstein, 2008,p.

425). Products with developed relationships will also exhibit a variety of emotions (Thompson, 2004, p.332). For example, an heirloom might invoke both happy and sad memories regarding the individual who originally acquired the possession. Nevertheless, projecting a positive emotional state from the initial onset of the product and human relationship may help to introduce a foundation for attachment to fully reside.

2.4.2. Attachment as a sustainable strategy. The sustainable culture that is seen as so prolific today has gathered interest since the first use of the term "planned obsolescence" in 1932 (Chapman, 2008, p. 59). Concern regarding the life cycles of products has only multiplied over the years. The life cycle of products is consistently being considered prior to production. Qualities of materials, recyclability, and the product lifespan are characteristically areas garnering the most attention during a product's sustainability analysis (White, Belletire, & Pierre, 2004). Contemporary design strategies go beyond evaluating the product and reflect on a more novel outlook. As Jonathan Chapman states, "it can be seen that durability is just as much about desire, love and attachment, as it is fractured polymers, worn gaskets or blown circuitry (Chapman, 2008, p. 59)." Traditionally from the designing and manufacturing perspective, product durability is associated with functionality rather than the consumer's desire to continue to own the object (Verbeek& Kockelkoren, 1998, p. 31).

Eternally yours is a group of industrial designers who focus on "cultural sustainability" not only to "strive for sustainability, but also for durability, by designing products in a way that stimulates longevity (Verbeek &Kockelkoren, pg. 2)." In *The Things That Matter* authors Verbeek & Kockelkoren offer an expansive meadow of philosophy arguing for a more thorough approach to culturally extending the lives of products. Their opinion of our society is as follows:

> We live in a throwaway culture. We discard products while they are still in good shape. It is not enough to make less polluting products, however important that may be, when they are replaced at high speed because people throw them away too soon. The environmental crisis is not only a technological problem, but a cultural problem as well (Verbeek& Kockelkoren, pg.. 1).

Products have become secondary citizens to this planet and are quickly discarded as a result. Once a quality product, such as a set of frying pans or a clothing iron found in the house of an

elderly couple, were regarded with high value for their longevity and sturdiness. Today, similar relics can be found in abundance at thrift stores and landfills cast aside for fashionable alter egos. While these products are still functional or easily repaired, designers and all creators must ask themselves why this is occurring. Exploring how products can be perceived as more than just throw away objects is only possible through creating intrinsic value. Designers are capable of turning over this paradigm by investigating empathetic qualities of products and engendering innate relationships.

2.4.3. Formation of an Emotional Product Relationship. Demir (2008) considered several existing models of emotion processing and product experience to help explain the development of the human and product relationship (p.139). From product experience frameworks, he recognized a consistent thread in time frame distinctions between types of emotional experiences. Short emotional experiences were often referred to as innate responses similar to pricking one's finger. Long emotional experiences were thought to involve some amount of reflection that can be seen in a weeping widow at a funeral. Finally, he noticed that these episodes are often described as building upon each other to create a "deep and sustained meaning" that results in a bonded product-user relationship (Demir, 2008, p. 138-140). He formulated his conclusions into the model below.

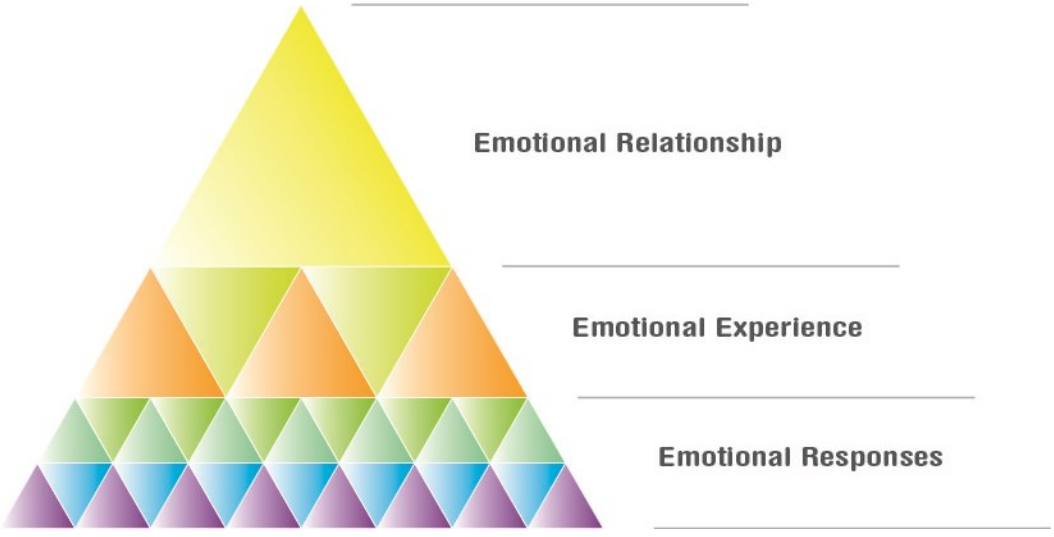

Figure 10. Responses > Experiences > Relationships (adapted from Demir 2008)

This hierarchical structure advances from systemic reactions based in neurological responses to a stratified bond dependent on prolonged interaction and magnified affective states (Demir, 2008, p. 140). Layered in levels of emotional exposure, each individual response builds to an additive process of creating a relationship. This emotional relationship is not dependent on one singular affective experience, rather the culmination of a product to "evoke meaningful moments during the course of the relationship…may give rise to mostly pleasant experiences" (Demir, 2008, p. 139). Affective stimuli and responses extend beyond basic functionality to "sentimentality, aesthetics, personal taste, touch, smell, feel and personality" (Demir, 2008, p. 140). Conclusively, Demir exhorts that behavioral evidence of a relationship is obvious as the individual has a "tendency to care for and caress the product and keep the product as long as possible (Demir, 2008, p. 140)." In essence, Demir's model suggests that if a product is able to create sustaining value with its user, this may evolve into a bonded relationship.

2.4.4. Creating Value. Humans are driven by a layer of subconscious influences underlying every action. Physiological responses, genetics, cultural upbringing and sociological interaction combine to establish our personal cognitive constructs (DiSalvo, Hanington, & Forlizzi, 2004). Nevertheless, these influences often reveal how people determine value within the world around them and more concretely within the products that they purchase. Value is an underlying characteristic that drives our willingness to not only purchase products, but to keep them, maintain them, and envision them as personal contributions to our lives (Savas, 2004; Demir, 2008). Savas (2004) provides, **"**One of the reasons underlying today's high consumption levels is the weakening of the emotional link between people and products" (Savas, 2004, p. 318)." Through advancing an emotional link, products can gain value. Thus, in order to cater to individuals, we must truly understand what creates value and how it is affected. Through analyzing how product experiences are first engaged, the importance of emotional cues becomes apparent as emotions are the underlying precept to how an individual interprets a space, object, or service.

Social identification of self, individuality, personality, and personal history are often displayed with successful attachment (Demir & Erbug, 2008, p. 84). As one participant of a study conducted by Demir and Erbug (2008) said,"I am quite satisfied with this watch. It just suits me

very well. It has an unimposing style. I am in general an unimposing person (p. 84)." The participant saw the watch as an extension of her personality; a physical representation of self. People are now expecting their products to hold higher meaning for themselves and thus raising the standard for emotional qualities presented in product design. Furthermore, with an abundance of available products and "alternatives, product users have become more demanding. They are now pursuing rich and pleasurable experiences within products (Demir & Erbug, 2008, p. 79)." Despite our rampant tendency to dispose of objects in general, recent philosophy on products asserts that the answer is not in the objects themselves, but in how we develop relationships with those objects.

2.4.5. The Rise of Consumerism. Histologically, people found meaning and value in contrived experiences established through cultural icons of religious foundation, social celebratory practices and ritualistic endeavors that distracted from the mundane every day activities related to survival (Press & Cooper, 2003). With the modern invention of tools came the ease with which people could complete similar tasks in relatively shorter spans of time providing more time for leisurely activity (Giard, 2005). In addition, people began to become dependent on both their new found freedom and the vast amount of trinkets acting as supporting roles in personal productivity. Consumerism today promotes store fronts of alternative meaning to a secularized economy (Jones, 1992, p.59).

Consumption is no longer merely a necessary act for survival; it provides an abundance of objects to advance and define personal style, identity, and social groups (Patler & Kurtgozu, 2004, p. 404). Michael Press and Rachael Cooper (2003) stress that we increasingly "define ourselves in terms of our styles of consumption and the values about our lives that they express…ours is a culture of acquisition, possession, and consumer experience" (p. 11). As objects in one's life act as agents of experience, these supplemental experiences help frame the culture in which one lives (DiSalvo, Hanington, & Forlizzi, 2004, p.252). These modern day tools, or rather products, have moved beyond simply assisting survival needs and in turn help shape the consumer culture that is present today (Giard, 2005).

The number of objects in the average household roughly one hundred years ago was around 500, which included furniture, cookware and other similar items. On the contrary, 3,000 objects or more flood the average household today—and this number only reflects "hardware" and does not include the numerous software applications, digital media, or programs on computers and TV (Press & Cooper, pg. 11). Globalization has since removed the predated national and cultural identities placed on objects and since then, brand identities and product styles have replaced them as signifiers for quality and identity (Chapman, 2008).

2.4.6. Semiotics. Objects in the environment, especially products that are purchased, act as "signs" that communicate various levels of attributes to the observer. Semiotics is the study of these signs which extend to "how words, photographs, styles and other design forms can work as a language to communicate a range of ideas, associations and feelings" (Press & Cooper, p. 17). In essence, it is a "study of culture and all of its components, physical or virtual, ordinary or extraordinary, verbal or visual" (Boradkar, 2012, p. 215). Furthermore, semiotics extends to anything that may be seen as a sign, but plays a particular role for design. Designing products, in theory, is the very act of creating new signs of meaning within the environment because each object conveys a set of information to be interpreted by an observer (Borakar, 2012, p. 216).

According to communication theory, once a perceived amount of information is recognized by a recipient this information then is filtered through the individual's "experience, education, individual values, and personal character" (Keller, 2004, p. 69). In the case of appraising people and things, objects that are seen as reflecting one's own perceived view of self are more likely to draw attention (Adams & van Gorp, 2012, p.123). Hence, every product that is purchased is "an expression of who you were, who you are, and who you want to be" (Adams & van Gorp, 2012, p. 85). Additionally, "we perceive product personalities based on the qualities of the same aesthetic and interactive cues that communicate human personality traits" (Adams & van Gorp, 2012, p. 85).

A study conducted on perfume bottles by Wellmann, Bruder, and Oltersdorf (2004) explored the possible significance between semantic gender characteristics in design and their correct perception by possible consumers (p.87). In total, 24 perfume bottles, 12 pairs of both

female and male perfume brands, were shown to forty students accompanied with a set of questions regarding the perception of gender for the forms. Their findings resulted in the strong ability for the participants to identify female forms, but only half of the male forms were identified correctly. The stronger the semantic connection to male characteristics, the more likely the participant was able to identify the bottle as male.

Neutrality in the forms, or rather a weaker sense of male characteristics, resulted in those forms being incorrectly sorted into the female category. The authors suggest that this is due to the long-standing cultural patriarchy and "in brief, everything that is not specifically masculine is automatically labelled feminine" (Wellmann, Bruder, & Oltersdorf, 2004, p. 89). Moreover, the stronger the semantic signals, the more likely the individual will correctly interpret this communication in an expected manner.

2.4.7. Product Communication. Communication begins prior to the interpretation of the product as a stimulus and requires some form of "language" that is exchanged from the sender to the recipient (Keller, 2004, 69). Information is gathered through the five senses of the individual and then processed through their personal characteristics as mentioned in the last section (Clarkson, 2008; Keller, 2004). When considering emotions, this information is interpreted through an affective state and subsequently judged (Keller, 2004). This interaction is beyond the will of the sender and it is suggested that certain precautions are taken in order to present information accordingly. Accessing as many senses as possible and offering any additional information provides clarity in processing an intended message (Clarkson, 2008 p. 187; Keller, 69). The interaction flows through a process with the first step consisting of the initial environmental stimulus "that can be quantified, measured, and reproduced" (Bonapace, 2002, 194). Stimuli are collected with the various senses and this information is transmitted to the individual's perceptual abilities such as memory or decision-making faculties. Motivation and emotion are then attributed to the stimulus resulting in behavior. Hence, behavior is reliant on the cognitive and psychological processes within the individual (Bonapace, 2002).

Clarkson provided a process representing an individual communicating with a product. Communication, in this sense, is the ability to send, receive, and interpret information (Clarkson,

2008, p. 186). This interaction includes several cycles of three phases: perceiving, thinking, and acting (Clarkson, 2008). Perception relates to the "ability to comprehend information" which can include the semantic physical arrangement of the product's pieces and the shape or form of a product as a whole (Clarkson, 2008, p.186). Thinking includes the effects of working memory, attention and performance, visual-spatial thinking, learning, recall, and long-term memory. Acting describes any "ability to transfer information to a product" which can occur in several ways such as manipulating controls or using an interface (Clarkson, 2008, p.186).

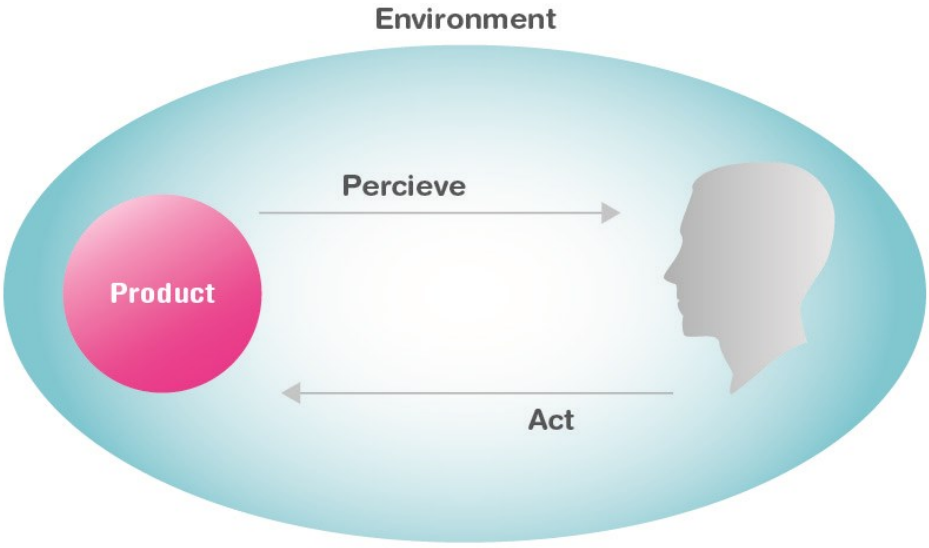

Figure 11. A Model of Product Interaction (adapted from Clarkson, 2008, p. 186)

This communication model suggests an exchanging relationship between the product and the user. It is important to note that this model exists on a contingency, continually cycling through phases of perception to promote interaction. As information is processed, it is passed back and forth between the user and product. Thus, each portion of this interaction is dependent on the engagement of the other half of the communication cycle.

A product's design, in itself, can be seen as a composed set of information (Restivo, 2004, p. 58). The communication process exists on a social dynamic, and as such the product design acts as one half of the communication cycle (Restivo, 2004). Similar to human to human communication, for a message to be sent, prior intentions have to be made by the sender in order for it to be interpreted successfully (Keller, 2004, p. 71). By consciously constructing emotional

cues, designs may be capable of sending more valid information regarding the product. Harnessing this ability is relevant to the future of design. Keller (2004) concludes:

> Based on the assumption that interpersonal communication will continue to have a very high rating in our society in the near future, it can be stated that emotional information added to that which is being conveyed serves as an aid to understanding it (decoding or assembling information fragments). This additional information, which can make use of all human sensory organs, is critical for the recipient's error-free interpretation of the information. A consequent requirement placed on innovative devices of the future is to incorporate more perception channels in communication and so give the sender information an opportunity to enrich it with additional, emotional information.

He presses the use of emotions as a way to activate all the senses and aid in efficient perception. In this way, emotions can be viewed as an additional conduit to process information to the user and enhance the overall product experience (Restivo, 2004, p. 58).

2.4.8. Product Experience Models. Experience models encompass the varying attributes that can have an impact on the user's interaction with a product. Product experience is the culmination of all levels of perception, but the models tend to focus on the affective experience drawing on existing emotions research for their frameworks. Experience models are taken seriously for their aptitude to create meaning in the human and product interaction that can result in lasting relationships, a solid brand identity, and enhanced use (Disalvo, Hanington, & Forlizzi, 2004, p. 254; Zeithaml, Bitner, & Germier, 2009).

The following model was developed from combining the theory of experienced cognition by Carlson (1997) and the concepts of emotional stimuli as presented by Dewey (1934) (as cited in DiSalvo et al, 2004).

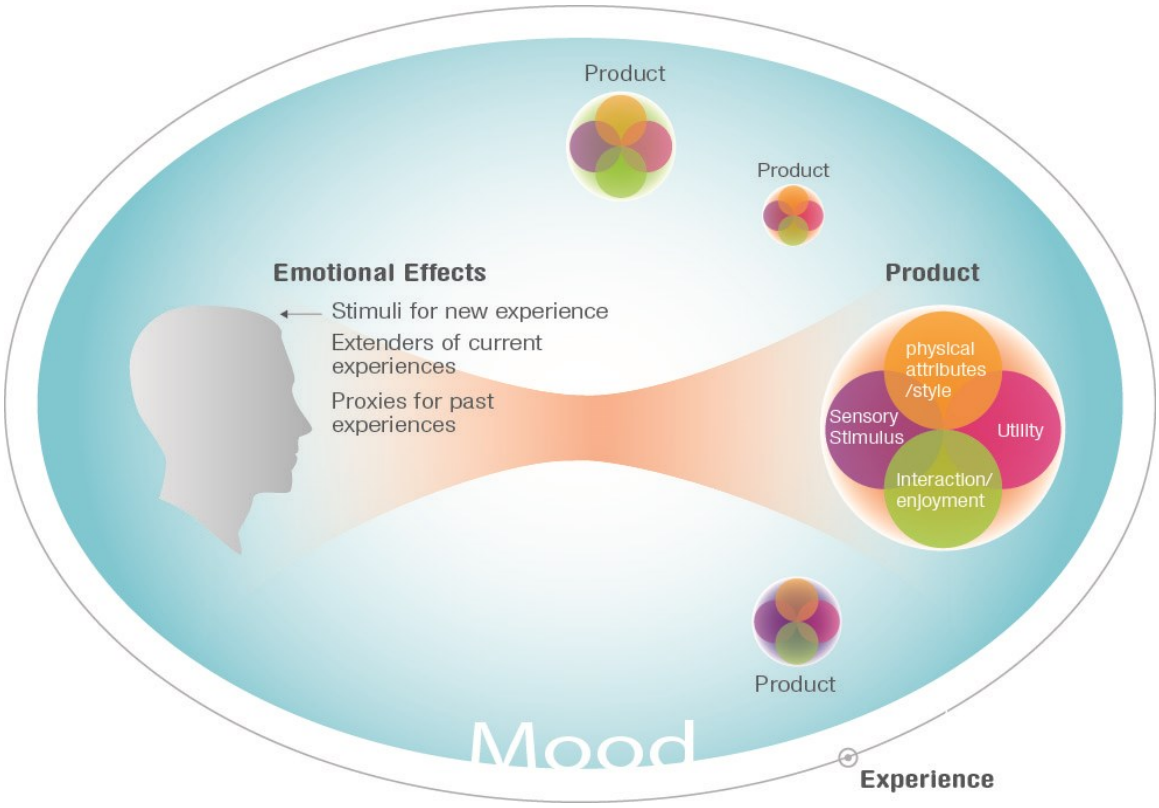

Figure12. A Framework for User-Product Experiences (adapted from DiSalvo, Hanington, & Forlizzi, 2004, p.253)

The theory of experienced cognition expresses “the state of arousal that comes with emotion and mood shapes the environmental information that we perceive;” emphasizing that mood and emotion have different results in interpreting information and perception formation (DiSalvo, et al., 2004, 252). Dewey (1934) considered emotion as pervasively molding experience. The model above was created to display that emotions are a culmination of involved stimuli within the environment. The seminal aspects of this model as it relates to the current study are found within the recognition of the multiple stimuli from the same product influencing emotion; the consideration of future, past, and current emotional effects; and the acknowledgement of multiple product qualities influencing behavior. Ultimately, this model holds that the individual creates a relationship with the product overtime from existing perceptions to novel perceptions yet to come (DiSalvo, et al., 2004).

According to Desmet and Hekkert (2007), product experience encompasses “all possible affective experiences involved in human-product interaction” including instrumental, non-instrumental, and non-physical interaction. Instrumental interactions can be seen as operating the product, non-instrumental represents the unnecessary interactions with a product, and non-physical refers to fantasizing or remembering interactions. In effect, these interactions can produce a variety of emotional responses from the user. These interactions culminate into the total product experience. The total experience with a product can elicit a varying degree of reactions from the users which include the physiological reactions, “subjective feelings, behavioral reactions, (and) expressive reactions” (Desmet & Hekkert, 2007). Respectively, the product may act as an exciting stimulus and make someone feel happy, which may draw them closer to the product and allow them to express their degree of pleasure (Jordon, 2002). A large portion of research has sought to acknowledge what attributes cause such a reaction. Desmet and Hekkert produced the following model as a collective depiction of the body of literature on product experience as a means to simplify their conclusive evidence on the topic.

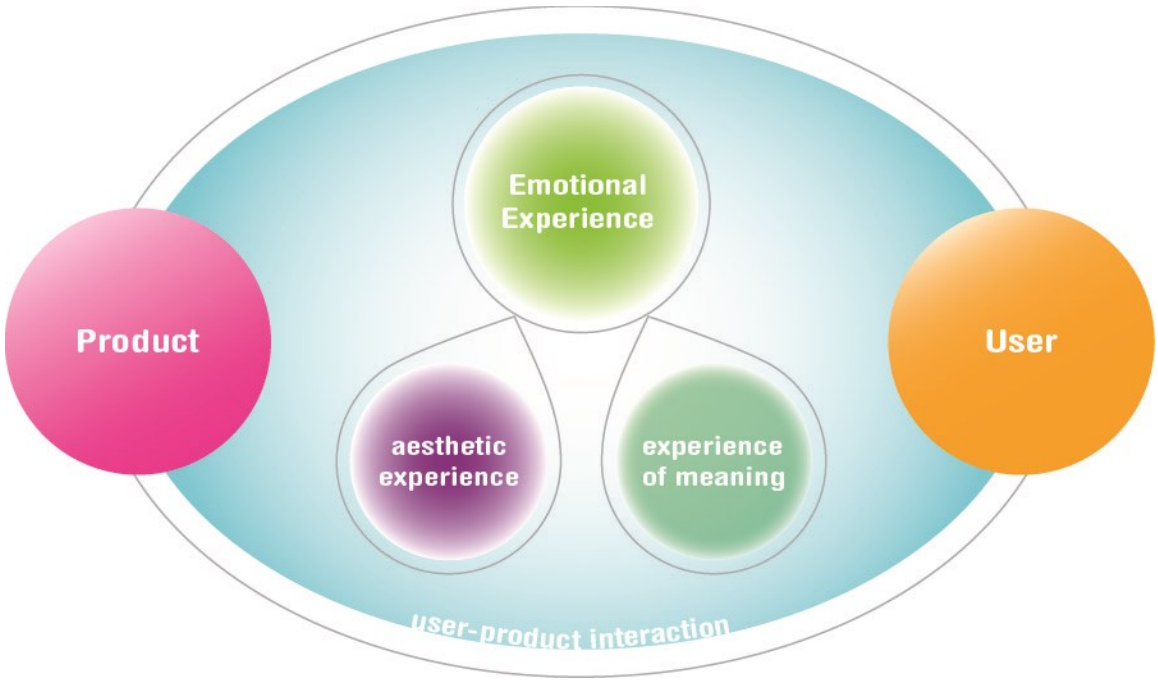

Figure 13. Framework of Product Experience (adapted from Desmet & Hekkert, 2007)

As one can see, the user and product interaction continuously cycles through stages of experience as long as the interaction is taking place. This interaction acts as a culmination of smaller, secular attributes. Desmet & Hekkert (2007) define the three experiential components in product experience as:

(1) Aesthetic experience (gratification of the senses),

(2) Experience of meaning (the elicitation of feelings and emotions)

(3) Emotional experience (the understanding of feelings and emotions).

Aesthetic experience in this model is not limited to the visual sense alone and instead can result from any of the senses. A leather bag, for example, can look appealing, make pleasant noises, feel smooth to the touch, and smell pleasant. Moreover, this is an example of "aesthetics interaction" which promotes that beauty can be experienced through physical touch alone. This ideal focusses on the "kinaesthetics" of touch, rather than the singular visual sense (Desmet & Hekkert, 2007, p. 59). Beyond the experience of the senses, the experience of meaning activates the cognitive processes of "interpretation, memory retrieval and associations, (and) we are able to recognize metaphors, assign personality or other expressive characteristics, and assess the personal or symbolic significance" (Desmet & Hekkert, 2007, p. 60). The last level of experience, emotional, has been covered extensively in previous sections. Desmet and Hekkert (2007) sum up this complicated interaction as "pleasant emotions pull us to products that are beneficial, whereas unpleasant emotions will push us from those that are detrimental for our well-being" (p. 61). Through experiences, individuals begin to create emotional interpretations of presented objects. In turn, these perceptions aid users in understanding the purpose and use of the product and further strengthen emotional connections.

2.4.9. The Product Experience Relationship. Within the human and product relationship, there are opportunities to exploit how these bonds are created and maintained in order to further the overall product experience. In doing so, these incremental steps can build upon one another delivering satisfying and memorable moments. In the long term, these interactions develop into something more—an experience relationship that can stand the tests of time.

2.5. Visual Perception and Aesthetics.

In the previous section, the communication and product experience models both identified sensory perception and individualized characteristic stimuli as engaging the user's attention. Aesthetic perception, in particular was identified as having a strong impact on the user's experience. The amount of information transferred from visually perceiving an object is abundant and subconscious. However, this does not lessen its importance for correct and valid interpretation; in actuality it increases the need for an immediate recognition of form, functionality, and purpose within the object (Norman, 1988, p.9).

2.5.1. Visual Perception. The first impression of an object helps explain the purpose of the object. As Donald Norman explains, "negative emotions kick in when there is a lack of understanding, when people feel frustrated and out of control—first uneasiness, then irritation, and, if the lack of control and understanding persists, even anger (2004, p. 77)." If a person is unable to distinguish the functional qualities or purpose of the form through aesthetics they will be unable to fully understand the purpose of the object. Understanding the form is essential to both recognizing the function of that form and also interpreting its meaning. The need to instantly understand our environment is within our natural instincts. As quoted by Chang and Wu (2009, p. 667) they explain,

> The ability to recognize and distinguish objects is important to human beings and all sorts of creatures. Animals need to recognize and tell the other party the enemy or the prey, poisonous or not poisonous within the shortest period of time so as to make proper decisions.

Chang and Wu (2009) are signifying that object recognition is driven by an innate biological instinct found in all animals that aids them in understanding their environment. Animals must judge their surroundings instantaneously in order to acknowledge threats and opportunities. Therefore, physiological responses that lead to object recognition are examples of evolutionary signs of attempting to understand one's surroundings.

In the article *Capturing Product Experiences: a split-modality approach*, the authors separated the use of sensory experiences of products in order to gage the dominant sense. The results of the study discovered that the visual sense was most prominent in interpreting an

object's identity. The authors suggested that "when people encounter an unknown object, they instinctively try to determine its identity and its potential usefulness (295)." Moreover, they discovered that "vision and touch provide the most detailed information about a product (312)." Therefore, designers can be assured that the use of the visual and tactile senses generate a majority of perceptual information.

Chang and Wu (2007) state that it "is often argued that much of object recognition occurs up the most general category level of abstraction, the basic or entry level" (p. 667). These authors argue that the underlying factors of a form are defined by "specific shape characteristics" that are first identified by global features followed by local features (Chang & Wu, 2007, p. 668). Moreover, products are analyzed by their overall form and then smaller details are later taken into consideration. Thus, a more complicated form may be more difficult and take longer to interpret.

2.5.1.1. Geon Theory. According to Berlyne (1971), "the recognition system is tuned to the specific shape characteristics of categories of objects and the representational object space is structured into classes of perceptually similar objects that share a basic set of features" (as quoted in Roberts, 2007). The controversial recognition-by-component theory, or Geon theory, was introduced by Beiderman in 1987 to help explain the tendency for people to readily identify like objects (Bouton, 2007, p. 292). According to this theory, all objects are made up of perceptual "geometric ions," barrowing from terminology related to molecular ions, which are the simplest perceptual units of objects. It was thought that "humans must first perceive these simple components before they can recognize an object's overall structure" (Bouton, 2007, p.292). An example is a briefcase that is basically constructed out of two geons; a curved handle form and a rectangular form. Geon theory has garnered little support in whole as it limits perception to categorization into mental models (Ware, 2008, p.110). Nevertheless, it does reveal that "objects can be identified far more rapidly if they are presented in views that clearly reveal the connections between component parts" (Ware, 2008, p.111).

2.5.1.2. Gestalt. Somewhat contrary to Geon theory, Gestalt psychology was a massive school of thought during the early 20th century which proposed the perception of an object as a whole was more predominant than the pieces themselves (Gestalt, 2014). A large body of work

circulates around Gestalt psychology and thus a series of “rules” were formulated for the cognitive perception of objects. The following is a definition of each rule provided by Bruce Goldstein in *Sensation and Perception* (2010):

> *Pragnanz*- Also called the law of good figure…every stimulus pattern is seen in such a way that the resulting structure is as simple as possible.
> *Similarity*- Similar things appear to be grouped together.
> *Good Continuation*- Points that when connected, result in straight or smoothly curving lines are seen as belonging together, and the lines tend to be seen in such a way as to follow the smoothest path.
> *Proximity*- Things that are near each other appear to be grouped together.
> *Common Region*- Elements that are within the same region of space appear to be grouped together.
> *Uniform Connectedness*- A connected region of visual properties, such as lightness, color, texture, or motion, is perceived as a single unit.
> *Synchrony*- Visual events that occur at the same time are perceived as belonging together.
> *Common Fate*- Things that are moving in the same direction appear to be grouped together.
> *Meaningfulness or Familiarity*- Things that form patterns that are familiar or meaningful are likely to become grouped together. (p.105-107)

Gestalt psychology became the corner stone of the now vast and plentiful breadth of study into aesthetics and their emotional, perceptual, and cognitive processing. Furthermore, through Gestalt influenced design styles such as modernism, forms with minimalistic aesthetic attributes garnered more attention in the marketplace and more interest in academic evaluation (Chou, 2011, p. 608; Giard, 2012).

An example of Gestalt theory in modern research is displayed in Chou (2011) during which eleven sets of Ipod docks/speakers were evaluated by five design experts. Through mapping Gestalt and minimalist features, a mathematical model was created to evaluate the speakers (Chou, 2011). The scores would represent the Gestalt-minimalism aesthetic values. After the speakers were scored by experts in the field, these scores were compared to the results of purchasing preferences of 30 university students. The products that garnered high preference

rates tended to hold stronger Gestalt-minimalist characteristics. Thus, to a degree, simple products are shown to increase purchasing preference among potential consumers.

Essentially, Gestalt rules and other "aesthetic principles can be viewed as heuristics that consumers access to make aesthetic judgments" (Kumar & Garg, 2010, p. 487). Heuristics, are "best guess" generalizations that aid in the quick interpretation of objects that are accurate a majority of the time (Goldstein, p.110). Like many human-dependent generalizations, aesthetic heuristics can fail or vary depending on the individual (Goldstein, p. 110). Nevertheless, their overall significant impact is clearly present throughout history and within current aesthetics research.

2.5.2. Aesthetics

2.5.2.1. General Aesthetic Characteristics. "Beauty, whatever it may be, is clearly so powerfully appealing to humankind as to be its own excuse and require no apologists" (Shusterman, 1992, p. 139). For decades, the study of what makes objects desirable and beautiful has issued a resplendent degree of attractive and unappealing aesthetic features. For instance, symmetry is often correlated with aesthetic preference (Jacobson & Hofel, 2002, p. 765). Moreover, symmetry is the "most important cue for the aesthetic judgment of beauty" in graphic patterns (Jacobson & Hofel, 2002, p. 765). Similarly, preference for architectural and graphic elements both correlate with designs that have a moderate amount of complexity (Roberts, 2007, p.43). A necessary balance exists between providing stimuli that are either too complex or too simple (Berlyne, 1971; Roberts, 2007, p. 29).

Even with lines, there is a propensity to express emotions as proven by Poffenberger & Barrows (1924) during which five hundred university students matched 18 different lines to 47 adjectives with emotional variation (p .200). Lundholm (1921), as quoted in *Design for Emotion*, explained that the variations in lines "imitates the motor expression of the emotion…lines symbolizing states of strong motor expression have short waves and acute angles and lines symbolizing states of weak motor expression have long and low waves" (p. 120).

In graphic shapes, consumers tend to desire an amount of harmony and typicality that is balanced so the "attentional resources needed and pleasantness in visually evaluating the

design" are both evenly considered (Kumar & Garg, 2010, p.1). Conclusively, a relative trend has been established in the literature that suggests a moderate amount of stimuli as being most appealing. An object is preferred if it is able to draw in attention and hold that attention without becoming over-stimulating (Wickens & Hollands, 2000). Motivation, learning, functional use, and memory are also positively influenced with an appropriate amount of stimulation and applied aesthetic qualities (Norman, 1986; Norman, 2004). General themes have also shown themselves in other varying bodies of literature. Balance, emphasis, movement, pattern, proportion, harmony, and variety are seven common aesthetic principles found throughout art history (Kumar & Garg, 2010, p.846; Kim, 2006).

As stimulation of the senses can be defined by several of the aforementioned qualities, table 1. was constructed to depict the varieties of aesthetic stimulation.

Table 1.

Stimulus Related Characteristics

Research Source	Signifier	*Inverse
(Berlyne, 1971)	Simple	Complex
(Jacobson & Hofel, 2002)	Symmetry	Unsymmetrical
(Kumar & Garg, 2010)	Harmonious	Unharmonious
(Kumar & Garg, 2010)	Balanced	Unbalanced
(Kumar & Garg)	Dynamic (movement)	Static
(Wickens & Hollands)	High Stimulation	Low Stimulation

*low levels of symmetry, harmony, and balance may actually result in more stimulation, but they are still considered qualities of stimulation.

***2.5.2.2. Aesthetic Traits in Products*.** Aesthetic traits have also been found to represent either dominance or submissiveness in product design. In the previously mentioned perfume bottle study, female forms were "round, warm, light/lucid, soft/delicate, golden,(and) waisted" (Wellman, Bruder, & Oltersdorf, 2004, p. 88). Conversely, masculine bottle features were "angular, straight, cold/cool, dark, silver, black, short neck and heavy base" (Wellman, Bruder, &

Oltersdorf, 2004, p. 88.) Physiologically, it is “quite natural that larger, louder, deeper, sharper, and stronger-tasting things provoke stronger emotional responses (Adams & van Gorp, 2012, p. 117).” Trevor van Gorp and Edie Adams (2012) compiled a list of dominant and submissive traits in forms which is displayed in table 2 (p.118).

Table 2

**Dominant versus Submissive Characteristics*

Trait	Dominant	Submissive
Arousal	High Stimulation	Low Stimulation
Visual	Angular	Curved
“	Straight	Round
“	Up	Down
“	Above	Below
“	Bigger	Smaller
“	Heavy	Light Weight
“	Robust	Delicate
“	In Motion	At Rest
“	Silver	Golden
“	Cool	Warm

*These traits were compiled from Wellmann, Bruder, & Oltersdorf (2004) by Adams & van Gorp (2012)

The knowledge of key characteristics as mentioned in the table above can assist designers in making appropriate decisions regarding design choices. For example, imagine a particular product concept requires immediate recognition and particular attention to detail; a soft, smooth surface would not be appropriate in this case. Consider a product that defers to its user and should be inviting; the smooth forms would now be sufficient (Adams & van Gorp, 2012). Products are often designed for a variety of applications or for multiple types of users. Medical equipment in a hospital has to be used by nurses and doctors of varying ages and abilities at all hours of the day. It is also a constant presence in the experience of the patient. Navigating both of these experiences can be complicated and any leverage that may assist the design of the equipment will ease this transition. Essentially, aesthetics can play a significant role in the

purpose of many products—discovering their true essence and then applying them pragmatically is the key.

***2.5.2.3. Affordances*.** James Gibson, a psychologist in the 1960's, engendered a revolutionary outlook that altered the way perception is understood. At the time, perception was viewed as the interpretation of an image of an object on the retina (Ware, 2008, p.99). Gibson argued that perception can be framed by experience and use potential. Gibson (1979), as quoted in Goldstein (2010), explains, "The affordances of the environment are what it offers the animal, what it provides for or furnishes." In this sense, affordance for an object "is the degree to which the properties of the object make it clear how it can be used (Unger & Chandler, 2012, p.198). Objects that can be sat upon may be interpreted as chairs, even though they are not in fact chairs. Thus, objects are perceived for their physical affordances for action (Ware, 2008, p. 99). Ware (2008) provides three examples in the statement:

> A flattish firm ground surface affords passage, through walking or running or maneuvering a vehicle. A horizontal surface at waist height affords support for objects and tools we are working with. Objects of a certain size, shape, and weight afford use as tools…a rock can be substituted for a hammer (p. 99).

Aesthetic affordances imply behavior and activate relevant brain systems to indicate the expected response. Thus, the presence of a handle provides the affordance of grasping and will draw attention as a result (Goldstein, 2010, p. 166). Positive and negative affordances both exist, as one can view a wall as a negative affordance and a flat ground plane as a positive affordance (Ware, 2008). Negative affordances limit behavior and positive affordances promote behavior. Understanding affordances assists in describing the potential actions of the user and how an object's purpose may be interpreted.

***2.5.2.4. Aesthetic Expression*.** The Gestalt architect, Rudolf Arnheim first presented the embodiment of space in his studies of architecture, art, and dance. He concluded, "Dynamic perception…is the very base of aesthetic experience. Shape and space must be felt as interplays of active forces it they are to convey expression. And expression is the language of art" (1990). Moreover, the exchange of space and shape produces perception of the aesthetic experience. Moving up a flight of stairs, for example, provides the experience of working against the natural

force of gravity (Van Rompay, 2008). Art was deemed to express some of the sensations through the perception of the onlooker (Arnheim, 1990).

In a similar view, image schemas and aesthetic expression leverage humanistic affordances to generate an impression of an object's personality. Image schemas are the effect of spatial-relational associations we experience in everyday interactions (Van Rompay, 2008, p. 345). For example, one might feel empowered if lifted up and above others, or intimidated if stationed below someone else. This creates an embodied association to the visual interpretation of upward or downward objects. Perceiving product expression is also subject to these spatial-relational constructs. An object that is enclosed shows a sense of feeling constricted or secure, whereas a raised product is likely to be perceived as dominant or proud (Rompay, 2008, p. 345). Moreover, products that are depicted with imbalanced features are often interpreted as unstable or restless (Arnheim, 1990; Van Rompay et. al, 2005). This process of interpreting objects is often a result of creating embodied projections with that object. As this passage by Rompay (2008) states,

> Perceiving product expression…should not be considered a passive, analytical process, but rather an imaginative process in which we feel or "undergo" the relations presented by the object. In this process, the perceiver 'takes' the perspective of the object perceived and comes to 'feel' the experiential consequences of the relations the object embodies. (p. 346).

One can see that product expression models the physical arrangements of forms after the bodily movements of people. As Rompay pointed out, this is a creative process of anthropomorphized form creation that extends to the conscious embodiment of objects.

An example of this is displayed by Van Rompay's (et. al, 2005) experimental study on perceptual changes of water jugs and alarm clocks. Modeled in Mya, a 3D modeling software, the products were systematically altered to represent slight variations in the form. The schemas of closure, verticality, and balance were each manipulated to reflect the behavioral actions of people (Van Rompay et. al, 2005, p. 327). Closure was found to be indicative of introversion, security and constriction, as people draw themselves inward physically when displaying these traits as well. In the same vein, verticality, or the projected height, was perceived as dominant, prideful, or

impressive. The last schema of balance resulted in unbalanced forms beings perceived as restless, unstable, and uncontrolled.

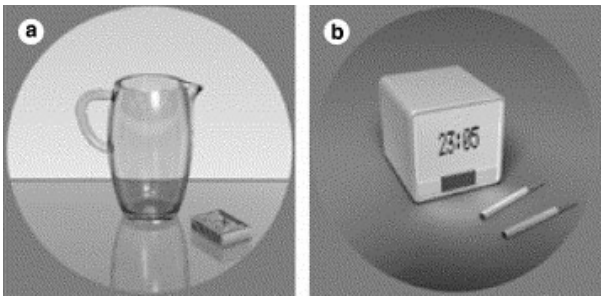

Figure 14. Rompay's Form Expression (Van Rompay et al., 2005)

The products were displayed with a computer and the participants scaled their impression of the object based on the previously mentioned characteristics. Despite the object in question, the relationships were supported. To what degree the products were perceived as depicting each descriptor was dependent on the type of object. For instance, balance had a stronger effect on the perception of the water jug than the alarm clock. The authors suggested this is most likely due to the slight variation in the alarm clock. The fact that one object is rectilinear and one is curvilinear may also have an added variation to the perception of the object. Areas of improvement for this study were noted as the participants both found it difficult to notice the variation in the form and to scale the objects accordingly using the provided procedure. This may be as a result of the forms still being presented in a 2D format (although very developed). In addition, this test was restricted to design students from the university. In general, this study shows that forms do tend to take on the physical perceptions of human behavior.

In a similar study, Achiche and Ahmed (2010, p. 93-107) attempted to create a fuzzy logic model that would be able to describe a set of characteristics that can be represented and evaluated as mirroring an individual's affective perceptions and personality traits. Figure 15 contains 10 forms 60 university students designed to represent various descriptive labels (such as aggressive, heavy, soft etc.).

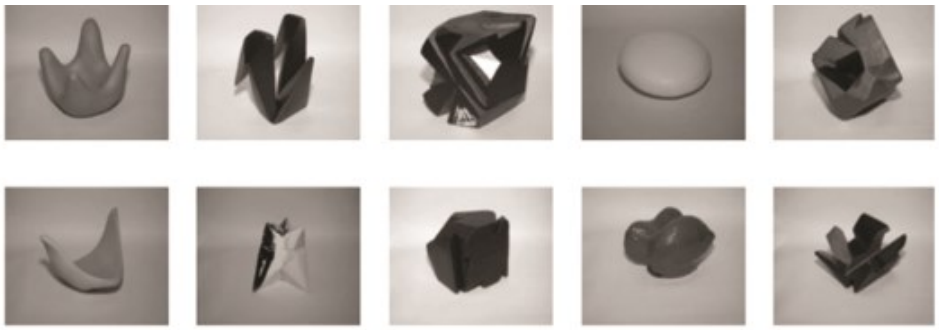

Figure15. Amorphous Expressive Forms (Achiche & Ahmed, 2010, p. 93-107)

Each student was presented with a set of words to use during the creation of their form that is known identifiers for particular expressions. The authors applied Gestalt rules to the shapes to signify how the design elements should be classified. The forms were then presented to a third set of participants who were instructed to rate the aggressiveness of pictures of the forms. More aggressive shapes had significantly higher rates of shape irregularities and "obeyed fewer symmetry rules or patterns." Additionally, the aggressiveness of the shapes compared to the perceptions of the end user group was found to be statistically significant (0.883 with a two-tailed p value of 0.000137). This study displays a significant analysis regarding aesthetic forms with emotional values, but was not applied to products and limited the types of participants to design and engineering students.

In another study conducted at the University of Ulster, 80 students categorized graphic images of kettles according to affective and personality driven labels (feminine, masculine etc.). The following figure 16 presents the 12 kettle silhouettes utilized for the study.

Figure16. Personality Kettle Forms (Crothers, Clarke, & Montgomery, 2004, p.427)

These images were based off of 3 primary silhouettes with varying spout, handle, and base. The primary silhouettes were derived from prototypical kettle forms as recent research "suggests prototypical preconceptions may also affect perceived character "(Crothers, S., Clarke,R., & Montgomery, J., 2004, p.427). The term prototypically refers to an object's ability to present itself in a recognizable and expected form as in a camera conforming to a rectangular shape. Participants were asked to rate the correlation between various keywords as least, moderate, or most like the suggested label. High frequency was associated with both most (28%) and least (23%) labels, but moderate forms were difficult for participants to label (19%) (Crothers, S. Clarke, R., & Montgomery, J. 2004). In addition, a significant effect was established between the perception of the descriptive label and a significant change in the silhouette form. The authors did find that some perceptions were based off of subjective evaluations sighting a kettle with a bulging front as either feminine or masculine depending on whether the kettle was considered "pregnant" or having a "beer belly" (Crothers, Clarke, & Montgomery, 2004, p.428). Due to the statistical nature of the method, these comments were not evaluated extensively. This study was also limited by using two-dimensional images instead of 3D forms.

In the final product expression example, Pascalle Govers, Paul Hekkert, and Jan Shoormans (2004) investigated whether or not the designed personality attributes for happy, cute, and tough were actually perceived as such by potential consumers. Drawings of 18 irons (6 of each label) were rated by eighty-eight respondents on a 5-point scale for the 3 target groups. Happy and cute irons were associated more with rounded features, although happy forms tended to be open and cute forms tended to be stocky. Tough irons were visualized as robust and big forms. Significant differences existed between tough and the remaining two categories, happy or cute. The authors suggested that the designs were in fact interpreted differently, but the more alike the category was in concept, such as happy and cute, the more difficult it was for participants to distinguish. The authors suggested that this may not be the case with three-dimensional products as the product form would be more distinct. They concluded "the difference

between round and stocky (cute) versus round and open (happy) would probably have been more clearly perceptible" if 3D irons were used (Govers, Hekker, & Schoormans, 2004, p. 348).

2.5.3. The Importance of Aesthetics. In the literature, aesthetics is described as going beyond the look of an object. Aesthetics build from contrived experiences to deliver the best possible solutions to a problem through afforded associations. Visual perception frames the world of product interaction and aesthetics is the global language of experience.

2.6. The Influence of Co-creation

This section is provided as a background to using a co-creative method for this research. As the purpose of this thesis is the exploration and application of theoretical constructs, the testing of this method is not treated as the primary goal. Nevertheless, the development and application of any method should be taken into consideration during formative research. The relevant literature that influenced the development of magnetic modeling is presented in support of its application.

2.6.1. Opportunities for Design Methods. Design research in particular is known for assessing qualities or navigating topics that seem intangible and nascent with extrapolated theories and flexible methods. This somewhat unsettling uncertainty during the preliminary phases of design often leads researchers to employing inventive tactics to get results. Traditionally, "new product development relies on market research, consumer behavior studies, future studies and trend analyses to uncover the existing, unmet, latent and future needs of potential consumers" (Boradkar, p. 69). However, traditional research also utilizes more standardized, lengthy, and resource depleting methods to achieve its goals (Suri, 2002). These analytical tools may be unfit for the task. According to the article by Jane Suri *Designing Experience: Whether to Measure Pleasure or Just Tune In,*

> Measurement, by its nature, forces us to ignore all but a few selected variables. Hence, measurement is useful when we are confident about which variables are relevant. Many designs, however, require knowledge into unknown variables, non-existent products or services, and inexperienced users. This malleable creation known and necessary for design requires methods which are untraditional in approach (Suri, 2002, p.164).

This is not to take away from the value that these approaches offer; merely new methods may provide potentially unmet design resource needs for the ever-evolving landscape of consumer expectations.

In *Creating Breakthrough Products*, Jonathan Cagan and Craig Vogel define this trademark feeling of uncertainty and vague conceptualization period as the "Fuzzy Front End." This process has three distinct phases which include: identification of product opportunities, understanding the product opportunity, and introducing techniques for product conceptualization. In all three phases of the "Fuzzy Front End" they suggest constant and repeated involvement of core user and expert user groups (Cagen & Vogel, 2002, p.112). Additionally, "the use of qualitative methods allow for broad investigation with little investment and these approaches are easier to summarize, evaluate, and communicate" (Cagen & Vogel, 2002, p. 109). A combination of consistent user group involvement combined with qualitative measures is suggested for businesses to be successful.

In design experience, a common tactic is to study the interactions the user may have with the product. Using prototype models to get user feedback is a standard strategy to "translate user feedback immediately in the to-be-designed product" (Rotteveel, 2011, p.133). Multiple renditions of the same product in 3D prototypes helps provide researchers with applicable feedback to their actual design including concept, aesthetics, and functionality (Baxter, 1995, p.285) . However, these prototypes are still designer made and participant bias may be applicable as participants seek to please researchers with favorable responses. One way to eliminate this bias is to bring the participant into the research phase.

2.6.2. Participatory Action Research. Participatory Action Research (PAR) is a sect of design research that wields a novel approach as the potential consumer's insights, goals, and reflections become a priority. The ultimate goal of PAR is consumer welfare, which "can subtly or dramatically shape the research process, the methods used, and the theories developed" (Ozanne & Saatcioglu, 2008, p.423). The PAR approach is phenomenological and inclined to the creative practices associated with art and design as potential users act simultaneously as both a creative and a researcher. According to Cornwall and Jewkes (1995), the outcome is less

important than the process as a whole and the researcher often becomes a “catalyst, facilitator, and participant” (as cited on the online Berkshire Encyclopedia of Sustainability). The researcher then must take on a variety of roles to help discover hidden yet valuable insights into the consumer’s desires, wants, needs, and dreams. Where once a human factors professional only sought to produce every level of physical comfort, today their talents extend to more perceptual, cognitive, and emotional abilities. Moreover,

> The human factors professional’s role becomes one of devising and championing ways to facilitate personal discovery about what it would be like for people to engage with a product or system we are designing. It also requires that ‘human factors’ entertain a broader, more holistic view of the relationship between people and the designed world than the discipline has historically (Suri, , p. 165).

It should come as no surprise then that researchers in all fields are expanding their talents beyond the obvious and functional elements of yesterday. They consistently seek out new ways of exploring design research methods that may provide a deeper user-product connection or an innovative product. Incorporating consumers and participants in the design process is one of these ways.

The concept of what role consumers play in the design process has systematically evolved from active purchasers of products to the current integration of interactive participants in design research. Consumers were once thought of as the “recipient of the product at the end of the production process (Sanders, 2002, pg. 3).” The realization that consumer perception has more significance led to the user-centered design approach where profiles of users at the beginning of the design phase frame the development process (Sanders, 2001, p.2). Users are then integrated and act as experts working alongside the design team to allow consistent involvement and an applicable uncensored reference (Cagen & Vogel, 2002. p. 112). Unfortunately, “due to training, background, education, gender and age, it is unrealistic to expect (or accept) that designers are able to rely upon their own experience, knowledge and understanding alone, when designing for others” (Mcdonagh, Bruseber, Haslam, 2002, p.231).

Adopting the necessary element of users, unskilled in design, as integral sources of innovation in the design phase allows for a variety of perspectives. Liz Sanders, the creator of

Make Tools and a long standing proponent of user involvement acknowledges that users “are capable of adapting products to better meet their own needs (Sanders, 2002, pg.2).” Furthermore, she emphasizes “the need to be directly involved in the creation and production of goods and services is pointing toward a human-centered design revolution, with the act of co-creation between designers and everyday people being the end goal (Sanders, 2002, pg.2).” Users’ involvement in every aspect of the design process will continuously reaffirm that the product or service will not only be successful, but is considered optimal prior to launching. As stated by Sanders (2002)

> If we can learn to access people’s experiences (past, current and potential), then we can make user experience the source of inspiration and ideation for design. And by making user-experience the source of inspiration, we are better able to design for experiencing (Sanders, 2002, pg. 2).

It is apparent that user involvement has grown in popularity, but the question regarding how to involve users into the design process is still being explored. This is especially true as some aspects of hidden consumer perceptions are difficult to decipher and emotional perceptions in particular remain misunderstood.

2.6.3. Say, Do, Make. Fortunately, the “say, do, make” approach developed through participatory research allows one to interpret difficult concepts quickly while immediately categorizing participant actions into easily decipherable groups. This is done through observing participants create their perceptions using tools, games, or activities to portray concepts. Figure 17 displays a “Make Kit” developed by Liz Sanders company Make Tools.

Figure 17. Make Tools Velcro Modeling Kit (Sanders, 2000)

The variety of pieces allow for numerous applications across many different companies and situations. Make Tools are current “scaffolds” within the creative phase of the design cycle. Similar, to the scaffolds used to build new levels of buildings, each level of the “Say, Do, Make” method builds upon each other to provide further insights into the user’s experience. The following figure represents a culmination of the elements described by Liz Sander’s “Say, Do, Make” approach.

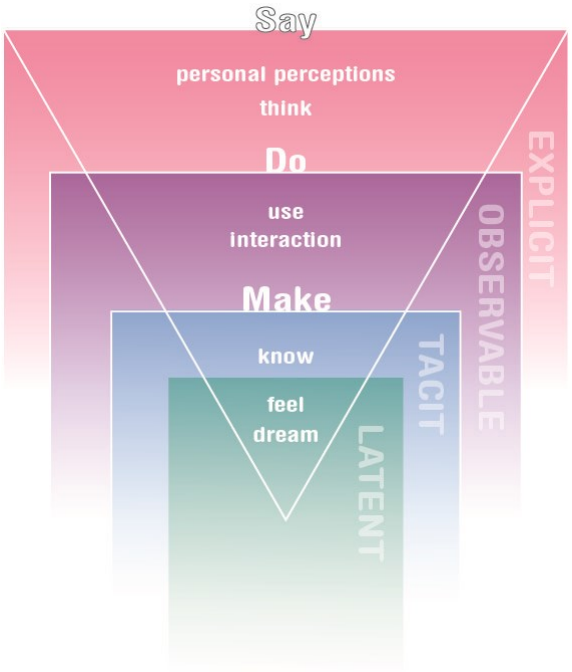

Figure 18. Say, Do, Make Scaffolds (adapted from Sanders 2002, p.1-3)

Through such techniques as observation, designers can view what people do, through interviews designers will hear what people say, and through co-creation designers can interpret what people make. Each area of this approach is necessary as each one lends a different perspective into these difficult concepts. In addition, a person may say one thing and do another or may be unable to express what they feel. Thus, each area of the approach allows for checks and balances to be weighed and repeatedly confirmed. Design researchers are now responsible for creating avenues of exploration by participants. These tools are often referred to as “scaffolds” upon which participants are inspired to build their perceptions of the topic in question.

For the sake of this research, participants are exploring their emotional perceptions of forms. This obviously falls into the "make" category of research as this level is most aptly attuned to revealing feelings and emotions (Sanders, 2002). As Liz Sanders states, "Discovering what people think and know provides us with their perceptions of experience. Understanding how people feel gives us the ability to empathize with them (Sanders, 2002)."

Thus, researchers are able to tap into how users feel about proposed solutions. Accessing "knowledge that isn't readily expressed in words" provides new insight into the user experience that would otherwise be left unsaid (Sanders, 2002). In addition, Make Tools allow for researchers to understand what users dream. As quoted in Creating Breakthrough Products, Rolf Jensen claims that the "future economy will be based on companies' ability to tell and sell stories…to understand people's fantasies…and to create products and services that create experiences closer to those dreams" (Cagen & Vogel, 2002, p. 61).Through making, researchers discover latent needs derived from tacit knowledge. The projection of latent needs is common in forerunning companies like Apple who are able to predict successful applications of current technology. "Seeing and appreciating what people dream shows us how their future could change for the better," and how we might be able to fulfill those needs as researchers (Sanders, 2002).

As predicting and evaluating emotional responses requires accessing latent qualities, using a Make Tool derived method like Magnetic Modeling is appropriate. Emotional connections to products are difficult to conceptualize, let alone observe, test, and apply in practice. Roshi Givechi and Velma Velasquez (2004) of IDEO explain the value of designing for emotions:

> To better design for emotion, we need to better understand people's emotions in relation to their products. In our practice, we have found that we can interpret emotions more clearly by connecting with people directly, sensing what they express at an intuitive level. Emotions are rich and complex, and a direct experience that allows the essence of emotion to be understood first-hand by designers provides better texture for design. We need to learn about the emotional subtleties that can add to a product offering by prototyping specifically for the positive space. This means prototyping a step beyond functionality to evaluate emotion and discover raw, gut level reactions.

According to the authors, positive space is the ability to facilitate and fuel empowerment, delight, and connection into the product experience. As presented in the quote above, they believe the

best way to do this in practice is observing individuals and connecting with them directly. Although previous research in product emotion and expression is controlled to establish verifiable measures of emotion and perception, it is not the only acceptable way for exploring unseen aesthetic relationships. In fact, the ability for co-creation to move beyond the established methods and offer insightful views of latent qualities is more adaptive to theoretical exploration and practice. Since connecting emotions to aesthetics is a vague area of research, an exploratory method such as Magnetic Modeling is applicable. Therefore, Magnetic Modeling can be considered a step beyond standard prototyping in order to evaluate the raw, gut level reactions prone to basic emotions.

CHAPTER 3

METHODS

3.1. Measuring Emotions Justification.

Emotional responses are difficult to capture, even with the advanced technology available today. This is due to the complex nature and attribution of emotions to objects, the variability and intricate fluctuations of emotions themselves, and the individualized perception of the user. Regardless, many attempts have been made to integrate methods and techniques for designers to evaluate emotional qualities of existing products. Furthermore, attempts have been made to understand the emotional qualities of amorphous forms and existing geometrical shapes. However, these studies are often conducted on products that have already entered the market and on shapes that have no formulated purpose. Additionally, these studies often occur outside of the creative process of design, within an academic realm, and may have limited applicability to the current design process.

There exists a disconnect between the measurement tools available and the depth of the emotional perception as experienced and created by potential consumers. A blatant need has been identified for a method that may connect latent qualities, such as memory invoking emotions and object directed emotions, as perceived by the user to the creation of an aesthetic form. The purpose of this study is to allow participants to draw from their latent abilities and help expand the knowledge of the emotional properties and perception of physical forms. The interactive methods utilized in this study assess emotional responses from participants through access to expressed latent behavior, thoughts, feelings, and emotions. An over-arching goal of the study was to create and test a methodological tool for assisting current design practitioners in producing more emotionally empathetic products.

3.2. Research Strategy Overview.

This chapter discusses the methodology and methods that were utilized in the four distinct phases of this study. The methodology of this research was comprised of a literature review, an image analysis, 2 pilot studies, a digital card sorting task, and a magnetic modeling task. These methods were chosen as they address the critical affiliations between each of the

primary areas of influence in product experience. Existing procedures for measuring aesthetics, emotions, and perception in emotional design, human factors, ethnography, and co-creation were considered while creating this research design. The tasks were hierarchical and followed a qualitative grounded theory approach. Grounded theory allows the researcher to use the information and themes presented in each phase to influence the next stage within the methodology (Charmaz & Mitchell, 2001). A multi-methods approach was utilized to allow for convergence of themes discovered throughout each stage of analysis. Both qualitative and quantitative types of analyses were applied in order to provide a broad scope of understanding regarding the research findings.

Table 3

Method Justification Table

Method	Purpose	Sample
Literature Review	Provide an understanding of current research and methods.	Peer reviewed research and books
Image Analysis	Formulate a hierarchical derived taxonomy of existing teapot forms.	500 images from 4 books/3 websites
Card sorting Task	Discern the emotional perception of existing teapot forms.	118 participants; 86 completed tests
Magnetic Modeling Task	Provide a comparison of a 3D form and participant interaction interviews.	13 Participants, 15 teapot pieces

3.2.1. Planning. Initial research focused on evaluating efficient methods designed to increase understanding of the latent qualities displayed by consumers and users in design research. Fields of research included industrial design, emotional psychology, applied psychology, aesthetics and human factors. These areas were investigated with a grounded

theory perspective, in which a general purpose of the research was predetermined, but the specific outcome and goals were formulated during the review. The growing trend of design and emotion continued to lead the direction and depth of the literature review until the initial concept of comparing existing design methods with an advanced version of Velcro Modeling (VM) emerged. At this point, a study design was formulated and appropriate procedures were taken with Arizona State's Institutional Review Board for study approval.

3.2.2. Goal. The underlying goal of the literature review was at first to gain inspiration for ways to thoroughly understand applied emotion theories in a design context. However, the breadth of the research revealed bridges between the distinct fields of industrial design, psychology, and aesthetics (among others). At this point the study design direction was chosen, research continued to provide supporting sources for concept mapping, analysis, interview questions and other related materials. In addition, overall themes and extant conclusions were gleaned in order to provide a comparison with the results from the various portions of the study.

3.2.3. Methodology. Information gathered from qualitative data was analyzed using a grounded theory approach throughout each stage of the research. Grounded theory allowed the researcher to develop categories and relationships through issue of the evidence rather than through preconceived assumptions. This study practiced the provided characteristics first presented in Glaser and Strauss'(1967;Glaser, 1978; Strauss, 1987) articles and later described in the Handbook of Ethnography (Charmaz, K. & Mitchell, R., 2001, p. 160) as the following:

1. Simultaneous data-collection and analysis;
2. Pursuit of emergent themes through early data analysis;
3. Discovery of basic social processes within the data;
4. Inductive construction of abstract categories that explain and synthesize these processes;
5. Integration of categories into a theoretical framework that specifies causes, conditions and consequences of the processes (Charmaz, K. & Mitchell, R., 2001, p. 160).

Through this process, the data represented a "working hypothesis" of the research (Kleinman, 1980)." Categories of different emotional relationships with various aesthetics were formed through observation and analysis in real time rather than once the information was gathered.

3.3. Image Analysis and Hierarchical Taxonomy of Forms.

3.3.1. Object Selection. In order to test for emotional attributes of 3D forms, an existing product with several distinct visual elements was needed in order to analyze results of a variety of form alterations. The teapot or tea kettle was chosen as the singular product for the remainder of the study for the following reasons:

1. A broadly recognizable object that it used cross-culturally
2. Established throughout time
3. Simplistic functional form
4. Assumed or semiotic functionality
5. Well established variety of archetypes
6. Easily manipulated by hand
7. Relatively small in size, but not difficult to visually perceive
8. Currently and historically established in the marketplace
9. A broad example of creative form generation
10. A vast amount of images readily available
11. Non-electric, so as to simplify functionality
12. A large variety of form details, surface patterns, and materials used
13. Various pieces that may be dissected

It was important to the researcher to use a well-established household product as this would limit any misunderstanding by participants' during the following phases of the study. Since exploring emotional aesthetics was part of the purpose of this study, functionality was limited. Some functionality was needed so as present the potential for the methods' applicability to other various product forms. Simplistic functionality allowed for a broad depth of form expression while also limiting the form to generic "rules" of functionality. Additionally, teapots and tea kettles were both used in this study as their functions are very similar and this would broaden the scope of the image appraisal and collection.

It is assumed that particular associations with the product choice may exist within the following population groups during the experimental stages of this study. These may include but are not limited to prior knowledge of the object's history, extent of previous use, or any negative memories that the participant's may have had with a similar product (hot water spilled, loud

whistling). However, these experiences are part of the individual participant's characteristics and do not necessarily detract from the overall focus of the study to analyze general form aesthetics and their emotional attributes.

3.3.2. Image Appraisal. In an attempt to become intimately familiar and engrossed with the product, great effort was placed into establishing the most basic forms available for teapots and tea kettles from the year 1700 to the current marketplace. A thorough immersion with the object's attributes was undertaken so as to ascertain the verifiable product form variation. Images from 5 books on teapots and images of teapots found on Amazon and Ebay, the Metropolitan Museum of Art website, and other antiques or product sourcing websites were scrutinized for both antique and currently manufactured teapot and tea kettle forms.

During this immersion process, sketches were made of the most commonly seen forms for the base of the teapot. Most of the attention was placed on the overall "base" of the teapot as larger shapes are seen more prominently (reference chapter 2, Aesthetics). Limited attention was paid to the secondary localized pieces such as the handle or spout. Two of the books were initially tabulated for frequency, yet these books contained images from individual collections, so the information was disregarded.

Sketching of the most commonly found forms was repeated on 3 separate occasions after several hours of viewing the images. The images and forms they contained were treated similarly as concepts presented in design research analysis techniques. For example, patterns in shapes were circled and identified in a manner consistent with affinity diagramming in which a broad variation of forms were first sketched and then patterns of similarity of shape were identified. Roughly 1000 teapot images were viewed during this process (at least 500 images were present in one book).

3.3.3. Image Collection. Archetypes were chosen based off of how often they appeared in the images viewed and how unique their aesthetic qualities were considered. The length the archetype had appeared throughout time and the prevalence of the forms found in geometry also aided in deciding on the familial structure of the teapot taxonomy as geometrically derived forms were considered unique.

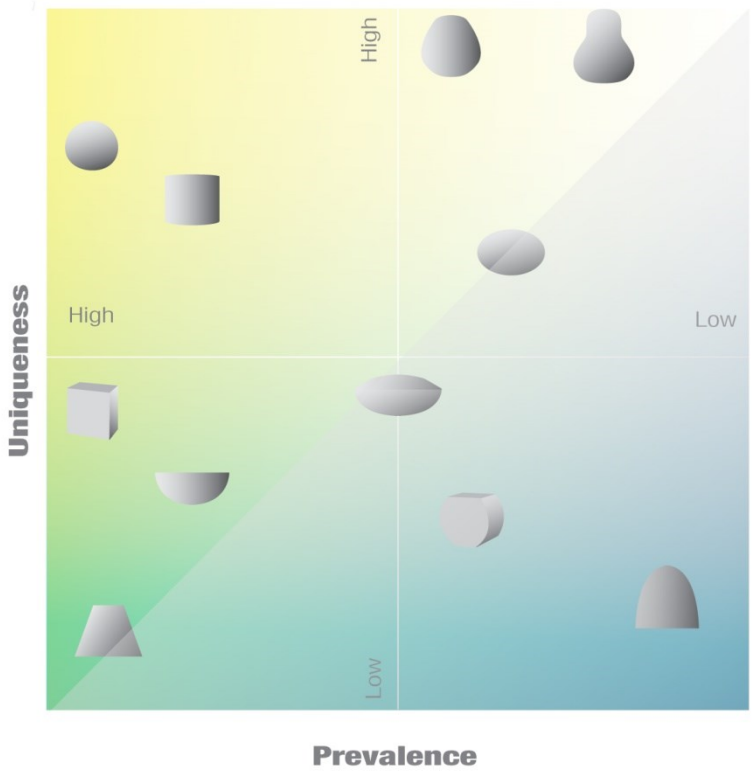

Figure 19. Teapot Base Prevalence and Uniqueness

Except for the pear shape, all other forms that were chosen have been established as basic 3D shapes with mathematical reasoning. The 8 base archetypes have been presented as the “parent” forms leading to more varied shapes with slight variations or “child” forms. Two archetypes were re-affirmed as variations as their prevalence and uniqueness were not considered substantially significant. The following figure displays the initial taxonomy of teapot bases derived from the viewing sessions.

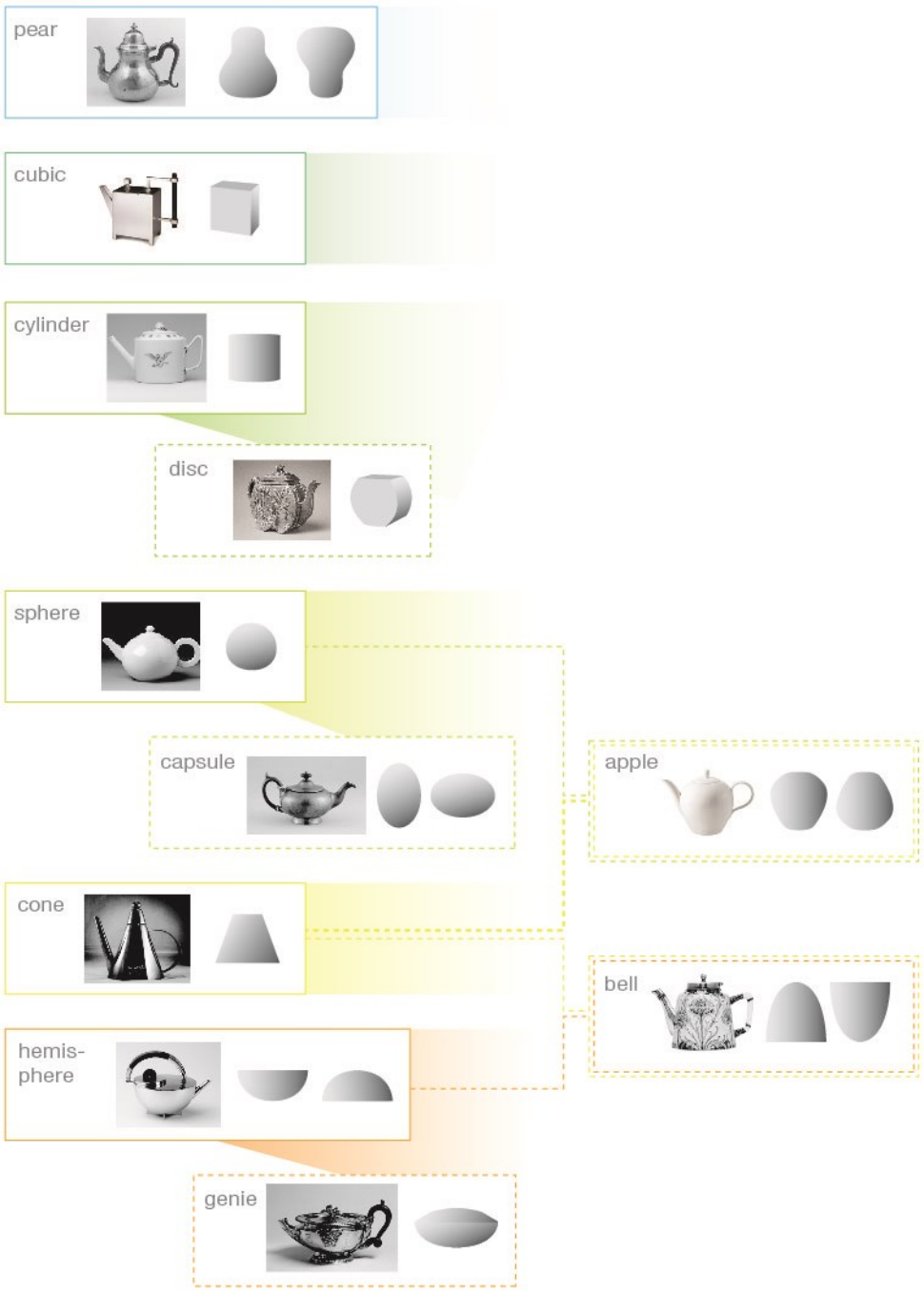

Figure 20. Teapot Base Taxonomy

The taxonomy is derived from discerning the various aesthetic elements that were found to be similar and dissimilar between forms. It is acknowledged that some bias may be displayed by the researcher. All images were altered to grayscale so as to eliminate the emotive qualities of color. Once the various basic shapes started to emerge from the viewing sessions, digital images

were collected with 2 images from the years 1700-1799, eight from 1800-1899, and 10 from 1900-1999. This was done to provide a range of years of manufacturing and design variation. Exceptions were made for both the cone and cubic teapots as their invention occurred much later than other forms and thus additional images came from the years 1900-2000.

In order to maintain a high standard of shape consistency for each base type selected in the images, rules were written for each form. The following is a list of the rules created for each base:

Apple Characterized by a rounded and circular edge. There are no significantly straight edges. However, it differentiates itself from a sphere as either the top or bottom translates into a smaller circumference. The rounded edge is also not flat to it differentiate from a cone.

Sphere The sphere has a very balanced and rounded form. The shape consists of rounded sides and top and bottom surfaces. The top and bottom must appear noticeably rounded. Any dissections placed through the sphere (as for a lid) must occur in less than half of the overall shape.

Cone Technically a truncated cone, this shape has mainly straight sides in their forward appearance that translates from a large to small circumference. The bottom or top must be relatively flat in appearance, though this shape may have filleted edges as long as the sides appear flat.

Hemisphere One side of the form follows a circular pattern, but the other side must be noticeably flat. In the case that the curve is the bottom of the teapot and the large flat surface the top of the teapot, there may be a smaller flat surface visible on the curved half. For the majority, the sides must appear to complete one curve and are extremely rounded.

Cubic This form must have at least four distinct flat edges that do not translate into a smaller shape (as in a pyramid). There may be additional edged surfaces within the sides of the cube, but four sides must remain visibly prominent. Slight

curvature may exist with edges that have been filleted, but the sides must maintain the overall appearance of being flat.

Pear With a significantly rounded side that appears to be the majority, a spherical "bulb" is present on at least one half of the object. This rounded "bulb" half then translates into a more vertical surface. The vertical surface does not translate for the majority of the other half of the object. Edges are often strongly filleted or paired with a rounded lid.

Cylinder This form has relatively flat edges that follow a circumference. For the most part, the sides do not translate inward or outward, though a slight translation is common. Edges may be filleted, but the sides must appear flat.

Some of the images were thrown out of the study after this process and the apple shape was deleted entirely as the rules between the sphere, apple, and pear were relatively similar and may have been too close for true distinction between conditions and visual elements. Prior to the rules being written, 156 images had been selected for the varying taxonomy bases with each group being represented equally. After each image was re-evaluated, 101 images remained that strongly represented their categories according to their rules. The following lists the number of images per base: 18 hemispheres, 17 cones, 16 cylinders, 17 cubes, 16 spheres, 17 pears, and 16 cylinders. Although these numbers are close, the slight difference may alter the remaining experimental stages of the study.

Analyzing the silhouettes of the forms also aided in recognizing other basic structures that commonly exist in each image. For example, most teapots have a lid, handle and spout. These forms were then dissected into their particular piece category so that the images could be analyzed for each feature individually. Tops, handles, and spouts were chosen by their prevalence within the image set. These patterns were established with a similar technique of sketching thumbnails of each spout, handle, and lid silhouette within the image set. The following forms were considered the most basic forms present in the image set of 101 images for the four form categories: base, handle, spout, and lid. The letters beneath them correlate to their code within the image set.

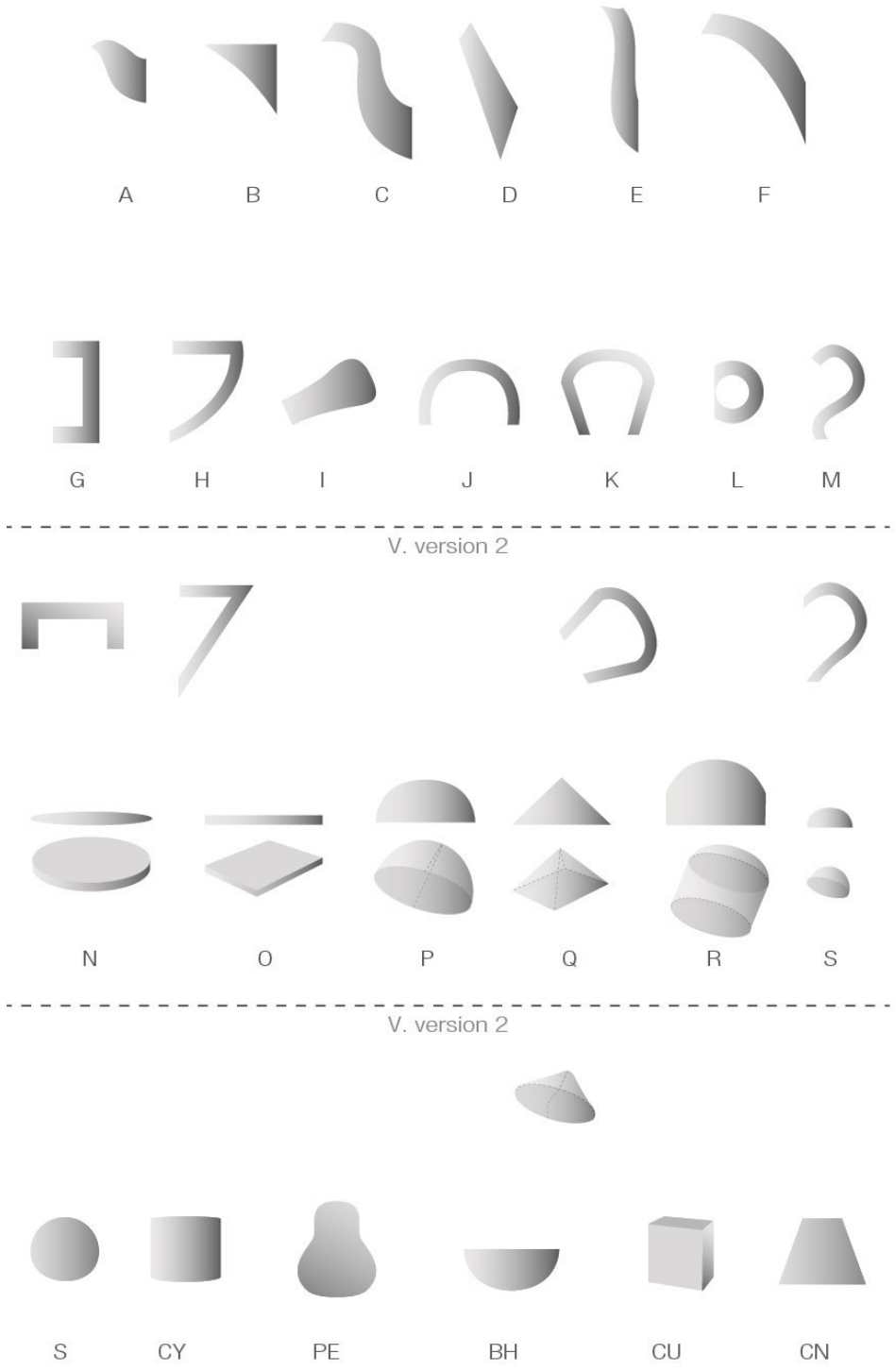

Figure 21. Teapot Forms and Codes from Image Collection

Again, the resulting image set consisted of 101 images with the above categories. It should be mentioned that although the remaining pieces were coded appropriately, their distribution in the image set differs greatly. The following is a chart depicting the distribution:

Table 4

Shape Quantities in the Coded Image Collection

Shape Type	Shape Code	Amount
Base	conical	17
“	cubic	17
“	cylindrical	16
“	hemisphere	18
“	pear	17
“	spherical	16
Spout	A	7
“	B	17
“	C	34
“	D	29
“	E	7
“	F	7
Handle	G	15
“	H	16
“	I	6
“	J	12
“	K	6
“	L	3
“	M	41
Lid	N	37
“	O	10
“	P	34
“	Q	11
“	R	3
“	S	1

As a result of the vast variability between piece amounts in the image set, many of the pieces were disregarded in further analysis. This will be discussed in future sections.

3.4. Digital Card Sorting Task

Card sorting activities are most often associated with user experience design and the creation of web-site maps and other forms of digital or informational architecture. Particularly efficient in determining quick categories and associations, this technique is useful to "create a hierarchy of content, categories, and subcategories containing items such as articles, documents, videos, or photos (Unger & Chandler, 2012, p. 125)." During a standard card sorting technique, users are provided with physical index cards labeled with a variety of concepts or items. The users then organize these concepts into proposed or self-created groups. Digital and remote card sorting tasks, such as the one performed in this study, allow a large number and variety of participants from various locations to complete the task (Unger & Chandler, 2012, pg. 126).

Other existing methods such as surveys could have been used for this portion of the study, but they do not specialize in the particular function of organizing information into groups. Surveys provide specific answers to questions and scales, but this data must then be analyzed into categories or to gather further knowledge regarding the relationships of the objects. Additionally, during a grounded theory method the researcher is often unaware of the exact topics that should be covered. Surveys can be flawed if "the researchers did not know what they wanted to find out" (Mitchell & Jolley, 2007, p. 208). Since the groups of forms were unknown, there was no way to test them using a survey.

Furthermore, the large population base that the card sorting task is able to reach is representative of products reaching a large variety of users in the market. The aim was to gather a broad understanding of generalized concepts regarding aesthetic qualities and emotional relationships.

3.4.1. Instrumentation. Optimal workshop's online card sorting software Optimalsort was utilized to complete the digital, remote card sorting task. This software was selected as it is one of two current UX card-sorting programs that allow use of images, and the only one that was found to provide a brief survey prior to the task. Participants were instructed to organize 20

randomly sorted black and white images from the total of 101 teapot and tea kettle images first determined in the Teapot taxonomy portion of the research. These images were “dragged” and “dropped” into 8 emotion categories. The image below is an example of the task.

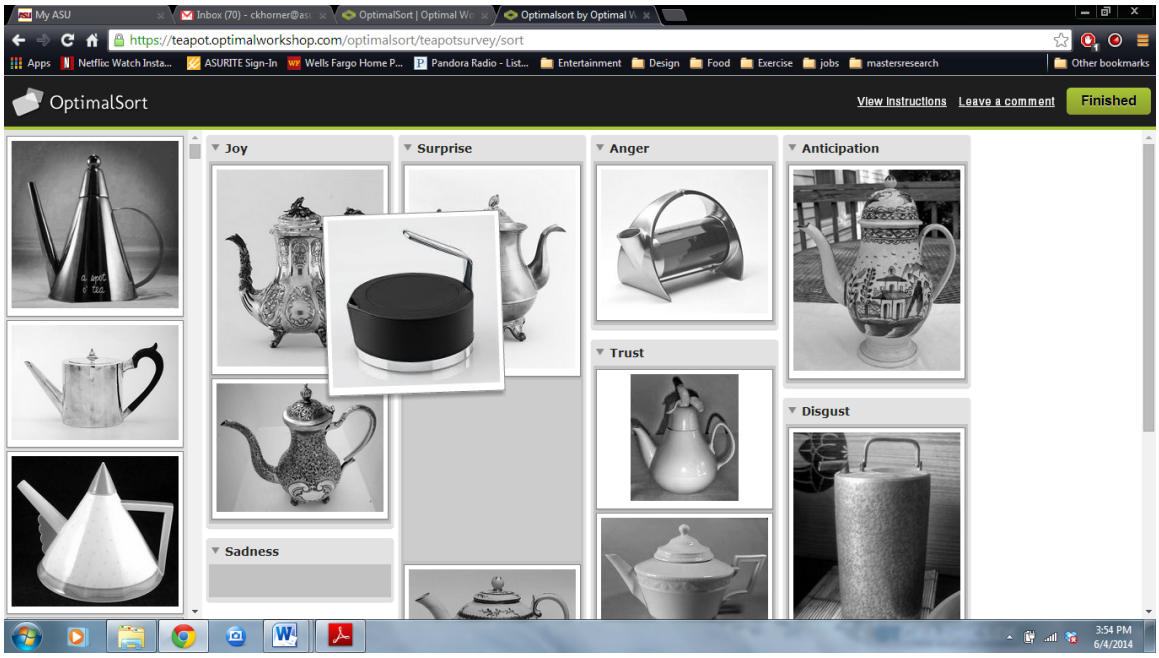

Figure 22. Digital Card-Sorting Screen Shot

The task was considered a closed card sort, as participants were provided with 8 emotional labels in which to place their images. Images were kept black and white to help deter participants from rating the color of the photos. The number of cards was limited to 20 as the pilot study revealed that more cards could be used, but an excessive amount may exhaust the participants. The 8 labels were taken from Plutchik’s second ring of his emotion wheel and consisted of the following terms: anger, disgust, fear, sadness, joy, anticipation, surprise and trust. These emotional labels were chosen for their even distribution of both positive and negative emotions, term recognition, and emotion-theory derivation.

3.4.2. Pilot Study: Digital Card Sorting Task. The purpose of the pilot study was to ascertain the clarity of the program and instructions and to appropriate the amount of images for the full study. A smaller version (15 cards) of the digital card sorting task was administered to three remote female participants ages 26, 32, and 54 on April 19, 2013. Participants for the pilot study were asked to complete the task as determined in the instructions provided in the

interaction (see Appendix B). Participants were not required to answer demographic questions and the questions page was kept blank. Once the card sorting task was complete, the researcher and participant communicated via phone regarding any difficulties with the task, confusion with the software, and the overall impression of the process.

Some difficulty was noted regarding locating the "finished" button once the task was complete. An additional, bolded instruction was added as a result indicating that the task is incomplete without pressing the "finished" button located in the top right corner of the page. The amount of images seemed to be well suited, but a small increase in images was deemed acceptable.

3.4.3. Participants and Sampling. During this first experimental phase, a digital card sorting task was initiated by 118 participants and completed by 86 participants. The large amount of abandoned tests may be as a result of the odd location of the "finished" button, but this is merely an assumption gathered from the pilot test. The experiment was launched on September 2013 and was completed on November 26, 2013. The average time for completing the task was 5.6 minutes. Participant sampling was not constricted to any particular group as the goal was to discover overall themes relevant to any potential user or consumer of products. Participants were gathered from online (Facebook and email) and word of mouth promotions of the study via the primary and secondary researcher. The card sort was open to the public and the link was distributed by any of the existing participants at will. Additionally, two classes of students attending ASU's College of Innovation and Technology were allowed extra credit for completion of the task. This was done to complete the card sorting portion of the study in a timely manner and increase the total number of participants. Participants were informed that their willingness to complete the study was considered an act of consent.

Participants were directed through a series of instructions, demographic questions, and then the task itself. Prior to the experiment, a basic set of participant information was collected for analysis including age, sex, and profession. Other questions were asked (see appendix) prior to the card sorting task, but these were only to provide a base of understanding regarding the participant sample. Optimalsort provided graphics based off the type of questions asked. These

as well as all of the demographic information from Optimalsort may be viewed in Appendix C. A brief amount of general demographic information (based off the top 3 highest answers to each question) is presented in table5 below.

Table 5

Card sort Demographic Table

Characteristic	Identifier	Percentage	Amount
Sex	Male	39.5%	34
“	Female	60.5%	52
Age	Mean		28.5
Education	Some College/Associates Degree	40.0%	34
“	Undergraduate Degree	41.2%	35
“	Master’s Degree	9.4%	8
Gross Ann. Income	Less than $10,000	16.3%	14
“	$10,000-$14,999	11.6%	10
“	$60,00-$74,999	12.8%	11
Race	White	71.8%	61
“	Korean	7.1%	6
“	Chinese	3.5%	3

*this table contains the top 3 most common answers for 5 of the demographic questions.

3.4.4. Data Collection. Optimalsort provides two different forms of data collection including a results matrix and a popular placements matrix. The results matrix shows the number of times that each card was sorted into the corresponding emotion category. The popular placements “matrix attempts to propose the most popular groups based on each individual card's highest placement score” (Optimalsort.com). Basically, the table shows the percentage of participants who sorted the teapot image into the corresponding emotion category. The popular placement data is available in Appendix E. The analysis was done using the popular placements chart as it held percentages that represent relationships.

3.4.5. Data Analysis. The data from the card-sorting task was analyzed through frequency paths, a pathfinder network and a content analysis.

***3.4.5.1. Image Groupings*.** Initially, each popular placement group was converted back into images and the dissected pieces were organized into the suggested emotion groups. This aided in an inceptive visual assertion of the data and provided thematic visual elements that exist within a broad scope of the research. Each type of analysis was done as an extension of a similar design research method referred to as clustering or grouping. Creating clusters of information provide insights into seemingly complex relationships (Kolko, 2011). These clusters can then be analyzed for general themes and multiple clusters aid in validating data (Kolko, 2011, p. 79-85).

3.4.5.2. Frequency Graphs. The popular placements data was then converted into graphic frequency charts for every piece in the original code set that had 6 or more representations. Anything less than 6 would not easily show a relationship in comparison to more prevalent pieces and was considered too insignificant to analyze appropriately. The bar charts displayed the number of images per a piece type that were selected for that particular emotion more than any other emotion. Moreover, they show the highest percentage relationships selected per an emotion as they relate to the particular piece. For example, handle type G had a high percentage of selection in four images selected for Disgust. Frequency charts are “a simple means of exploring…data sets” and “recast them in a way which counts the frequency that certain things happen” (Robson, p.421). This basic form of analysis can reveal simple relationships at a glance.

3.4.5.3. Pathfinder Network. As stated previously, the card sorting data was converted to percentages so that each cell in the matrix represented the percentage of times each teapot or kettle was assigned to each emotion. These data were then normalized to fit a scale of 0 (minimum similarity) to 1.0 (maximum similarity), and submitted to the Pathfinder network scaling algorithm (Schvaneveldt, Durso, & Dearholt, 1989). Pathfinder is a graph theoretic technique that takes as input measures of item similarity (or psychological distance), and generates networks in which a link between any two nodes exists if and only if that link represents a shortest length path

between any two nodes. In this way, Pathfinder reduces the data to show the most important relationships. Pathfinder accepts parameters to help define the nature of the graph. One includes the minim value for which two items would be considered related (and thus a link would be included). Examining a histogram (Appendix D) of the similarity data showed that the top 25% of items had a similarity value of 0.25 or higher. Thus, 0.25 was chosen as the minimum similarity value. In various research studies (Branaghan, 1990, Branaghan & Hildebrand, 2011; Branaghan, et al, 2012), Pathfinder has been shown to be effective at representing strong relationships between items.

The network was converted into a graphic representation using the original images so as to reveal their aesthetic qualities. Emotions and the images they connect to were both visible in each graphic network. As each graphic went through a conversion process, the distances between objects may have been altered to allow for all of the images to be viewed collectively. Nevertheless, the researcher attempted to maintain an honest representation of both the images and their association to a particular emotion. Some variance was deemed negligible as the strength of the relationships was still apparent.

3.4.5.4. Content Analysis of Pathfinder Network. Aesthetic qualities were derived from the literature review and were developed into graphic diagrams as a way to represent the visual relationships to the emotions. The major themes were placed on a circular axis and scored depending on the prevalence of a certain characteristic. This provided a more objective, strategic, and repeatable analysis of specific characteristics to be identified within each emotion category .This is a form of a content analysis which has been recognized as a successful measure of "works of art, images, maps, sounds, signs, symbols and even numerical records" (Robson, 2011, p. 349). Neuendorf (2002) views content analysis as " the systematic, objective, quantitative analysis of message characteristics (as cited in Robson, 2011, p. 349). However, content analyses do not have to be strictly quantitative. They are also known for constructing inferences for many different types of materials that can replicated as necessary (Robson, 2011, p. 349). Both the qualities of stimulation found in table 1 and the dominance/submissive found in

table 2 were constructed into radial diagrams. Specific definitions for the terms in the radial diagrams can be found in the definitions section of the introduction.

Emotion groups were related to specific aesthetic categories based on whether the features of the teapots in the images were found to present a certain characteristic. From the inside out, the rings in the diagram represent if the image cluster exhibited the traits in a small degree to being abundantly depicted. These traits were not considered mutually exclusive as a form can be both sharp and smooth or stimulating and unstimulating. The data is still considered subjective to the researcher, but it provides a way to potentially replicate the thematic conclusions in future studies (Robson, 2011).

3.5. Magnetic Modeling

3.5.1. Magnetic Modeling Evolution. During the literature review, it was recognized that most aesthetics research had been done on 2D images, existing products, or previously contrived 3D amorphous forms. In a creative context, this limited the research in aesthetics as researchers relied on photographs or sketches to test forms that had been designed with specific aesthetic languages. Thus, the goal of this portion of the research was to create a method that was not only in 3D, but also allowed for manipulation of the 3D aesthetic traits by participants. The participants were encouraged to create their perceptions instead of simply relying on rating existing design languages produced by experts. As discussed in the literature review, when participants manipulate a portion of the design this is considered co-creation or co-participatory research.

Plenty of co-creative methods have been established as effective partners to design research including collages, cognitive mapping, brainstorming, diaries and workbooks (Sanders, 2002). Many of these types of methods are used for creative exploration and inspiration regarding a user's experience. This particular study sought to establish a more verifiable connection between aesthetic variables and emotion. Although some creativity was needed, the amount of creativity had to be controlled in order to make connections between standard relationships. Moreover, one set of connections were recorded in the previous card sorting task and this portion acted as a confirmation or denial of those relationships. In addition, a 3D method would allow

comparisons to be made with the 2D aesthetic results from the card sorting task. Thus, the researchers decided to modify an existing 3D method referred to as Velcro modeling.

Velcro modeling is a less common technique used in design practices today that was first introduced by Liz Sanders at Make Tools. The method takes basic shapes and covers them in Velcro to allow for attachment of smaller more localized forms. Sanders (2002b) remarks that Velcro modeling

> Allows people to embody and express their ideas in low-fidelity, three-dimensional models. Ideal for use after other tasks have been used for immersion, activation and dreaming, Velcro-modeling allows people to actively embody their ideas in a hands-on manner (p. 9).

Velcro modeling in essence allows people to shape their concept for an ideal product. Often, an entire Velcro modeling kit will have hundreds of forms in its arsenal to allow for vast variability in concept generation (Sanders, 2002, p. 9). To a limited degree, this method is mostly successful in assisting the participants' imagination regarding the form of the object as well. However, this method is generally only used for placement and large alterations in aesthetics testing have yet to be promoted. This may be due to some limitations regarding the rough texture of pieces covered in Velcro. Furthermore, this tool does not allow a large variety of potential for analyzing aesthetic combinations in a controlled setting. It would be intensely difficult to draw many comparisons among hundreds of shapes.

Thus, the concept of Velcro modeling was combined with the current theme of 3D printed proto-types to create a new method that is proficient at altering aesthetics. 3D printing manufactures pieces or entire products is multiple materials using a computer aided design (CAD) program. Moreover, Kobayashi owner of an company located in the Manoa Innovation Center states "3D printing is a bridge between prototyping and full production" (as quoted in Jolyn, 2013). As 3D printing becomes more established and cost effective, design studios will be more likely to integrate this type of generative model making throughout all stages of the design process (if they have not already). Testing proto-types is standard practice in design and 3D printing allows for rapid ideation and prototype testing (Jolyn, 2013). According to the article *3D Printing Prototypes Faster and Cheaper* (2013), the benefit of 3D printing is that prototypes can

be produced at a fraction of the cost of tooling and the turn-around time is in days rather than weeks or months. Aesthetics evaluation using a prototype is possible, but unfortunately prototypes must first be generated by designers in a CAD program and then presented to potential consumers. In order to truly test aesthetic combinations intuitively, it is necessary to provide a method that allows for both concept generation as well as a physical form that is representative of an actual product.

The combination of concept generation in Velcro-modeling along with the standardization and popularity of 3D printing inspired the new method proposed by this research referred to as Magnetic Modeling. Magnetic modeling uses 3D printed pieces of an existing product shape that are imbedded or lined with magnets that may be manipulated to represent specific concepts or themes proposed by the researcher. Ultimately, the participants become the creators of the product, but the amount of creativity is contained to the themes in question. The variety of shape combinations is also limited which assists in reducing the amount of analysis necessary for interpreting data. Magnetic modeling is similar to Velcro modeling in that is provides a standard set of pieces that are interchangeable. It differs in that the surface of the models may be less obtrusive and the pieces are derived from an actual product. This is more applicable to the design process as it allows the designers to promote a specific concept and have it evaluated by the potential users. This is similar to prototype evaluation. Thus, a bridge between the two concepts was constructed and magnetic modeling with the use of 3D printed pieces was developed for this research.

3.5.2. Constructing the Instrument. Fifteen interchangeable teapot pieces were 3D printed in plastic and lined with neodymium magnets and steel bolts. Selection of the pieces was based off of the results from the card sorting task during which common forms and the forms which were strongly attributed to positive or negative emotions or a singular emotion were taken into account. Four bases, three spouts, four handles, and four lids were identified as prevalent in the card-sorting task. Aesthetic attributes identified in the literature review were also taken into consideration when determining which pieces displayed a variety of established form dynamics. Below shows the final pieces and their full modeling capabilities:

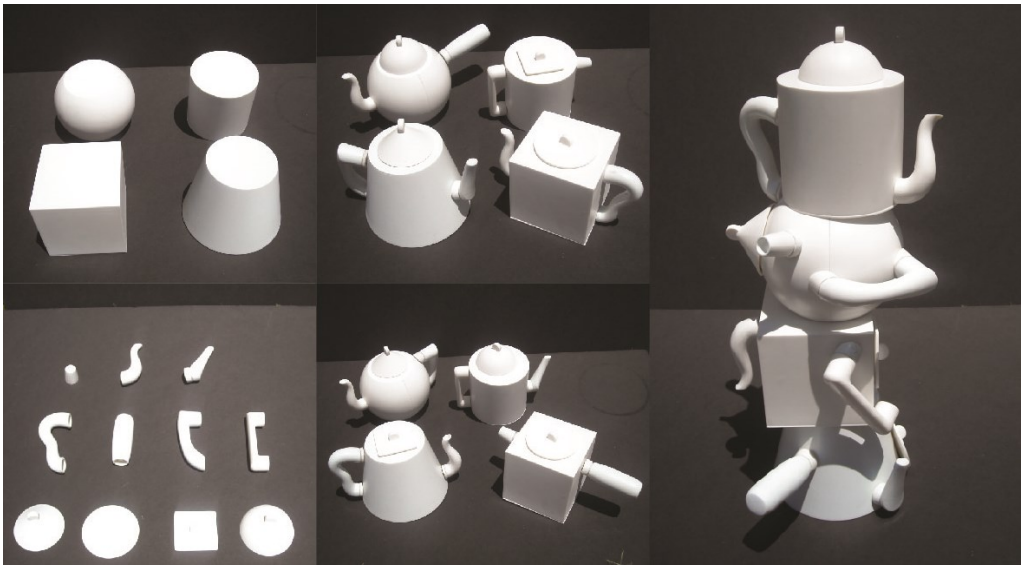

Figure 23. Magnetic Modeling Pieces

Pieces were kept hallow while being modeled in rhinoceros, the CAD software. Hallowed surfaces and the plastic material were found to be the lightest and offer the most flexibility for use in initial testing. Initial printed models of the handles and spouts were found to be too heavy even when hallowed out. The spout pieces in particular would not stand upright in the most likely position for a spout to be placed. Therefore, it is suggested that if this process is repeated that plastic models be used. As some of the pieces were printed in ivory and some in white, all pieces were sanded smooth (from 60 to 320 grit sandpaper), primered white (high build auto primer), and then sealed with 3 layers of clear coat spray paint. This consistency in appearance helped control possible variability in perception regarding the forms and assisted in the durability of the surface of the models. A great amount of detail was paid in an attempt to make each model smooth in texture and completely white, although some minor differences may exist.

To account for the variations in attachment to surfaces, 9 interconnection pieces, affectionately called nubs, were developed to go between the spout/handle and the base of the teapot. For example, the flat edges of handles could not attach flush to the surface of the spherical shaped base, so wedge-like nubs were provided for the participants. Three different sets of nubs were provided: a flat set, a thicker flat set, and a wedged set. The nub concept was

developed after some ideation sketches were performed. These sketches aided in determining which nubs were most likely to be needed in order for the rest of the pieces to fit comfortably with each other.

Every piece, including the nubs, contains some form of neodymium magnets. Every base piece was lined with a combination of small neodymium magnets and anodized steel bolts. Bolts and magnets were both super-glued to the inside of the pieces. Prior to gluing, bolts were placed with the magnets for at least 24 hours to magnetize them. Handles and spouts contain larger neodymium magnets comparative to those used to line the inside of the pieces. This was to help keep the pieces upright during the manipulation experiment. The image shows the insides of all of the bases as an example of the internal component patterning.

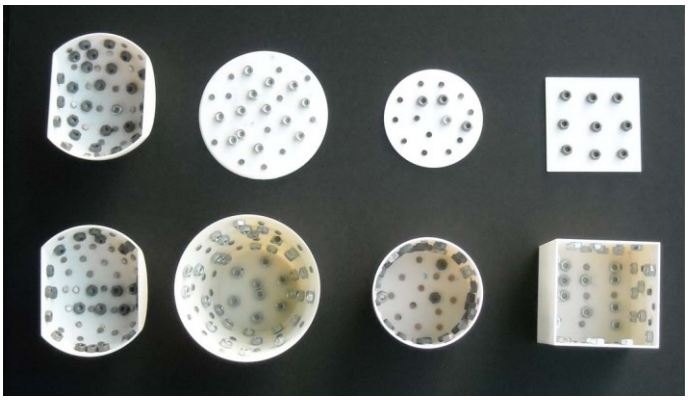

Figure 24. Internal Magnetic Patterns

3.5.3. Semi-structured Interviews. Semi-structured interviews were conducted in conjunction with or after the interaction portion of the magnetic modeling task. During semi-structured interviews, "the interviewer has an interview guide that serves as a checklist of topics to be covered and a default wording and order for the questions, but the wording and order are often substantially modified based on the flow of the interview" (Robson, 2011, p.280). Additional questions may also be added to "follow up" on the statements of the participants (Robson, 2011, p. 280). As the purpose of this research is to explore the relationship of emotions and aesthetics in the context of a product, interviews were necessary to root out these latent topics. Some questions were prepared prior to the experiment (see Appendix F), but these were merely starting points for the researcher and the participants to expand. The advantage of interviews over other

methods such as observation or surveys alone is the flexible ability to alter “one’s line of enquiry, following up interesting responses and investigating underlying motives” (Robson, 2011, p. 280). Explicit comments and details that may also indicate mental connections and thoughts that are otherwise unapparent.

3.5.4. Pilot Study and Testing. A short and small pilot test was done with one female participant age 27 and one male participant age 34. The pilot test was conducted in order to both test the functionality of the pieces and the interview topics in question. One base, two handles, two lids, and two spouts were used during this experiment. Participants were asked to manipulate the pieces to represent the emotion anger. Interviews lasted roughly 10 minutes per a participant. As a result, the researchers decided that more questions could be asked in future iterations of the process to both keep the time reasonable while also encourage more thorough responses. Participants each signed a consent form and were offered the instructions to read. As neither participant actually read the instructions, this was taken into consideration in the formalized experiment.

3.5.5 Instrumentation. Thirteen video recorded interactions/interviews took place at the participants’ homes in order to ensure they each felt affectively comfortable in their surroundings. Prior to the experiment, participants were asked to read and sign a consent form as well as fill out a demographic survey (Appendix F). They were then read the instructions by the researcher so as to build rapport between the participant and the researcher as well as to ensure the instructions were thoroughly understood. The following is an excerpt from the instructions:

> You will be constructing four different teapots using the pieces in front of you. The teapots will each be photographed once you feel the teapot is complete. After each teapot is constructed, we will discuss your rational for your chosen pieces. You may also “think aloud” while placing your pieces, but are not required to do so. Each teapot must contain at least and only one piece from each of the following categories: base, handle, spout, and lid. Feel free to position them in any way you see fit and if the pieces are unable to stay in your exact preferred position, you may hold the pieces while the picture is taken. You may start with any piece and each base may be flipped to represent your impression of the emotion.

Participants were then told to randomly select four cards from a deck of eight as they were presented in a face down “fanned” position by the researcher. Each card contained a handwritten emotion label. Again the 8 emotions from Plutchik were selected: anger, disgust, sadness, fear, joy, anticipation, trust, and surprise. Participants were allowed to select different emotions if they did not understand the meaning of the word (this was particularly helpful for two Chinese participants). This study does not focus on the linguistic usage of terms and how they may influence perception. Thus, the researchers felt understanding the term was essential in order to portray it effectively.

The participants were instructed to model 1 teapot at a time each modeled after one emotion from their selected set. Again, participants were encouraged to think allowed during the task if they felt it comfortable doing so, but that they would have the opportunity to discuss their design decisions after each teapot was complete. Once each teapot was constructed, the pieces were dissected, put back in their original place, and then the process would repeat. Participants were encouraged to model whichever emotions out of their selected group that they desired in whatever order they decided to follow. The fifteen 3D printed plastic pieces and 9 nubs were laid out in the following order: bases, spouts, lids, handles, and nubs. A demonstration of a nub and handle or spout attaching to the side of the base was presented during the instructions to ensure the process was understood. Pieces were laid on two black foam core poster boards to aid in consistent perceptual variation as well as for clarity during analysis of the videos. Participants were limited to only one of each type of piece per a teapot, but were ensured that each piece may be reused in future iterations.

After each teapot was constructed, and at times during the construction (if the participants commented), semi-structured interviews were conducted. The length of the interviews varied with each person with the shortest lasting 42 minutes and the longest lasting one hour and 48 minutes. A guide was constructed prior to the experiment, but many additional questions, often referring to positions or actions of the pieces, were asked off-hand. After all teapots were constructed, overarching questions were also asked regarding the entirety of the process and general themes considering all of the pieces and emotions. If any questions that

were asked off-hand delivered insightful responses from the participants, the researcher would record it for future interviews.

Besides short notes regarding the questions, the researcher refrained from taking notes during the experiment. As the topic deals with latent experiences, note-taking may have inflicted a feeling of pressure or expectations on the participant. The researcher's focus was paid to the different movements and selections of pieces so that any applicable questions may be asked. As many participants quickly switched pieces, this high amount of attention was necessary by the researcher. Participant comfort was also kept a primary goal during this particular phase of the research. Rapport building was maintained with consistent eye contact, smiling, and positive affirmations that any choice was appropriate in the hopes to build the confidence and support of the participants. Below is a series of frames taken from one interview.

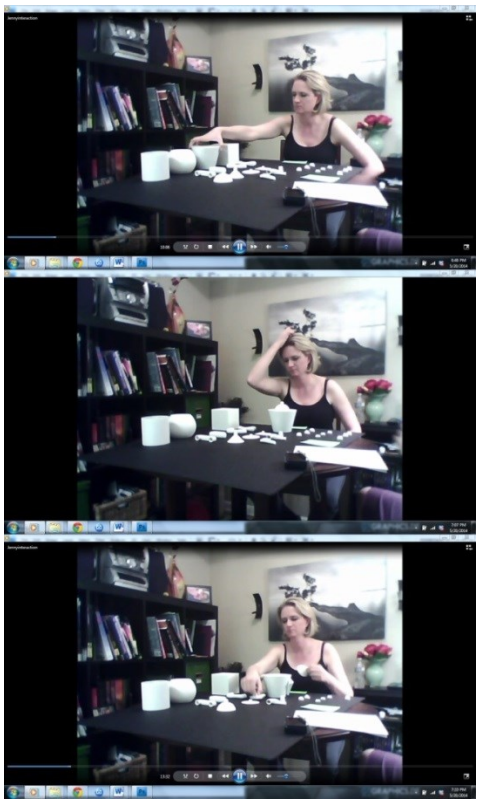

Figure 25. Magnetic Modeling Video Screen Shots

3.5.6. Participant Sampling. A convenient sample of 13 participants, 7 male and 6 female, volunteered for the magnetic modeling experiment. A convenient sample was determined

most appropriate as a previously defined relationship between the researcher and participant might encourage a more comfortable atmosphere. Again, as this experiment deals with latent abilities, participant comfort was kept as a high priority as a way to promote a fluid amount of creativity and intuition within the participants. Participant and researcher relations have been known to improve process validity as "trust and rapport are important in generating quality data" (Hirshman, 1985).

As a convenient sample was gathered, some attempts at providing a variety of individual personalities, education levels, races, ages, and career were considered during the selection process. Nevertheless, as one can see in the table below, a majority of the population was Caucasian or white, had some form of education, and fell into the 18-30 age range. The following is a demographic chart using fictional names of the magnetic modeling participants.

Table 6

Magnetic Modeling Participant Demographics

Name	Education	Race	Gender	Age	*Career Field
Adam	Bachelor's	White	M	18-30	Edu./Unemp.
Ah Cy	Bachelor's	Chinese	F	18-30	Stu./Design
Anna	Master's	White	F	18-30	Education
Dale	Some College	White	M	31-42	Pharmacy
Derek	Some College	White/Mix	M	18-30	Analyst
James	Master's	White	M	18-30	Education
Jessica	Some College	White	F	42-54	Service
Jewel	Bachelor's	White	F	5-68	Psychology
Nathan	Some College	White	M	31-42	Stu./Retail
Sebastian	Doctorate	White	M	18-30	Medical
Serena	High-school	White/Black Mix	F	18-30	Financial
Thomas	Bachelor's	White	M	55-68	Civil Planning
Yanmei	Bachelor's	Chinese	F	18-30	Stu./Design

*"Stu." means current student. "Edu." For education. "Umemp." for unemployed.

3.5.7. Data Collection. After each interview was conducted, the researcher engaged in a short debriefing period during which notes regarding general impressions of the interviews were recorded. Photographs were taken of each teapot that was constructed. These were coded according to the teapot key in Excel for analysis. The order of which emotions were constructed by the participants was also recorded by the researcher as well as any additional questions or small reflections. After all interviews had taken place, the video recordings of the interviews were transcribed and reviewed for physical, non-verbal forms of communication.

3.5.8. Data Analysis. Transcribed data was sorted in accordance with thematic open coding using a grounded theory approach. During thematic coding themes "serve as a basis for further data analysis and interpretation" (Robson, 2011, p.467). These themes are developed and then each portion of the interview that coincides with that theme is noted accordingly. When the researcher is also applying a grounded theory approach, these themes "arise from interaction with the data" and "are based on the researcher's interpretation of the meanings or patterns in the texts" (Robson, 2011, p.467). The researcher's interview guides and research questions were both derived from themes presented in the literature review and the card-sorting task. Moreover, evidence consisting with the Say, Do, Make approach served as some initial themes for coding. Although these themes were taken into consideration, special attention was given to novel data as this is identified as a weakness to open coding (Robson, 2011, p. 468). In addition, the differences between the card-sorting task and the magnetic modeling surfaced many new themes. These themes were divided into the Say, Do, Make categories and synthesized into 4 personas with a suggested 5^{th} possible persona.

In order to evaluate the relationship of aesthetics and the perceptions of the user, another image cluster was created as a comparison to the networks produced by the card-sorting task. Content analyses were also performed on these groups using the aesthetic qualities found in the literature review. As the participants' images were already sorted into emotional categories, an additional network was unnecessary. In a version of visual coding, aesthetic variables in each emotion cluster lended a series of themes regarding design elements and their emotional attribution. All the themes derived from the literature review, card sorting task, and the magnetic

modeling were compared as well as any strengths or weaknesses that were identified in the process. A new model regarding the process of emotional form attribution was developed as a result.

CHAPTER 4

FINDINGS

4.1 Introduction

This chapter is dedicated to the findings derived from the data, participant responses, and formation of conceptual diagrams that are representative of the data. This section will cover the card-sorting (CS) material first and then review the magnetic-modeling (MM) findings. Each section will individually address the results regarding the teapot pieces, the emotions, and how they both interact. The Magnetic Modeling results also discuss four personas developed after the interviews as well as a basic analysis of the modeling results as presented by the participants. Moreover, an analysis inspired by the "Say, Do, Make" approach is discussed. In accordance with grounded theory, each phase will also provide the thematic elements that were used to inform the next stage.

4.2. Card-sorting Findings

4.2.1. Popular Placement Groups. As stated in the methods chapter, Optimalsort supplied a popular placement chart with data representing the percentage of times an image was selected per an emotion. This chart also made a suggestive grouping of the data according to the emotions. However, these groups were categorized with the codes rather than the specific teapot images. Thus, the first step of analysis was to transfer these suggested groups back into a visual format. In addition to the images, the corresponding parts as labeled in the image codes were also placed in graphic alignment within the suggested emotion. Each type of piece (handle, spout, etc.) was also grouped according to their emotion and piece type. Thus, all the spouts in anger, disgust, and ear etc. could be viewed collectively. An example is provided in the image on the following page. This process allowed for general themes to surface and directed the remainder of analysis used on the data.

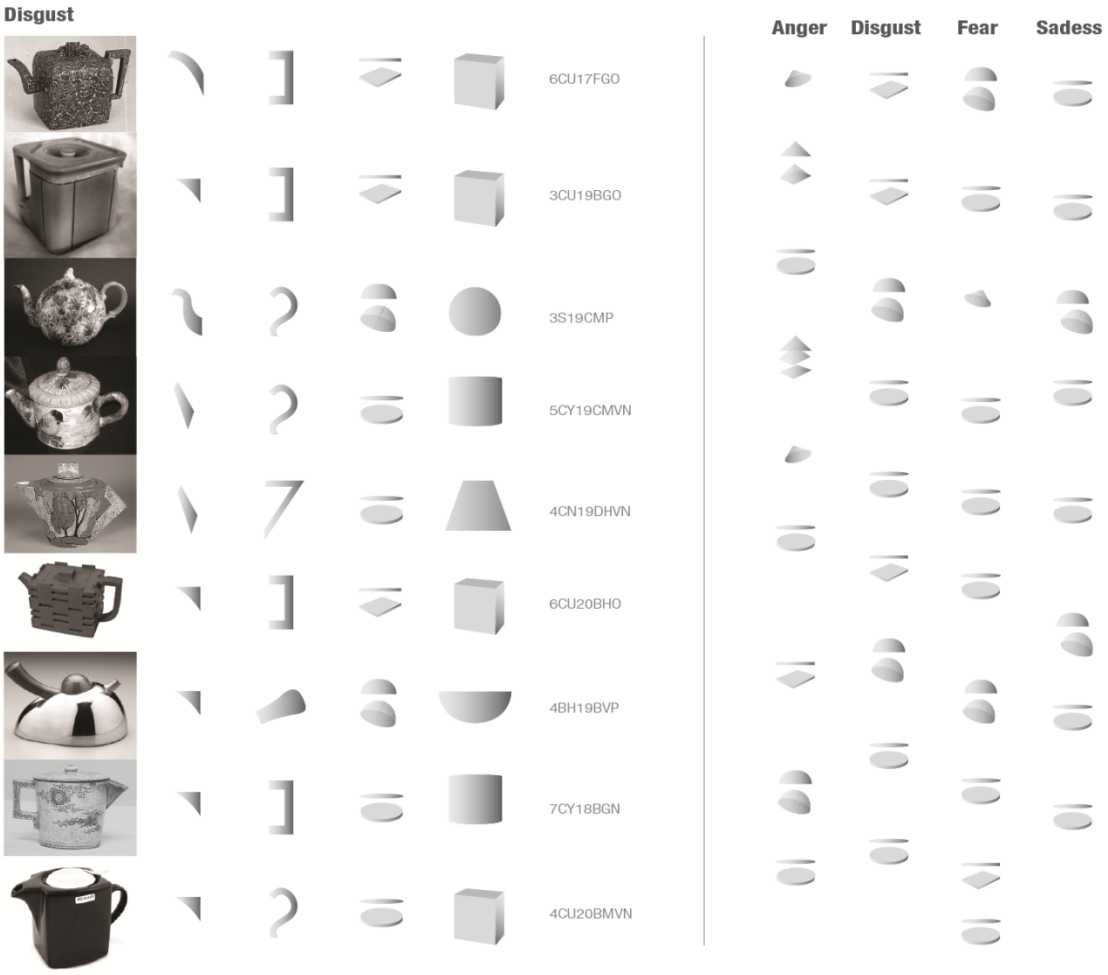

Figure 26. Initial Popular Placement Groups

The above image shows the images and pieces for disgust as well as a simultaneous collection of lids which fell into negative emotions. The remainder of the emotions were also arranged in this manner to view the data in an applied context. Several considerations were gleaned from this initial set of images including the following:

1. Some pieces occur more frequently within certain emotions.

2. There are obvious differences in total between negative and positive emotions and their corresponding pieces.

3. A piece may occur in low numbers in the total image set, but still have a high frequency in a particular emotion.

4. Some pieces may actually act as an “indicator” for a particular emotion if it is only presented or highly presented in one emotion.

5. The pieces were viewed in a group so analysis of these relationships should be done in a similar style.

6. The complexity of the relationships required further analysis.

This first step allowed for an initial interpretation of the data during which other possible types of analysis were considered for the remainder of the study.

4.2.2. Piece Frequencies. As frequency was recognized as a strong theme within the popular placement groups, the rate of occurrence for each piece was put into dimensional bar charts. The numbers represent the amount of images that were categorized most often in the corresponding emotion. Thus, the numbers are indicative of images with high selection rates by the participants. For example, there were seven images with a spherical base that had a strong relationship with joy.

4.2.2.1. Base Frequencies

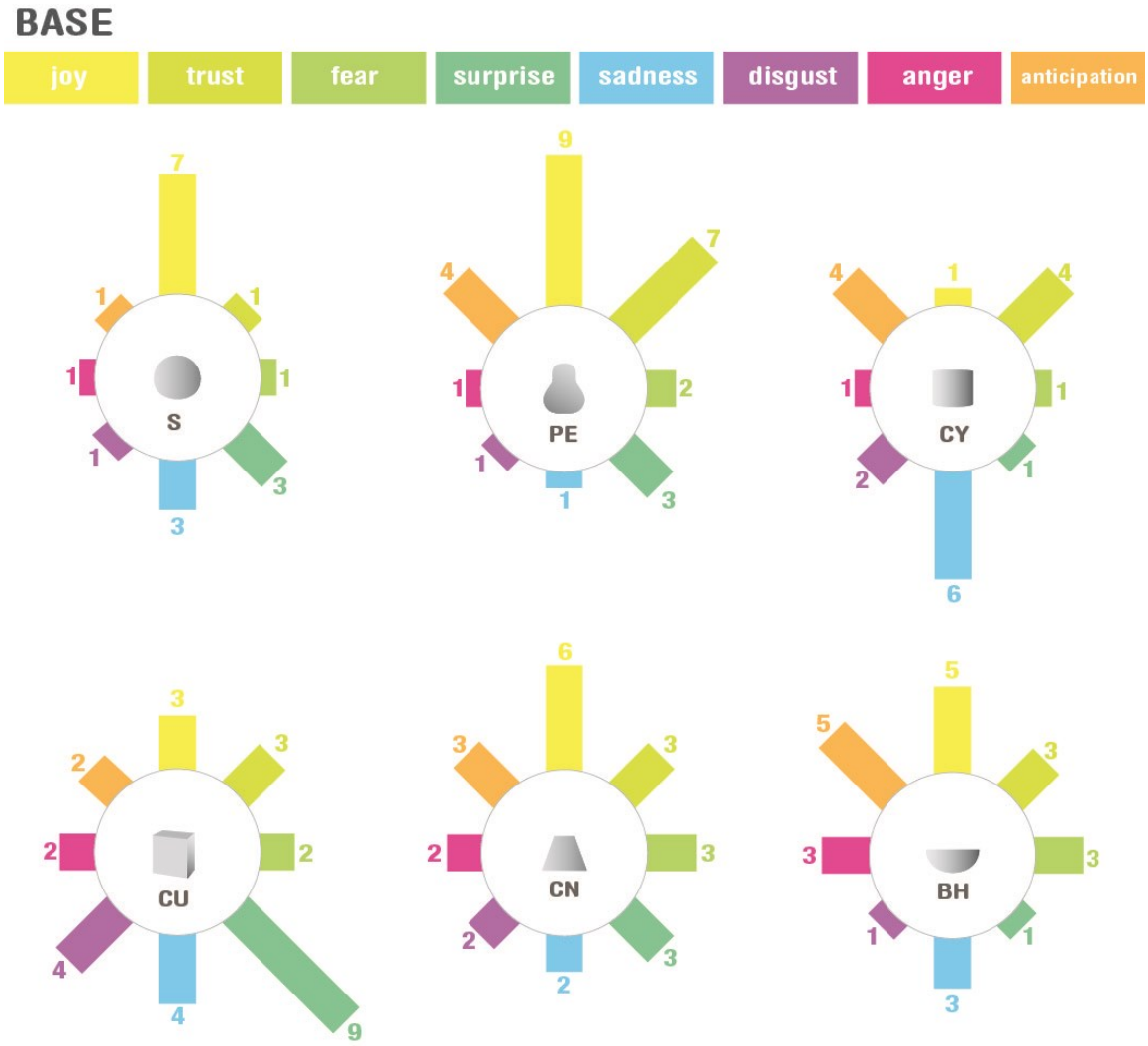

Figure 27. Base Frequency Charts

The data was placed in circular bar charts versus the traditional format as they tend to reveal more information regarding the totality of the emotional experience. Moreover, if one considers the affective qualities of two negative emotions, as in sadness and anger, they may reveal an overall negative experience, but the arousal state may be unclear. Using the base frequency charts as an inspiration, general themes were observed for each piece in the teapot code. The following themes were identified for the relationships between the pieces and emotion:

Spherical (S)- A generally high arousal state is recognized. If the form is negative, it represents sadness. There is an obvious connection to joy.

Pear (P)- A high arousal state is noted with a strong association to positive emotions. However, this shape connects to a large variety of emotions and its true essence is unclear.

Cylinder (CY)- Sadness is strongly displayed. The emotion expresses a sense of uncertainty. This is the only base with a strong negative response over other emotions.

Cubic (CU)- All positive emotions are evenly represented except for surprise which extends twice as much as any other emotion. A possible negative association is noted. It may be considered unusual (surprising is also uncertain).

Cone (CN)- There is an even distribution with the exception for joy as this form tends to be more positive. Context or other attributes may be important (due to many emotions being shown).

Hemisphere or Bell/Hemisphere (BH)- This base has mostly positive associations with some mixed emotional attributes noted. It has the most images for anger out of all the bases. Anticipation and joy suggest an optimistic shape. There is some negative potential. Context or other attributes may be important.

4.2.2.2. Spout Frequencies

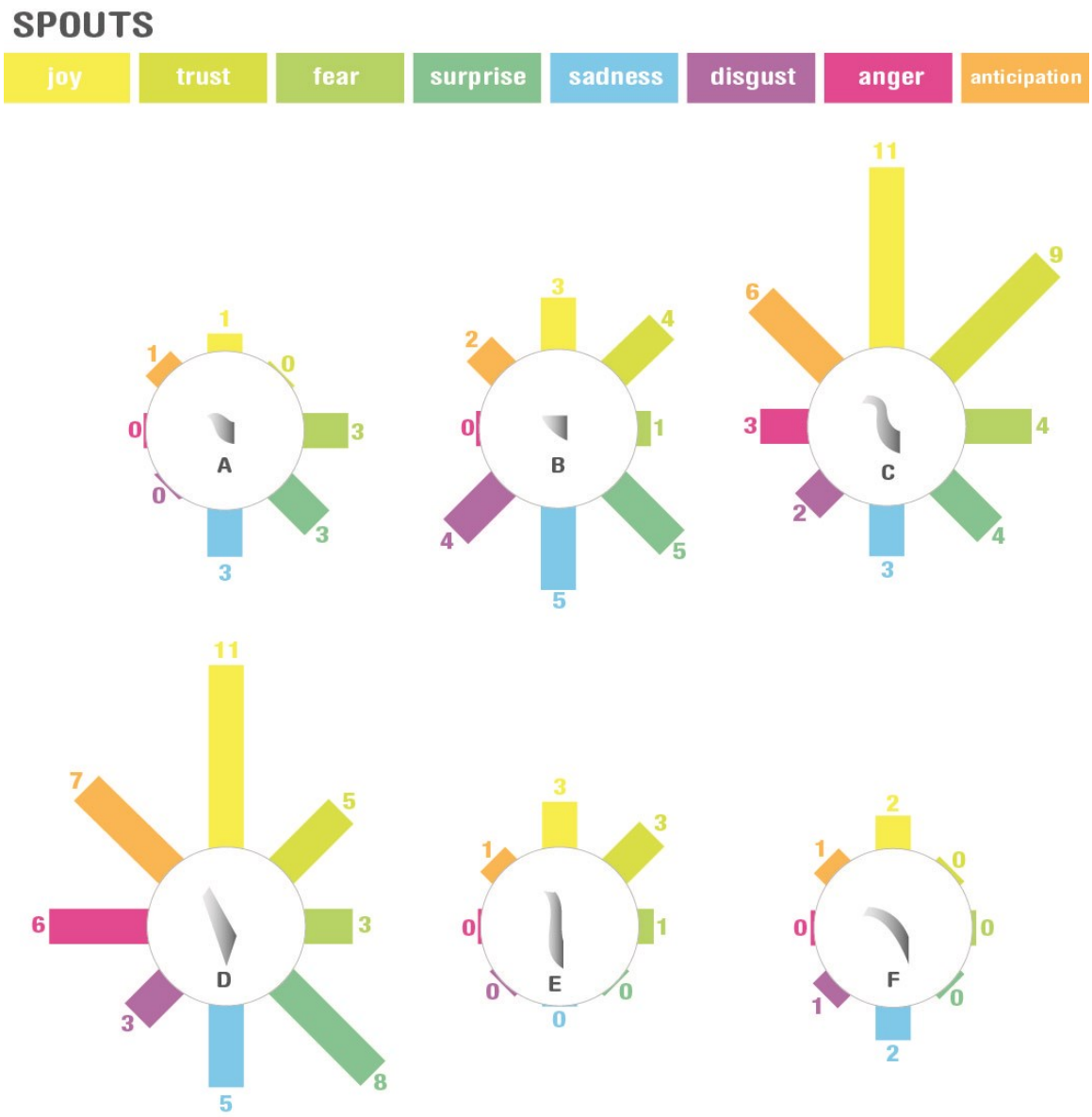

Figure 28. Spout Frequency Charts

The following themes were discovered in relation to the spout categories:

Small curved spout (A)- Is categorized more often in two negative emotions with relation to surprise which reveals uncertainty or apprehension is associated to this spout.

Small straight spout (B)- Is associated more often with negative emotions, although an almost equal representation with positive emotions is apparent. A majority of the representation is in surprise and anticipation which reveals uncertainty and curiosity.

Curve Spout (C)- With one of the highest total frequencies in the set, this shape is relevant to many emotions. Joy and trust are depicted most often. There is an association to anticipation and surprise.

Straight Spout (D)- A high total frequency presents a vast representation in the straight-spout. Although this spout is most often positive, it also has the highest negative association. This suggests context or other shapes may alter its perception.

Tall Curve Spout (E)- With such a small amount of total frequency in this set, it makes it difficult to draw conclusions. That being said, similar patterns are seen as with the curve spout (C).

Lilting Spout (F)-There is a small total frequency that is evenly distributed in negative and positive emotions.

4.2.2.3. Lid Frequencies

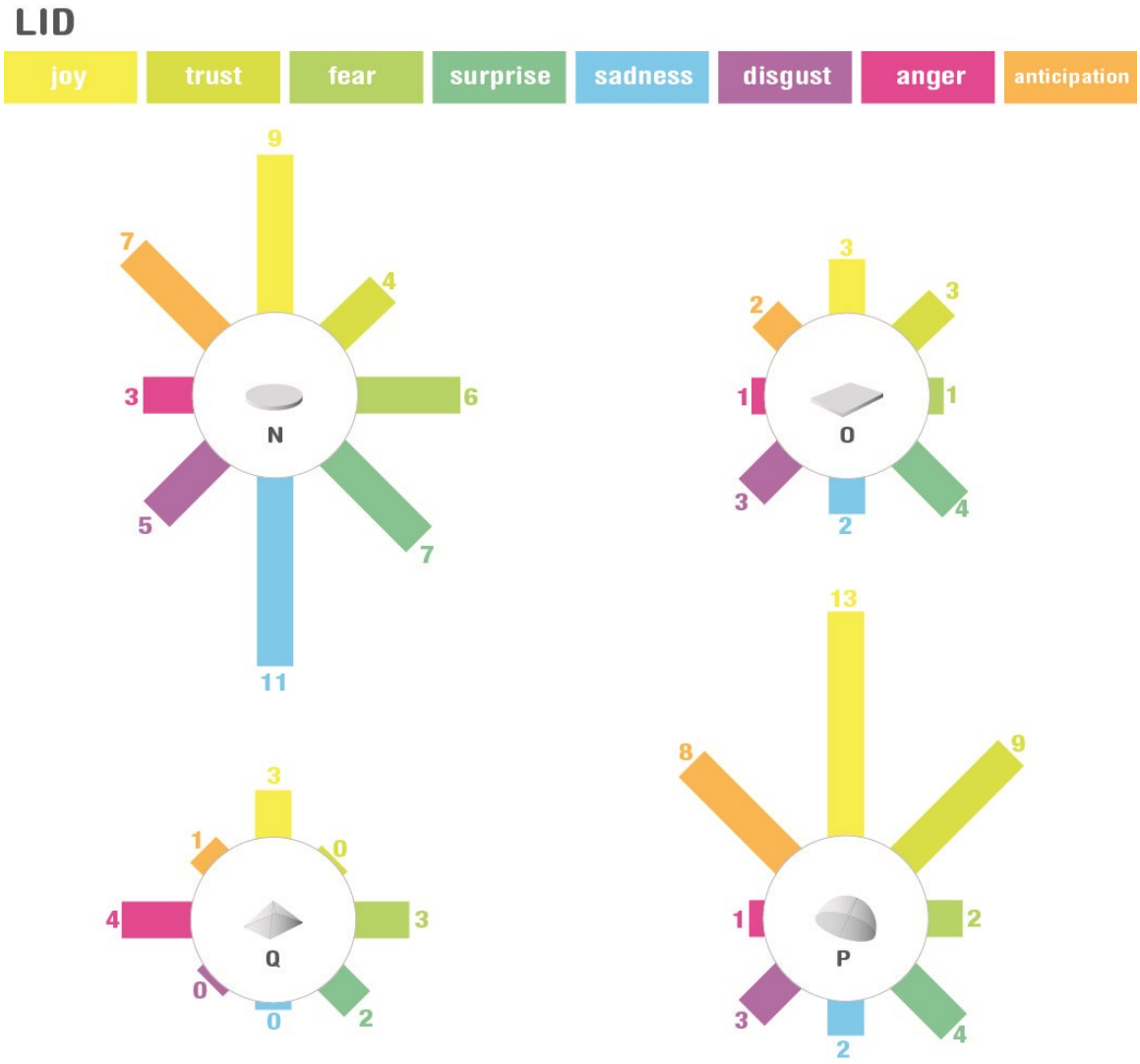

Figure 29. Lid Frequency Charts

The general themes identified for the lids are:

Flat Circular Lid (N)- A high total frequency is noted. It is strongly associated with sadness more than any other emotion. A mixture of emotions is represented and it has the highest rates for disgust, anticipation, trust, and surprise.

Flat Square Lid (O)- This piece is rated most for surprise than any other emotion. This piece is generally positive with a possible tendency to the negative. Thus, the positivity or negativity of this piece is unknown.

Dome Lid (P)- It is positively associate with trust and joy. This piece is mostly connected with joy, but anticipation and surprise are also noted. Other emotions are possible, but this shape may be help to alter the perception for more negative shapes. Combinations and context may provide a more thorough comparison.

Cone or Pyramid Lid (Q)- This piece is highly attributed to fear and anger which suggests a negative connotation. Some positive or intrigue related emotions are seen, but it is not obviously evident in comparison. Again, context and more combinations may offer more evidence.

4.2.2.4. Handle Frequencies

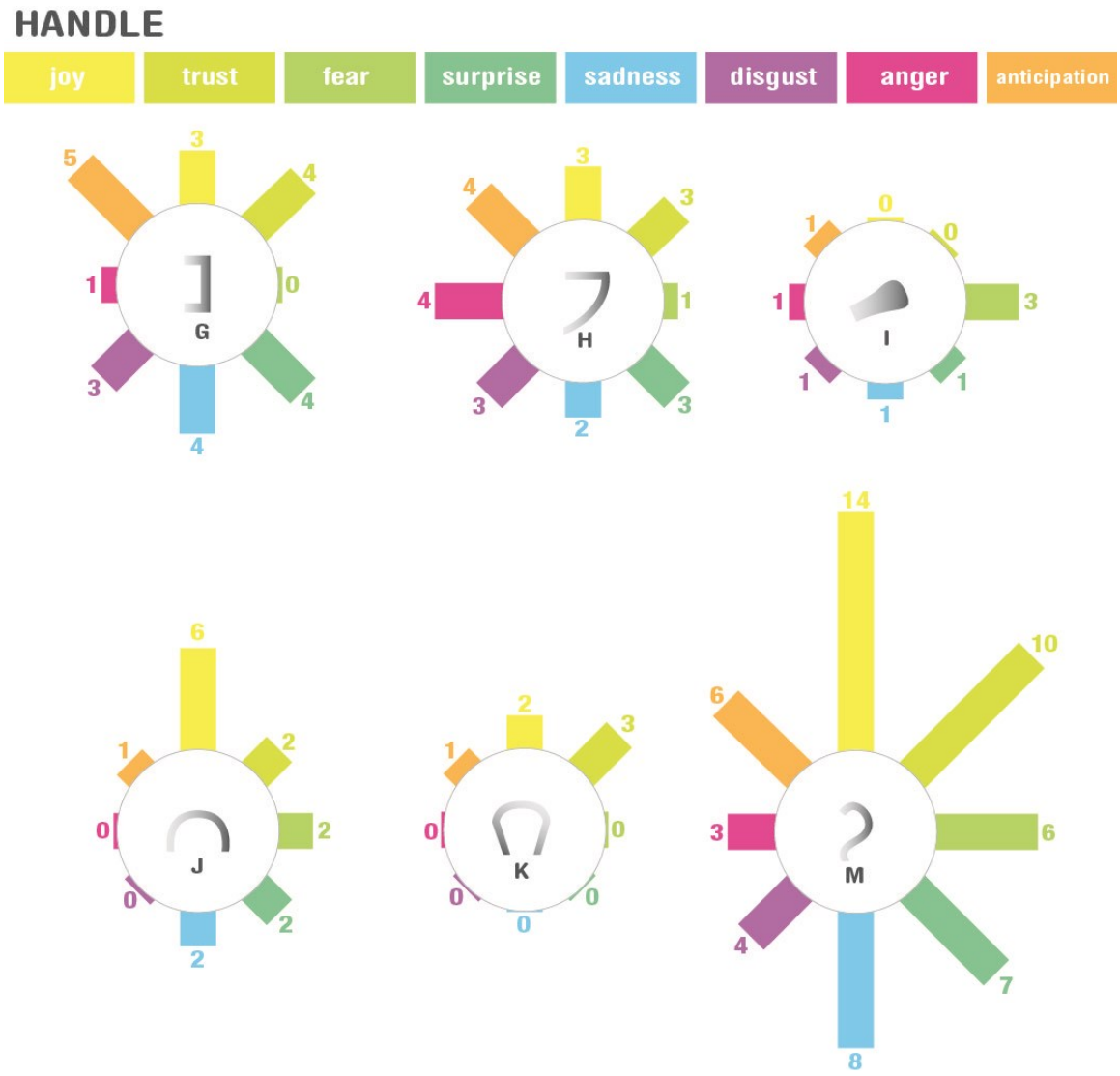

Figure 30. Handle Frequency Charts

The themes for the card-sorting handle types are as follows:

Squared Handle (G)- This handle has an even distribution for many emotions except for fear and anger. It has one of the noticeably high rankings for anticipation, especially in relation to the other emotions. Context and combinations may have an effect.

Half Handle (H)- This half-handle (named for being half curved and half straight) exists in a broad range of emotions. A slightly more negative connotation is associated with this shape. It has the total highest negative connotations for disgust and anger. The

apprehensive intrigue emotion of anticipation is also noted. This may be a negative form, but it is not entirely arguable from this data alone.

Post Handle (I)-This piece has a strong indication for fear in comparison to the other teapots and to the other emotions for which it is rated. An even distribution is also noted except for joy and trust, which are the most positive emotions. This shape may be negative while also expressing some intrigue or uncertainty.

Arc Handle (J)- This shape is indicative of joy most often with a fairly even distribution among the other emotions. The exception occurs with the two most negative emotions of disgust and anger. This suggests that this shape is generally positive.

U-shaped Handle (K)- This handle has a very low amount of frequency in the total image set, thus any relationships may be difficult to decipher. However, whenever the piece has been present it tends to be positive.

Curvy handle (M)- The most common handle type in the set, this form is generally positive with two strong relationships with joy and trust. There is a strong representation in sadness as well. The large numbers in the emotions anticipation and surprise also may represent some uncertainty or unexpected nature. The true nature is unknown as this shape has a broad base of emotions.

4.2.2.5. Summary. As one can see, the frequencies of each shape offer general information with reference to the quality of the emotional relationship. However, the images that manifested these shapes actually depict multiple relationships co-existing on the same plane. There is no way to dissect, from the current charts, how these forms relate to one another in their collective combinations. Additionally, the emotional quality of each separate piece is not fully understood as the other shapes in the combination may alter the identity of the piece.

4.2.3. Emotion Network. In accordance with the findings from the card-sorting frequency charts, further analysis was necessary in order to understand the images and their emotional relationship. Some themes regarding the pieces were gleaned from the frequencies, but it was not apparent what trends existed in the emotions as a whole. Thus, the popular placements data was processed through the networking software Pathfinder in order to view images as a whole in

their respective emotional relationships. Unlike the popular placement groups, Pathfinder is capable of displaying all relationships associated with the images at once. As stated in the Methods chapter, the links that are depicted in the following network show the relationships between the image and emotion. Thus, the shorter the distance of the image to the emotion, the stronger the association between the two objects. For added visual clarity, the links were colored according to their emotional connection. If no link is present, the two images do not have a relationship, even if they are close to one another. Additionally, the codes will be referenced using the first five figures as they distinguish the order in the group followed by the base code and the century of production.

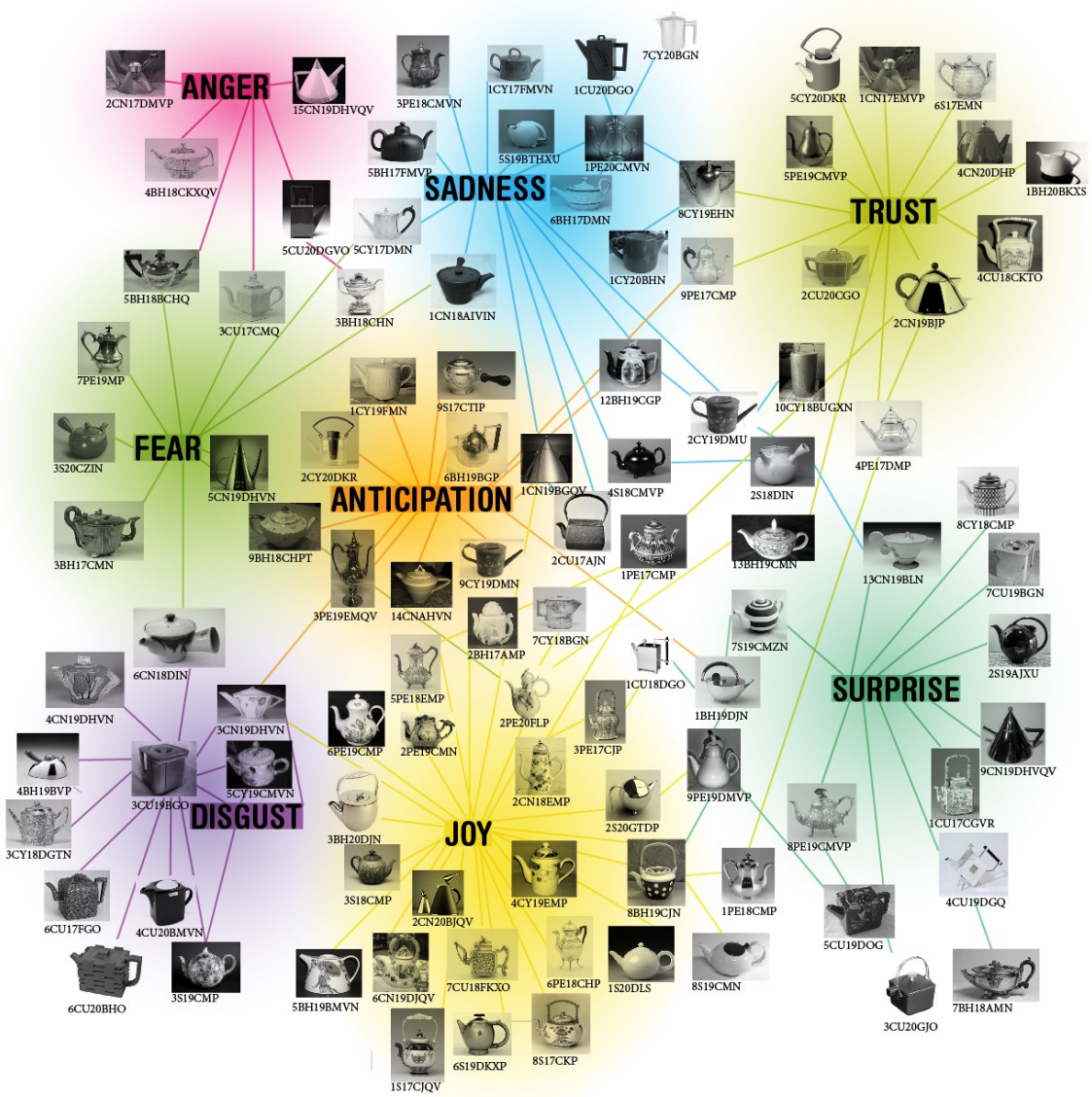

Figure 31. Pathfinder Emotion Similarity Network

Since the above image is very complex in nature, each emotion shall be presented with a close-up image that accompanies the insights derived from the aesthetics characteristics of the teapots in those groups. The graphic content analysis also accompanies the thematic descriptions of some of the aesthetic qualities seen in the emotion groups.

4.2.3.1. Anger

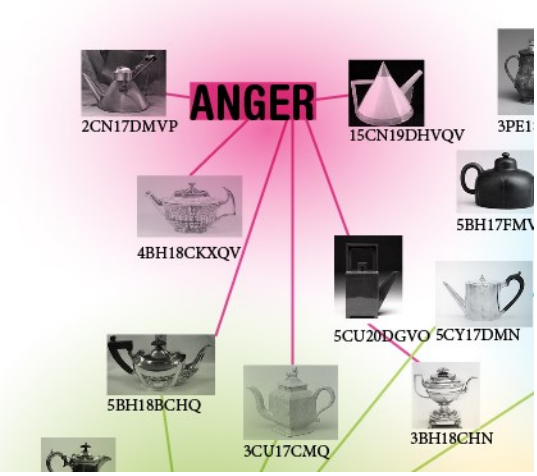

Figure 32. Anger CS Cluster

The anger cluster is a particularly small group which may be due to the choice of object as a majority of the images were placed into positive emotions. That being said, anger does seem to have a series of familiar traits and overall themes associated with this group of objects. One of the first traits that appeared was the use of angles in the handles, the edges of the teapot, and the degrees of the handles and spouts. Furthermore, the commonly found straight spout appears to roughly extend at a 75º angle from the surface on which the teapot rests. The bases of the actual spouts are also consistently the same width through to the opening of the spout which makes them more slender overall. The handles are nearly all at a right angle from the base as well. This angle and the additional simplistic, flat, and modern styling of the surface create sharp edges on the handles, tips of the spouts, and on any small details as well.

These teapots tend to lack a sense of commonality as the certain elements may appear to be unusual for a teapot. For example, the teapot 4BH18 bestows a rather dangerous aesthetic element in the point of its handle. This trait is very unusual and exists only in this image (out of the many that were studied, and the total set as well). This handle, the heights of the teapots 5CU20 and 3BH18 may make the observer question the ease of functionality with which to pour the teapot. One should also note the angle of the base on the teapot 3CU17 as it is one of the only cubes with a front facing edge, as the handle and spout are placed on the edge of the

corners versus on the flat of sides. In general, cones, cubes, and unique hemispheres with large and angular secondary elements persist in this category. Nevertheless, the two closest relationships connect to cones. A broad mix of century origins suggest that teapots from any era may be interpreted as aggressive or angry with the right combination of elements. Material and shade of contrast do not appear to distinguish these teapots, but surface texture is limited. Tight lines, and sharp edges, with a large presence suggest dominant features. Controlled and cohesive design languages promote that these teapots are most likely not confusing or misunderstood. They are hard, geometric, unusual, and aggressive.

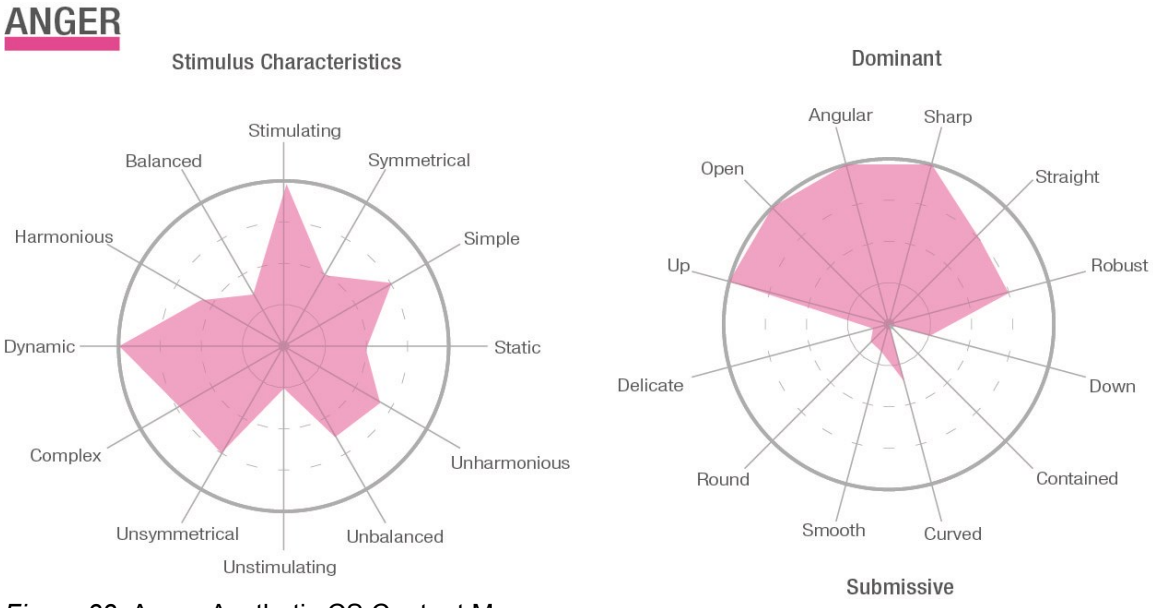

Figure 33. Anger Aesthetic CS Content Map

4.2.3.2. Fear

Figure 34. Fear CS Cluster

As fear and anger are both negative emotions, some similarities exist between them, but in general they are very different. Fear, for one, has more stunted forms that are low to the ground plane on which they sit. At least five out of the ten images present themselves as being smaller in appearance (although the actual size is not known). They also reveal a more closed and contained appearance as the handles and spouts are rather stunted and close to the body of the teapot. One form, 5CN19, is very similar to the conical teapots in anger, but it is even more extreme. This is demonstrated by its tall height and extremely exaggerated angles. This offers a vastly different interpretation of the concept of fear. It makes one ask the question, “Are these fearful teapots displaying fear or is this a singular teapot that makes people afraid?” There may actually be elements of both types of perception. Take, for instance, the ends of the spouts on 2PE20, 3CU17, 7PE19, and 3BH17. All of these forms vary in size and dominance, but each one exhibited a sharp, snake-like tip on the end of the spout. This may be the only element that places 2PE20 into this category as it is strongly related to joy. Anthropomorphic “feet” are also present on a small scale in two of the images. Each teapot in this group is untraditional and/or

unique. This may extend from a cultural difference as the smaller, stunted spouts with the post-handle are more commonly found in Asian cultures. There are still consistent variances that may have landed these teapots in the fear group. Unbalanced qualities in the spout and handle combinations are prevalent in almost every image and can be displayed by the differences in height placement or extension, the unsymmetrical alignment, or the combination of one curvilinear form and one rectilinear form. Questionable functionality is also present as many of the handles, as in 7PE19 or 3S20, do not smoothly flow from the handle to the base. Although they are connected, small design elements such as the curls at the end of the handle or the small base of the handle make them appear as though these pieces could break off or are at least distinctly separated from the base. Mismatched design elements, pieces, and surfaces may contribute to a general sense of confusion presented in fear. Abnormal forms, untraditional combinations, and questionable functionality make the observer uncertain in regards to these forms.

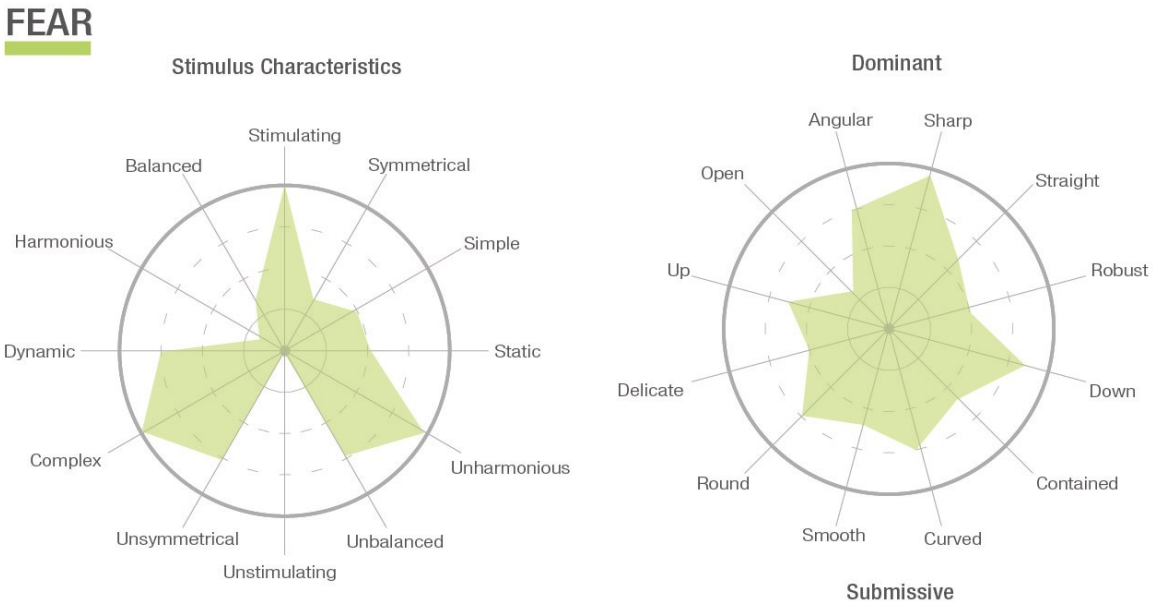

Figure 35. Fear Aesthetic CS Content Map

4.2.3.3. Disgust

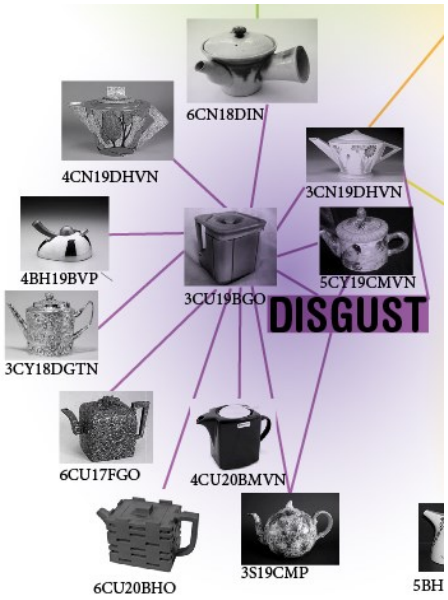

Figure 36. Disgust CS Cluster

Disgust is an oddly organized group as most of the teapot connections are actually made to the central 3CU19. This is actually an image of a teapot that was most likely created in the early to mid-20th century to be used on ships (Anderson, 2006). As such, it is industrial in its appearance, has a compact handle and spout, but would be less likely to tip over during a rough sea voyage. For the average individual though, this teapot appears to be difficult to manipulate. It is questionable whether one could get a good grip on the handle in order to pour this bulky object. Bulky and uncomfortable functionality can also be seen in 4CU20. This form is also industrial, plastic, and possibly perceived as lacking financial or qualitative value. The remaining images have a variety of materials and styles. One element seems to be clear in at least six out of the eleven teapots; tight, busy, surface texture or patterns. For many, this texture covers the entirety of the teapot. This may be why 3S19, which is spherical and displays many of the traits associated with joy, is placed in disgust. In addition, geometric art deco patterns are present on two of the teapots as well as distinctly sharp and uncomfortable handles. Four handles in total have at least one sharp edge and the straight spout with its characteristic pointed angle is prevalent in this group. Angles in functional elements like handles present possible discomfort

during use. Many cubes and cones are also seen in this group, which means that angles are persistent in the many of the bases as well. Some of the teapots appear to be odd as in 4BH19 or the weirdly stretched handle of 3CY18. Or, they are characteristic of design languages of particular eras as in 4CN19 and 3CN19 which are both art deco in appearance. Although confusing in nature, unlike fear these forms also portray a large presence similar to Anger. Conclusively, the disgust group is full of excessive stimuli which tie this varied group of teapots together.

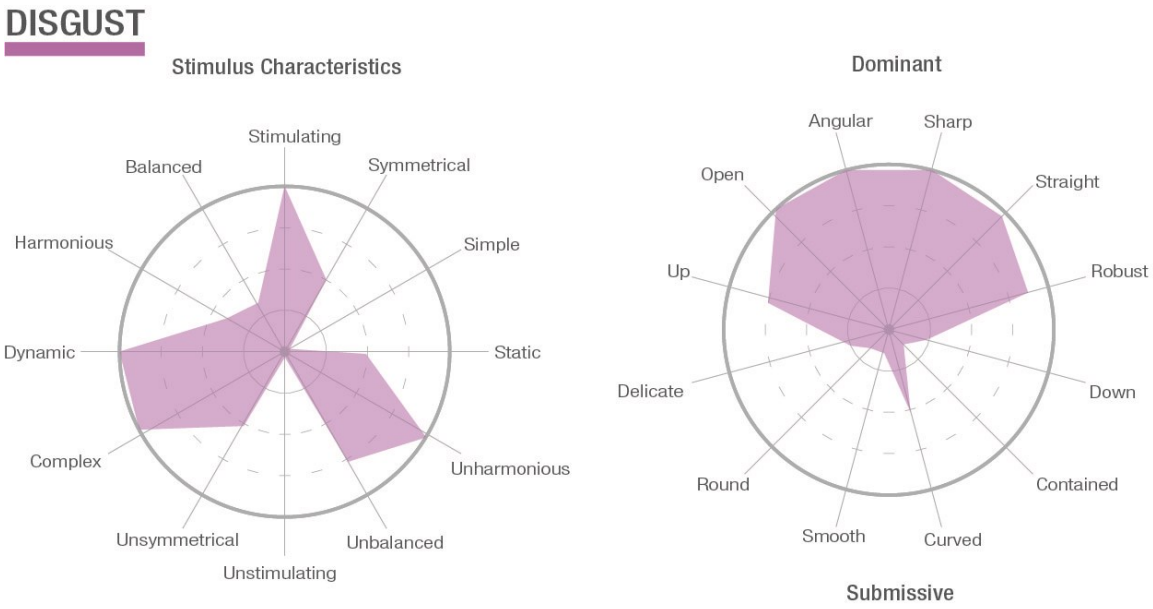

Figure 37. Disgust Aesthetic CS Content Map

4.2.3.4. Sadness

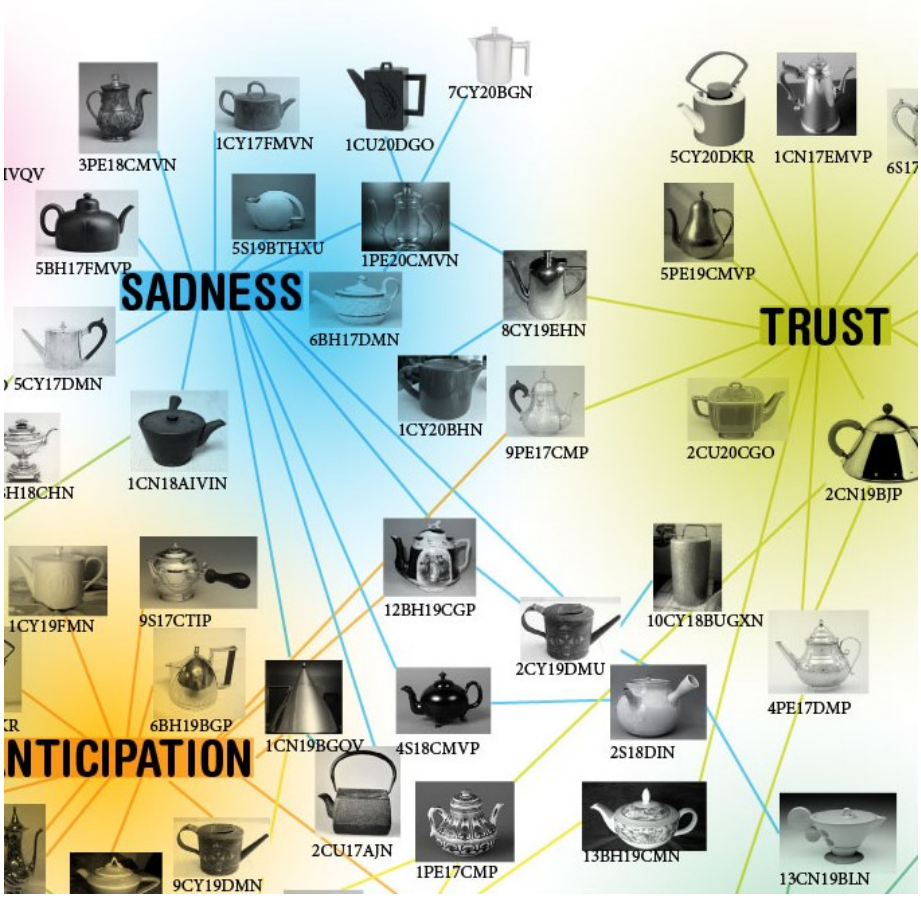

Figure 38. Sadness CS Cluster

The sadness cluster is very broad and connects to many emotions stretching to anticipation, surprise, trust, and fear. Thus, many of these forms can be perceived as different emotions depending on the individual and context. Simplicity and bottom heavy designs are evident among all the teapots in this group. Many of the designs are also squat, as in short and wide. The eye is often drawn from the top of the teapot to the base as in 1CN19. This cone is very wide at the base and very small at the point of its cone lid. Another general trait is a high contrast in shade, meaning, the teapots are either black or white, or at times black and white. This is evidence that even though the color is removed, the shade of an object may also have an effect on perception. The surfaces of the teapots tend to be muted, absorbing the light. The teapots that are shiny, tend to reach out to other emotions as well. Many of the teapots are strict

geometric base shapes with little edge filleting. This limited detail in the forms presents a crisp line and easily understood object. There is a wide variety of base types presented with close relationships to sadness, but simplicity in design with limited or no surface texture or additive design elements suggests a low level of stimuli. Consistency in handle and spout emersion and height, as well as an even weight distribution between the two can be seen in at least 12 of the photos. This becomes more true as the teapots get closer to the center. The handles and spouts are also close to the base of the teapot which results in a contained product. That being said, a common tendency for the spouts to have a lilting tilt as in 5BH17, 1CY17, 6BH17, and 1CN18 trace the eye downward or anthropomorphize the teapot. Many of the handles and spouts are slightly curved, but a sad teapot is as simple and submissive as possible with a downward directional pull.

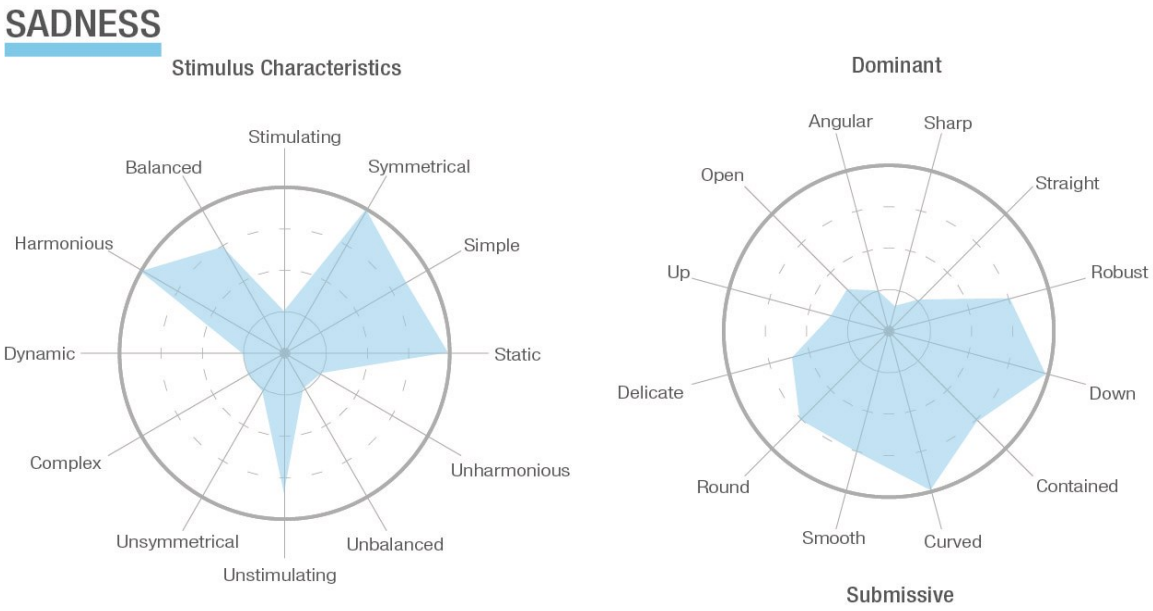

Figure 39. Sadness Aesthetic CS Content Map

4.2.3.5. Anticipation

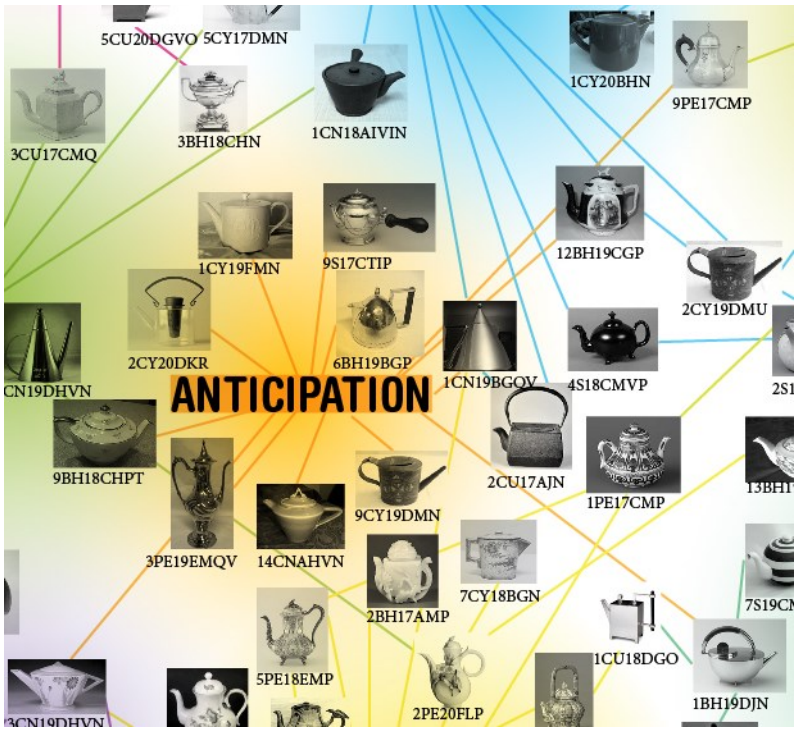

Figure 40. Anticipation CS Cluster

The first trend one may notice when viewing the anticipation cluster is that six out of the twelve teapots are metal and with the added glass teapot, seven are shiny. Another theme that is instantly noticeable is the variety of form and element combinations. Rectilinear secondary elements such as the handle or spout can be found on curvilinear bases. The same can be true for the opposite paradigm. Overall, these forms are more traditional than the negative emotions of fear or disgust, but they still present a mismatched presence with combined design elements as in 9S17. Prominent handles are also visible as they often create an outward visual flow. There are broad size differences between the handle and spout as in 6BH19 and 1CN19 where the handle outweighs the spout. Some unusual dimensions exist as in the stretched look of 3PE19 and the elongated heavy handle of 9S17. In total, the group ranges from bottom heavy forms as in 1CN19 or 9BH18, tall forms as in 3PE19, and forms with an open appearance as the handle

and spout extend away from the base (9CY19, 1CY19). This directionally outward appearance is fairly consistent with a majority of the forms. The combinations tend to show cylinders with straight spouts or cones with small straight spouts. This suggests, again, a common theme of slightly curved surfaces combined with rectilinear additions. A sense of movement and direction dominate these forms. Ultimately, these teapots are stimulating as they invoke interest or curiosity with the combinations of design elements, surfaces, and dynamism.

Anticipation

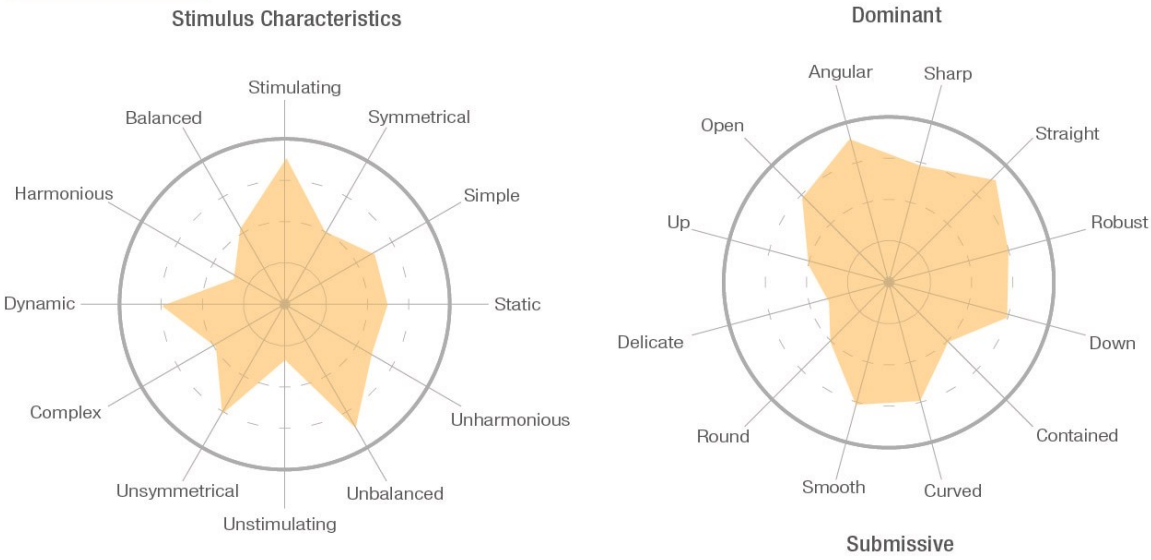

Figure 41. Anticipation Aesthetic CS Content Map

4.2.3.6. Joy

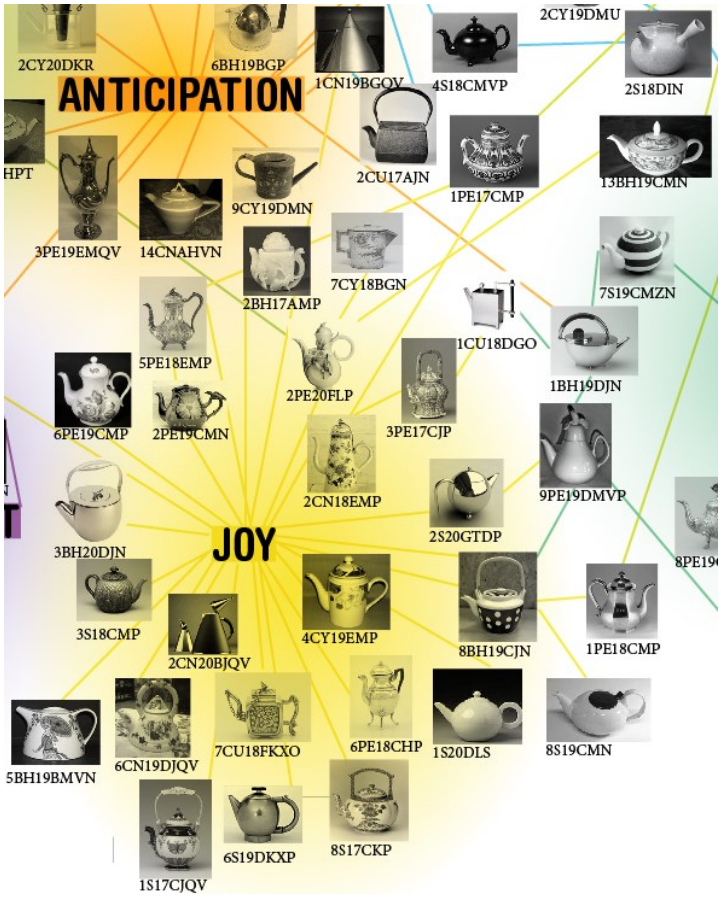

Figure 42. Joy CS Cluster

As to be expected, joy has many rounded, smooth, and curvilinear elements. Smaller pieces, as in the handle, lid, spout, details, or edges, are also very organic and smooth. If the base of the teapot is more rectilinear, the edges are strongly filleted as in 7CU18 or the secondary elements of the lid, handle, and spout are all rounded as in 4CY19. Dome lids are also more common as one looks closer to the center of the cluster. Another defining trend is the flower prints and patterns that are everywhere, but very modern or simplistic patterns are also obvious. Nearly all of the teapots are gray or white in color with only three or four in this large group that may be considered dark. A vast majority of the teapots are considered traditional, but there still persists to be some more modern styles as in 1S20 and 8S19. Cohesion concerning the design language seems to be the important determinant of what makes a teapot relate to joy. The

benefit of having such a large example of joy related objects is that smaller details begin to surface. For example, the “feet” of 2S20, 6PE18, 7CU18 are anthropomorphized. The 2S20 teapot also looks as though it may have a tail. A variety of combinations exist as there are tall and open forms, as in 3PE17 or 2PE20, and short and cute forms, as in 2S20 and 7CU18, all represented in the same emotion. Short stubby spouts and long slender spouts also represent contrasting patterns such as 5PE18 and 2S20. The heights of the handles and spouts are even and they are symmetrically aligned on the same sides of the base. Filleted edges, rounded handles, or slightly curved rectilinear forms present a smooth and fluid object. Most importantly, all stimulating elements are evenly distributed and do not overwhelm the observer. If the teapot has a flowered pattern, the form is simplistic. If the forms are slightly more intriguing, the pattern is kept to a minimum. Cohesion, symmetry, and rounded forms, are all strongly depicted as an even amount of stimuli and balanced aesthetic traits are apparent.

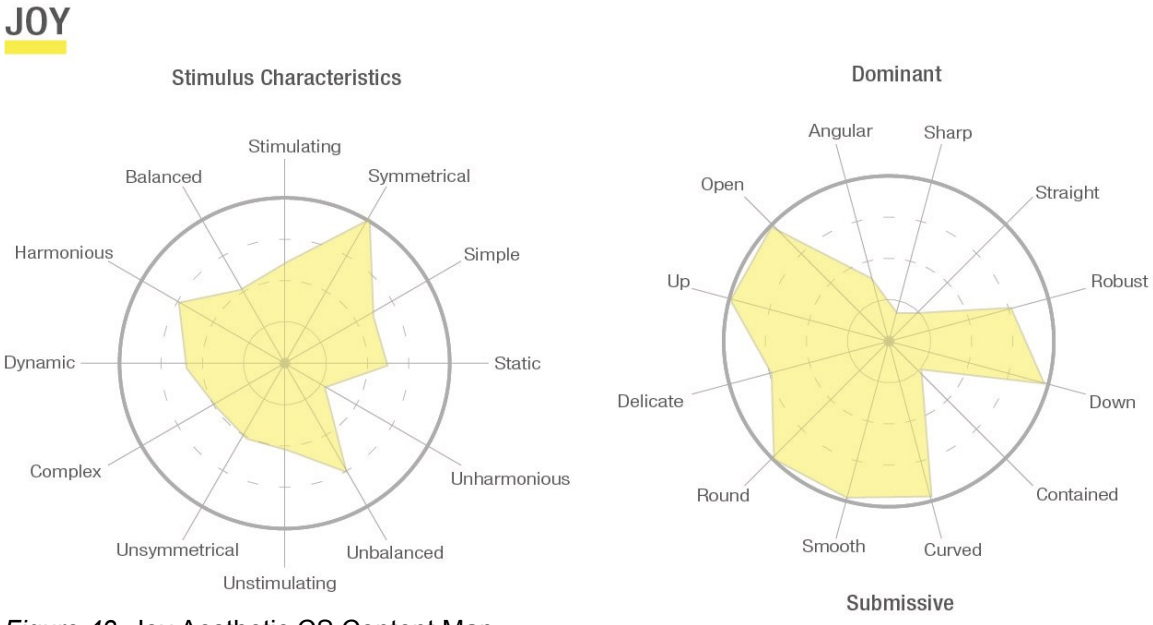

Figure 43. Joy Aesthetic CS Content Map

4.2.3.7. Trust

Since the image clusters of trust and surprise are entwined with some links, they will be presented together.

Figure 44. Surprise and Trust CS Clusters

Classic, traditional, and sturdy teapots are depicted with wide bases, lasting materials, and functional designs in trust. Metal, plastic, sturdy ceramic are apparent in all of the teapots in

this group. Cubes, wide cones, and rounded forms with extra base elements present a series of stable forms. Added to this stability are the wide-mouthed and curved handles that seem easy to grip. Spouts also have wide bases as they extend out from the surface and grow smaller at the tip. Thus, whether the spout is a straight spout, a curved spout, or a small straight spout, they also appear stable and firmly attached. The spouts are commonly straight or a standard curved-spout which implies their purpose is easy to interpret. All of these stable elements combined with larger frames give these teapots a large presence. Nevertheless, this dominance is moderated by the simplicity of the object as the shapes have little added or unnecessary details. This is further shown with the design consistency as it is a predominant paradigm. For example, the lids always match up to their bases as cubed teapots have square lids and rounded teapots have rounded handles. Functionality is important as all of the lids have a low profile and many have a distinguishable nob so as to easily lift them from the base. Congruent styling is pervasive as exemplified by teapots that are all modern or all classic. There is little or no material changes within the same form as exemplified by 5PE19, 1BH20, and 2CU20. Only one teapot in this group has surface print which limits patterns in this cluster as a whole. These teapots are trustworthy because they moderate each source of stimuli and are easily distinguishable as functioning and sturdy.

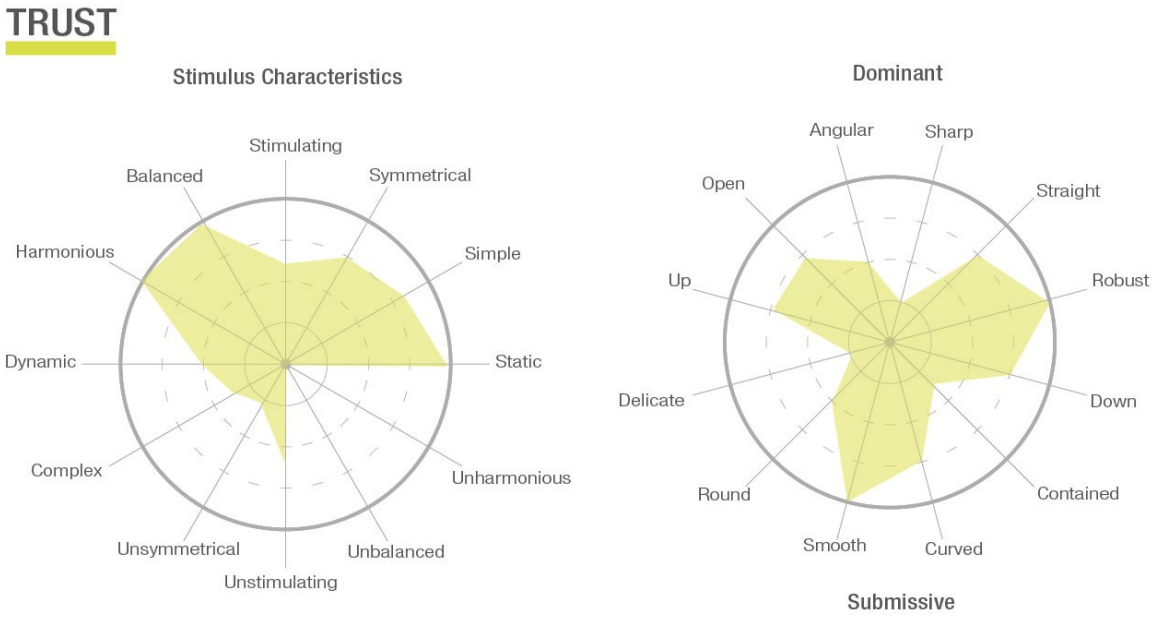

Figure 45. Trust Aesthetic CS Content Map

4.2.3.8. Surprise

The surprise cluster from the card-sorting task combines a balanced amount of stimuli similarly found in traditional teapots with unique features that draw attention and curiosity. Take a traditional teapot that has a tall cylinder base and a curved handle and spout, then add an interesting surface print; this can be seen in 8CY18. A strong visual pull between features of an object, movement, is a common occurring aesthetic in surprise. Flipped cones with the small side down reveal an unstable base, but a dynamic sense of upward movement. The teapot 4CU19 is the only cube that is turned on the edge of its point. Teapot 2S19 has a long, swooping handle that presents a sense of movement to an otherwise traditional spherical base. Movement is also apparent in the repetitive circular print on 7S19 as the eye is drawn up and down the form. The amount and type of print and associated details seems to help determine if the emotion is positive or negative. The two other cones with art deco patterns were placed in disgust, but 13CN19 has a simplistic print and handle comprised of two circular discs. These teapots are unique. Many cubes and cones are apparent, but these forms are not aesthetically traditional. Unlike the unique teapots found in the negative emotions, these teapots have consistent design languages and a balanced amount of stimuli. For example, 8PE19 and 9PE19 both have small animate details, but their material is consistent and their external elements are balanced in height and dimension. Symmetry is consistent with nearly every teapot in this cluster. The other potentially negative teapot base, the cube, is also present, but these cubes have sleek and clean surfaces. The rotated diamond alignment of 7CU19 gives an otherwise safe form intrigue. The surprise group is ultimately balancing its stimuli sources similar to other positive emotions, but has a remarked increase of unique elements unseen in other groups.

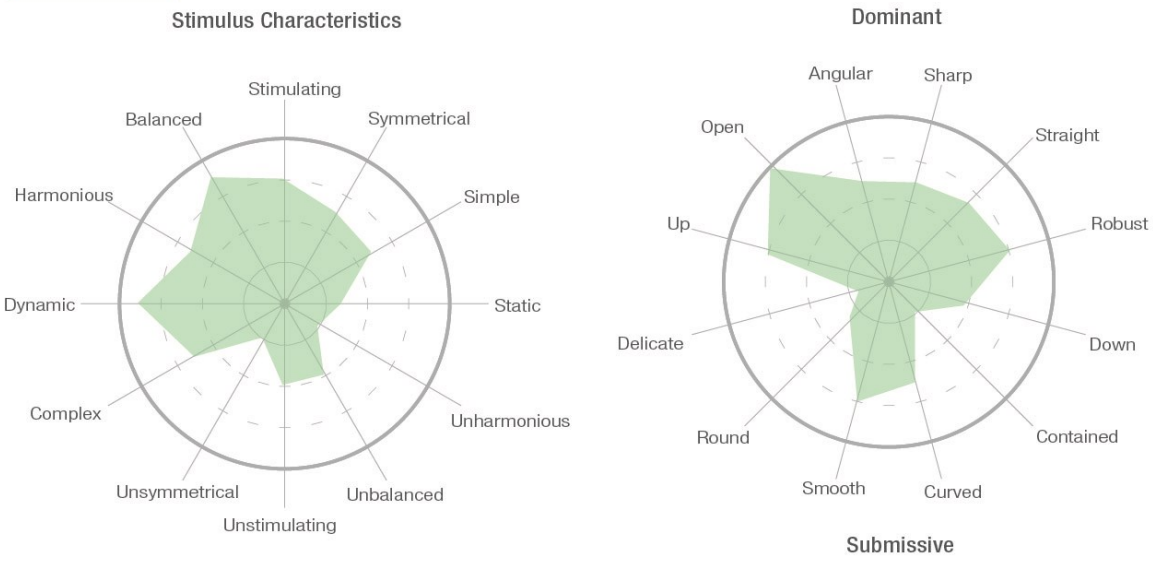

Figure 46. Surprise Aesthetic CS Content Map

***4.2.3.9. Closing*.** Each cluster revealed a definitive set of aesthetic qualities associated with the emotion. Some relationships related to the combinations of forms in each emotion were also presented. As stated previously, this method is subjective and must be re-evaluated to strengthen the validity of the findings. Limitations also persist as the forms could not be controlled for their patterns, shade, and slight changes in details. One curved handle might be slightly different from the next and in turn present a mixed or altered emotion. One cannot observe in real time why certain pieces were picked and placed, what questions the individual asked themselves, or why certain forms are perceived in a particular way. The people behind the card-sorting task have no voice in that method. In its very essence, perception changes from one individual to the next. The trick is retesting the general themes presented in the card-sorting task with live and in person participants that can explain their choices. That is exactly why the magnetic modeling method was created and applied.

4.3. Magnetic Modeling Findings

4.3.1. Introduction. The findings for the magnetic modeling task have been divided into three different sections based off of the perceptions of the interview participants and the "say, make, do" approach by Liz Sanders. The first section presents the four personas and a

suggested scale reflecting the types of perceptive processes shown by the participants. The second section covers what the participants said and did during their interviews. Support for the personas is provided through the presentation of statements made by the participants and connection to the thematic body language displayed. Finally, the third section will present the findings of what people made during their interview. This section will focus on themes gathered from the magnetic modeling clusters and constructed content maps as an overall analysis for each emotion's relation to aesthetic elements.

4.3.2. Personas and their Perceptual Biases. Throughout the interview process, participants were found to greatly differ in their modes of perception and their rational for choosing certain pieces altered per an emotion. Four different styles of perceptual framing were lifted from the interviews as the statements, behavior, and modeling choices of the participants supported these categories. Due to the size of the study, there may be more mechanisms of emotional perception in the general populace. As such, one participant's distinct behavior may be an underrepresented category and his actions are also examined in comparison to the remaining participants in his designated persona.

***4.3.2.1*. Developing Personas.** One might question how these personas evolved from the data, but the answer is simple: the participant's statements that ended or started their rationales were noted and compared to how often these same themes were repeated in the total interview. Furthermore, the themes that occurred most often and strongly influenced the participant's behavior were an indication of how they perceived objects. If the participant repeated the same themes on multiple occasions with varying emotions, their perceptual tendencies became a pattern which was then synthesized into a persona. Most generally speaking, many participants' first impressions were the start of a deeper vein of information infused with their perceptual bias; a mediating frame of consciousness on resulting behaviors. For example, the easiest persona to recognize is the functionalist as any decisions made will result in either a functional or dysfunctional product and any other consideration is deemed less important to depicting their interpretation of the emotion. That being said, these ancillary tendencies aid in accurately sculpting the range of beliefs and behaviors of the four personas. The personas simply

encompass a series of traits commonly displayed by the participants within an encompassed identity.

4.3.2.2. **Defining Personas.** As it was just mentioned, the functionalist is of course primarily concerned with the functional qualities as a way to define how the object will be perceived. The group of functionalists, on a whole, tended to be male, slightly older than average, and were one of two largest groups with four participants. If a functionalist participant was asked to model a negative emotion, they would do so in a manner that would make the teapot dysfunctional. More positive emotions would then produce a highly functional teapot. It should be noted that the idea of functionality does not actually mean the teapots became more functional. In fact, with one or two participants the teapots that were supposedly made to be highly functional would actually be very dysfunctional. Thus, this means their perception of what makes a functioning teapot may be altered by the form attributes, their past experiences, or a misguided understanding of teapot functionality. Regardless, their perception of functionality determines their choices in placement, pieces, and rationale.

An aestheticist develops their teapot models in a similar manner as their perception of what is beautiful or makes up an attractive object will inspire their resulting forms. Again, their perception of beauty may change depending on the individual and their backgrounds, experiences, and creativity. Interestingly, both aestheticists in this task were design students of some sort or considered themselves designers. One may assume that the aesthetic training a design student receives may assist in bringing this quality out in an individual. Furthermore, the two participants were both Chinese and their cultural background may have also emphasized aesthetics. However, similar to all personas, other participants marked as an alternative persona shared similar interests or expressed comments concerning the desire to make an attractive or unattractive teapot. As such, it was identified as a consistent consideration for many of the participants. That trait was simply not the most predominant concern for them overall. Aestheticists, rather, use beauty as a standard to define good emotions and ugliness to define bad emotions.

Whereas functionalists and aesthetics were rather easy to determine, one group was extremely difficult to recognize—the conceptualists. The difficulty readily identifying this persona lies within their tendency to rely on common conversational nuances. Story-telling, for one, is a typical thread that these individuals use to inspire their perception. Objects, animals, a mental image, a reference from a story, or any other concept that creates a picture is used for creative license. For example, Mrs. Potts from the movie *Beauty and the Beast* was referenced on several occasions during the interviews. Coincidently, all of the conceptualists were male and two engage with role playing games (RPG) on a regular basis and another considers himself a writer. Again, it is shown that previous knowledge and experiences may alter an individual's perception. Conceptualism was often a method triggered by other personas as well when their foremost mode was not engaged by the emotion. Nevertheless, those individuals with this persona as their strongest framework repeatedly engage in referencing existing objects. Moreover, their actions are geared by a mental image of sorts that represents the qualities they connect to the emotion. They take pieces of that image and try to replicate it in the pieces of their models.

The final group may actually result in the most prominent implications for studying emotionally inspired designs as they use or express the emotion to define their perception in an applied context. As one of the largest groups, and one that is predominantly female, emotionalists offer a more empathetic viewpoint to the task. Emotionalists are intuitively connected to the pieces that display the emotional characteristics. Through a series of trials, the emotionalist determines which form is most representative of the emotion. When describing their resulting product, they often restate the qualities of the emotion and how the pieces represent those qualities. For example, if an emotion is full of energy, they will attempt to make the teapot appear energetic as well. This significantly differs from the other personas as the emotionalists do not have an existing scheme that assists them in gaging the pieces other than a personal definition of the emotion itself. Oftentimes, even this definition is modified to fit the task as it is uniquely challenging to take an abstract thought and replicate it in a 3D object. They do not fully entrust their perception to the strategic rules of beauty or function, but rather use them to help define the emotion. Thus, a common tendency for the emotionalist is to use all of the other persona traits to

inform their decisions if they are unsure. Nevertheless, they trust their gut instinct, intuition, or feelings to guide them most often.

***4.3.2.3*. Personas Scale.** The personas were derived not only from the participant's for which they defined, but also from the entirety of the interview themes combined. As such, the personas mirror the general concerns of all the participants. Hence, the personas are not mutually exclusive. Meaning, the participants generally had one strong perceptual bias paired with degrees of the other personas. Therefore, a sliding scale was constructed as a result of this phenomenon in order to accurately portray each participant's range of perception. Below is the scale, as well as an example.

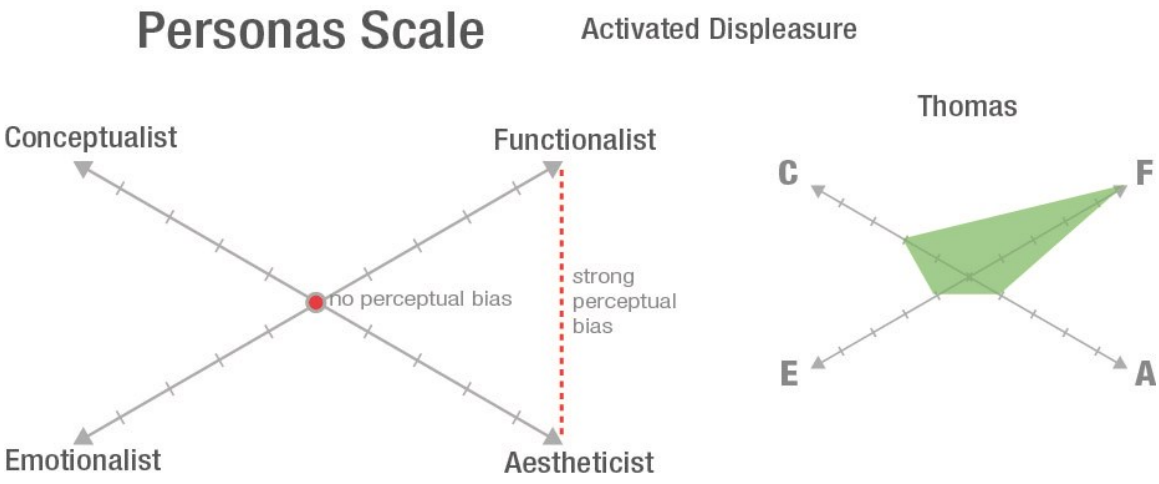

Figure 47. Personas Scale

All of the participants were scaled according to the diagram and these images may be found in Appendix G. Doing so further aided in determining how similar or dissimilar the personas were from each other.

Conceptualists, for one, do not tend to mention aesthetics in their rationales. This may be due to the image they are attempting to portray does not necessarily yield to an aesthetically pleasing design. Moreover, they are using aesthetic traits other than beauty to define their teapots. However, they often mention functionalism as a secondary concern while modeling if the concept allows it. Emotionalism tends to assist their designs as their internal definitions of the emotions can provide fodder for more pictorial representations.

Emotionalists display the broadest maps out of all of the participants. Their intuition leads them through a series of choices reflecting what may or may not “feel” appropriate. Conceptualism and aesthetics are mentioned as they may aid in applying their somewhat malleable definition of the emotion into a physical object. Functionalism is only mentioned on a small scale, but many of their teapots are actually functional. This suggests, functionalism may play a more subconscious role, but is not overtly pursued.

In opposition to emotionalists, functionalists rarely rely on their feelings to determine their pieces. Emotions are intangible and what they like is a tangible theme to guide their actions. Some of them may turn to aesthetics to guide them as well, but this is rare as beauty is foregone for function. Conceptualism is more likely to supplement their functionalist viewpoint as an application or situation that constitutes the use of a teapot may offer more varieties than standardly available. Overall, the functionalists have a very direct and strong reliance on their perceptual bias and can limit themselves fully out of the other viable perspectives.

As the persona with the smallest amount of participants, the two anesthetists differed greatly in their range of perceptual bias. One borrows themes from emotionalism, while the other expands across conceptualism and functionalism for unknown insights. As these two participants are designers in trade, this may suggest their ability to fluidly combine a variety of elements into objects. However, this is not fully supported as they still have a heavy persistence to cater to aesthetics.

The persona definitions offer a broad understanding reflecting the means by which the participant’s initiated their modeling process and also supported their decisions in their final product. Unfortunately, this does little to describe the intricate nuances in their behavior. The next section will offer supportive examples of persona statements and behavior as derived from the data.

***4.3.2.4*. What Did they Say and What Did they Do?** Statements made by the interview subjects penetrate the philosophical underpinnings of their emotional ideologies and securely refine the aforementioned personas. Acting as anchors, their comments often define them as individuals and at times signify the particular persona to which they belong. For instance,

Sebastian was a difficult individual to discern a leading persona until he continuously mentioned that he is a functionalist. The name of the persona actually came from this conversation. The exact words he used: “functionality always needs to be first,” and “I’m a functionalist.” Prior to these statements, he was consistently switching between a conceptualist and a functionalist viewpoint. Thus, how the individual perceives themselves can actually alter their behavior. Sebastian believed he was a functionalist, stated as much, and then continued to model his teapots with functionalism at the forefront.

4.3.2.4.1. Functionalists. Functionalists have a tendency for these blatant remarks on their behavior. One such example occurred with Dale after he was asked why he kept the pieces in a “standard” alignment across the teapot while modeling disgust. The interaction proceeded in the following manner:

> Notes—With a thinking expression, he looks down, observes his teapot and leans in closer to get a better view. He does not touch the teapot, but shifts his head from side to side.
> Dale—“It would not have occurred to me to have deliberately off-set the handle.”
> Notes—He looks again, moves the handle so that it is off balance from the center line.
> Dale—“Well now that I think of that…yeah, that’s horrifying”
> Notes—He draws his hands back in a clenched position as if he doesn’t want to continue touching the pot. He then moves the spout off-center to the opposing side of the handle. He leans way back and lifts his hands up and away from the teapot.
> Dale—‘Yes, I’m horrified”
> Notes—We proceed to take another photo of the “disgusting” teapot.

During this small moment in time, several conclusions can be drawn from Dale’s actions and words. First, he often makes blatant comments regarding his own behavior unquestioningly. He understands his actions and reasons for each piece and placement. Second, as an extremely functional person it is difficult and outside of his conscious process to consider moving the items from a centered alignment. This is a particular trend associated with a majority of the participants. Again with the emotion disgust, Anna also remarks on why she kept her standard vertical alignment “I wanted symmetry, I lined up the handle with the spout…I wasn’t trying to make it look like a tinker toy.” Third, acting against his innate desire to make everything function actually

causes Dale to exhibit disgust for the teapot. With this participant, this act was incredibly surprising as he showed very little to no emotional connection, intrigue, or reaction up until this point.

Generally speaking, functionalists are very direct and understand their rationale for their designs. They often use words to express functionalism such as “works like,” functions, structure, stability, “feels like” (referring to their hands), and motion (referring to the actual use of the teapot). They also have a strong tendency to refer to stereotypes with positive emotions as tried and true functionality that will surely fulfill their needs. As Anna remarked on her trust teapot, “it’s a teapot-shaped teapot—traditional. If you have to guess at the trustworthiness, you have to assume the company knows what it is doing by changing things on you”. Change from the traditional, expected, and easily understood is usually bad. Dale comments, “I trust controlled eccentricity…eccentricity shows personality, but drawing your eccentricities away from an established pattern show that you’re too far out of my comfort zone.” Their themes then represent a controlled and contained ideal of the emotions. Form must first and foremost follow functionality to these individuals.

As functionalists generally have a solid standard of functionality they are using to define the emotions, their behavior is direct and to the point. When asked questions, they respond quickly unless the question requires more feeling or refers to aesthetics. As a result, they have some of the shortest interviews. When one has a complete understanding of their actions, they do not have to reflect on their behavior. Functionalists produce their models in the shortest time frames. They may attempt one or two spouts, but the decision is made quickly once it can be identified as functional or dysfunctional. As they often share conceptualist traits, anthropomorphized teapots may be produced to a small degree. This is generally in addition to the functionalist concept or added on as a secondary theme. They tend to talk with their hands, but this is used to mirror the physical object in front of them (tracing the outer perimeter)or to motion a use (as in pouring the teapot). Their personal energy, as shown by animated expressions or voice volume, is usually consistent or lessons as the interview progresses. This suggests that these individuals do not feel the emotions they are expressing. Their faces can be

drawn in thought, but this is usually brief. Very little hand contact is made with the models as the functionalist will view their creation, ponder it quickly and then decide to continue or change the pieces. An intriguing insight is that the functionalists will often change their teapots after they have settled on the design. These "post-completion" changes suggest that the interview offers a new viewpoint on functionalism than their original scheme. Their statements are clear and immediate, their actions quick and purposeful, and their modeling is efficient. As such, the pieces and their functionality are more important than the overall theme of the emotion.

4.3.2.4.2. Aestheticists. In contrast, the aestheticists hold little regard for functionality as beauty determines the positivity or negativity of the form. They tend to use phrases and words that describe the appearance of the models such as "looks like," form, placement, lines, fits, matches, pretty, ugly, looks good, and looks bad. While modeling anger Yanmei mentions that the "hard lines represent angry" as a reason for selecting the cube. A physical attribute is thus identified as communicating the emotions. As for disgust she justifies her mixed combination of elements as, "to me, disgust is a thing that I don't like…so disgust is something that looks not very good." When asked if she doesn't like the cone base since she picked it for a negative emotion, she replied with

> "I think it depends on the other pieces…I think those ones (cube and sphere bases) are more modern, so I picked this one because it is more traditional. Then the other parts, these both have straight lines (square lid, post handle), and I picked this one (referring to the curved handle) because it doesn't go with the other parts…these two parts (handle and spout) especially don't match very well."

Yanmei even mentions that disgust represents an object that is not attractive and as a result proceeds to combine random aesthetic elements. Therefore, a disgusting teapot is one that lacks cohesion in aesthetic elements. This theory can extend to the individual pieces themselves as displayed when Ah Cy explains why she selected the handle for anger as, "I picked this handle because there is a conflict here" and then she proceeds to rub the pointed edge of the half-handle. Attuned to recognizing the aesthetic elements of each form, aestheticists will draw on these insights to model their teapots.

Modern, simplistic and rounded styling is often their preference for positive emotions, while traditional to the simply abnormal looking teapots will represent the negative emotions. Ah Cy constructed some of the strangest teapots to the point that it was difficult to take one picture which displays all of the odd angles and placements. This broad range of creativity usually draws from many of the other persona traits to produce a model, but aesthetics reign supreme. Disconnect from symmetry, balance, and similar ideals will always reflect a negative emotion. The behavior of aestheticists is often slower than the functionalists as they tend to turn the pieces around in their fingers, place them on the base, and then rotate the entire model to confirm their objective. Inspection by eyesight becomes highly exaggerated as they lean in to view the pieces and have very little physical touches with the model. Multiples of the same types of pieces, such as two different handles or three spouts, are commonly practiced in the beginning of the first model. Moreover, they tend to have an idea of which pieces will likely fulfill an emotion, but do engage in some minimal piece swapping when faced with a challenging design. Visual comparisons assist in choosing between pieces. When the model is complete, they tend to continually "fix" the pieces during the interview so they are exactly aligned according to their specifications. Unlike functionalists, aestheticists are indirect in their answers and rationale. A long pause after the questions allows a look to their model for answers. Due to more observation of their teapot, their interviews are moderately long, lasting a little over an hour for both participants. Their model becomes their reference as the aesthetic elements present physical design languages created by the participants. The individual pieces are more important than the overall concept, but they do collectively build a suitable design language.

4.3.2.4.3. Conceptualist. Conceptualism is a trend that many of the participants use to aid them in developing a mental image to model. Circle of trust, dunce cap, and a jack-in-the box were all themes stated by the conceptualist Nathan. Metaphors, stereotypes, anthropomorphism and stories are commonly associated with the conceptualist perceptual bias. When asked why he used the spherical teapot for joy, Derek responded; "One of the things that makes me super happy is really good food and when I'm full of good food I always say that I'm fat and happy. So, it's a fat teapot."

Derek clearly anthropomorphized the teapot; imposing his own feelings and making the teapot appear human. As opposed to the other personas, conceptualists repeatedly use these tactics and often switch between many for the same object. Take, for example this comment by Adam while describing his joy teapot:

> "This (curve spout) it's goofy, but it looks a little bit like an elephant's trunk and then that's why I put it high. It's a trumpeting elephant (laughs). That seems joyful to me. It's sort of hands raised, trumpeting elephant. If you wanted to do that as a theme now this is a circus tent (referring to cone lid)."

While many people commented that their curved spouts (either up or down positions) resembled an elephant's trunk, Adam quickly switched from an elephant's trunk, to hands raised, and then a circus tent. He followed these ideas up with the following mental image:

> "It very much feels like people like to drink tea outside. I dunno, that's sort of the joyful idea I had in my head I guess. If I imagine people drinking this tea, they are probably in a garden as opposed to a parlor since I'm an American and only associate tea with British people. So people don't drink tea in places I am. It flowed through my head as an image."

Again, a quick embrace of several images flowed through his head to provide themes presented in each piece of his teapot and even a context of use. Derek also did this while describing the negative emotion of fear: "When you're afraid of stuff you're emotions are kinda going crazy and everything's awry…you can have crazy nightmarish mixed up images that don't really make any sense." As a result, his teapot had mix-matched design languages and odd placements with angular or sharp elements.

As many of the other personas referred to a negative emotion as either traditional, untraditional, or odd, a unique quality of the conceptualist is to piece together a well-defined vision that reflects existing objects or situations. Adam's description of his anger teapot:

> You have a straight line through there (handle and spout) it kind of reminds me of a weapon in some ways. This feels like the handle on a knife or something. That (spout) doesn't have any nice curve like a normal teapot would; it could almost be a barrel coming out of a gun like in a battle ship or something. It's straight through, like it was imbedded, almost like it was stabbed through…or like it's a weapon pointing at you. Like those things in business where you're supposed to intimidate people by leaving a letter opener pointing at them. If you had this teapot pointed at them that would be an

aggressive conversation as opposed to using the Mrs. Pots teapot. It's kind of an art of war teapot."

Again, Adam switches through several metaphors and narrates a story through his teapot, actively comparing, advancing, and explaining his concept.

The conceptualist use of mental imagery as supportive devices often results in a quick modeling and long answers by these individuals. Overall, the interviews are medium in length as the long answers balance out the short modeling time. Consequently, each piece reminds them of something or is used as a constructive addition to a cognizant idea. The beginning of each model may result in them staring quietly at the pieces, but this tends to be brief. Similar to the functionalists, their concrete use of an idea makes their decisions, movement, and comments more direct. During the onset of the interviews questions, they do not talk with their hands as they are referencing the teapot by eyesight and connecting it to their metal image. After the description is connected, the conceptualist will expand on their ideas and in doing so starts to move and talk with their hands during this portion of the description. They use words like "I think", "it reminds me of," "similar to," and "it looks like" while expanding on their choices. In an effect of expanding their stories, these individuals have a higher rate of post-completion changes as they may discover a piece or placement that better represents their concept. The overall theme of the design concept therefore is built on the pieces, but the concept is most important to portray.

4.3.2.4.4. Emotionalists. The emotionalists are a fascinating group, as they can often be spotted more by their nuanced body language, facial expressions, and changes in behavior. Their statements do support that they use their intuition, but this is usually after some reflection. For example, Serena describes her model of surprise, "maybe that's what I thought of with the volcano (referring to the cone), those elements building up and then boiling over…destroying everything in sight (she laughs)." It is also apparent in the previous quote that she drew on conceptualism to assist her modeling. However, these traits are not mutually exclusive and the emotionalist will often use these images to portray the feeling they have when experiencing the emotion. It is not necessarily about what they say, it may be more about how they say it. Consider Jessica when describing her sadness teapot,

"Sometimes you feel down on yourself…even for Mother's Day, you can question yourself, "Am I a good mother?" And, you can focus on that emotion and you can think of all the thoughts that follow that."

Notes—frown on face, head turned down and remains quiet for a moment

Through her description, Jessica is revealing her feelings that inspired her design. More importantly, she actually displays the emotion to a small degree.

As the emotionalists often transfer they thoughts or feelings of the emotion to their teapots, the emotionalist teapots are usually anthropomorphized more than any other persona. James provides an excellent example with this interaction from his interview:

James—"To me, fear is the unwillingness to engage with the world"

Researcher—"Were there any experiences, feelings, or definitions used to begin modeling?" (this question was asked of all of the participants' first model)

James—"I started with the base and it was sort of instinctual…with which of these matches…when I conjure up the gut instinct fear, which one of these shapes would most match that sort of synthetically"

Researcher—"So you sort of thought about what you felt like and then sort of put that into the form?"

James—"Then once I got the sphere I sort of rapidly, not quite consciously put together why the sphere seemed to me the one that most closely fit fearful and so then I picked the other elements to…complement that thought"

Researcher—"Were you trying to represent both the theme and look?"

James—"Both to complement the idea of being withdrawn and not reaching out into the world"

Even when asked if his decisions were conscious, James recognized that his process was more instinctual, intuitive, and sensing based. He refrains from focusing overtly on the image of a turtle that is withheld in its behavior and instead reflects on the actual feelings. This does not necessarily mean he was actually experiencing the emotion at the time, although his shoulders drooped more often and his body posture was markedly smaller and lower while modeling. The participant Serena, on the other hand, often remarks on feeling the actual emotion while modeling in the two following examples discussing joy and sadness respectively:

"I love this shape (speaking to the sphere base), it's so joyful, it feels me with joy!"

"I don't want to do it…because it makes me sad to do it."

Thus, the emotionalist persona has a wide range of individuals comprising this category. As three of the four participants openly expressed feeling the emotion they were modelling and the one did not, this may suggest the potential for a fifth persona. The researchers refer to these individuals as strict intuitionists, but more support would have to be gathered in order to confirm if these two groups are actually distinct in the general population.

All of the emotionalists display a strong degree of concentration during their modeling tasks. Quiet and purposeful, these individuals are focused on the task at hand. As the questions are being asked, they are often attentive, then remain in silence for a period reflecting on their choices. At times, it is unclear if they actually know why they chose the pieces that they did until after they answer. This does not mean they do not take the activity seriously, rather, it implies they are more reactive in their choices. Moreover, many of these individuals will place all of the pieces in a particular category on the base at once. Their hands will remain on the pieces and continuously touch them individually as they decide on which one holds the emotion they are modeling. They rely on tactile and visual feelings, even though it appears some of these movements are unconscious. They also try more placements of the same piece moving them up high and then down low and seeing which one “feels right”. Piece swapping is rampant as they can repeatedly place a spout, leave it for a time while they address another piece, and then go back and change the spout. Moreover, their decisions are not concrete until they are done. A common occurrence that takes place with the emotionalist after all pieces are on the teapot and they are observing their model, they suddenly say “OK, that’s it” or “I’m done.” This decision is sudden, but when they feel it is correct, they are done.

For the extreme emotionalist, facial expressions, body movements, and voice volume will mirror the emotion they are modeling. Serena in particular showed the broadest range of behavior as she swayed quickly while modeling surprise, sank low and laid her head on her hand while modeling sadness, and raised up high on her heels leaning over the teapot while modeling anger. Serena, Jessica, and Jewel each increased their voice volume while modeling positive emotions, the loudest emotions being surprise and anticipation. Emotionalists talk with their hands, lean backward and forward and side to side while observing their model. The phrases and

words “feel like,” sense, energy, motion (depicting the emotional energy), and “gut instinct” are all commonly used. Curiously, three of them expressed their tendency for perfection. Thus, the general theme of the emotion is most important, but they are extremely particular about the pieces they select.

4.3.3. Closing. As one can see, the participants each have a perceptual bias that acts as their initial response to the objects in their environment whether it be functionalism, aesthetics, concepts, or emotions and intuition. Perceptual biases not only outline their expectations, but they also offer further information into their perceptual processes. Now that personas have shed light on the thoughts regarding the pieces, the process, and the people themselves, all that is left to understand is the product itself. This is deemed the “make” portion of the “say, do, make” process by Liz Sanders and it presents the results of the participants’ magnetic modeling experiment.

4.4. Magnetic Modeling Findings and Comparison

4.4.1. Introduction. The purpose behind conducting the magnetic modeling method was two-fold: 1) to unearth the discussed personas as they relate to their perceptual bias and 2) to compare the results of the aesthetic attributes found in both the card-sorting task and the magnetic modeling experiment. This section addresses the second of the two concerns, delving into the results of the magnetic modeling images. The aesthetic content maps are displayed along with a general description gleaned from the interviews and reviewing the images. This portion will provide a comparison that will be covered in the discussion chapter.

4.4.2. Full Magnetic Modeling Diagram. The pictures taken from the magnetic modeling task were collected, sorted into their emotions, and then outlined with the color that matches the persona of the participant who modeled the teapot. The green represents the functionalists, the purple indicates the conceptualists, the pink shows the emotionalists, and the orange photos were modeled by the aestheticists. Descriptions were drawn from the interviews and images. The concept maps were derived from the aesthetic content of the models.

Figure 48. Magnetic Modeling (MM) Cluster

4.4.3. Anger

Figure 49. Anger MM Cluster

As one can see, the predominant bases in this cluster are the cube and cone. More cubes are associated with anger than in any other emotion. Many of the participants remarked on choosing the cube for its sharp edges and the cone for the angled sides. Other rectilinear elements found in the half handle and the squared handle are seen, as well as the straight spout or nub spout. An interesting combination can be seen in three images using the post handle and nub spout combination to “stab” through the base. This was commented by both of the conceptualists in this emotion category. The only curves in the pieces of this group exist in the rounded surface of the post-handle and cone base. Flat square lids are found in four of the images and cone lids are displayed in three images. Only one image has even symmetry and weight distribution and two images have angled and unaligned arrangements between the handle and spout.

One teapot, with a nub spout pointed down, was anthropomorphized to suggest a person looking down upon another. The top left image has the most varied piece placements and orientations constructed and was done so by an aestheticist. Functionalists both mentioned the need for control and thus picked sturdier handles which allowed for a “firm grip.” The emotionalists both describe the necessity to remain contained while experiencing anger, but each of the models has an offset secondary attribute. The anger category in total displays the most cubes, nub spouts, post handles, and flat square lids. Therefore, anger is connected to sharp, angular, and aggressive combinations.

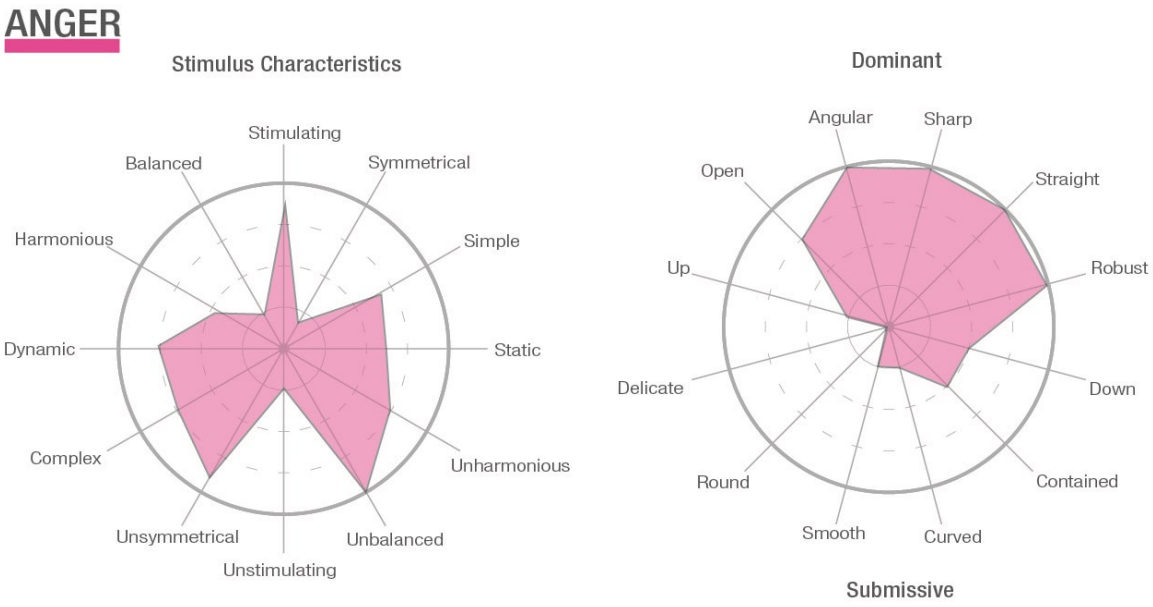

Figure 50. Anger Aesthetic MM Content Map

4.4.4. Fear

Figure 51. Fear MM Cluster

The modeling for fear resulted in forms that were contained and had a mixture of aesthetic elements. Fear displays a range of bases, with the most popular choices being the sphere and the cube. These are paired with the squared handle, the post handle and the half handle. No representation of the curved handle is seen. The nub spout is the most common spout with three appearances. The curved spout is displayed in two images, but this is in addition to rectilinear handles and bases which makes the combination unharmonious. Although the participants had the capability to elongate the distance of the secondary elements from the

body of the teapot, many of them wanted the handles and spouts to be as close to the base as possible. During two of the six interviews, the participants expressed the desire to keep the teapot as simple and insignificant as possible. A “contained” theme was expressed by all three of the emotionalists and the one aestheticist. Four of the six interviews also expressed the desire for the pieces to have a downward direction.

The aestheticist and the conceptualist both described their teapot pieces as not matching or displaying “discord,” and they as well as the functionalist each describe their teapot as abnormal. Nonstandard alignment between the handle and spout as well as unbalanced size differences between these two elements are shown in five out of the six images. A mixture of curvilinear and rectilinear elements is displayed in four of the images. There is one image with an extremely unique variation of visual elements that was produced by the aestheticist which was actually incredibly unstable due to being turned on its curved side. Moreover, this supports the theme of disharmony. The cone lid and the flat circle lid are both evenly distributed in the images. Some minor amounts of cohesion are displayed with the lids as the cube has a square lid, the rounded sphere and cylinder both have flat circle lids, and the more angular cone and cube have angular conical lids. Conclusively, both the elements and the descriptions of these elements reveal a variety of different interpretations for fear. Unharmonious combinations to simple and contained shapes are both prevalent in this group as this emotion is subject to interpretation.

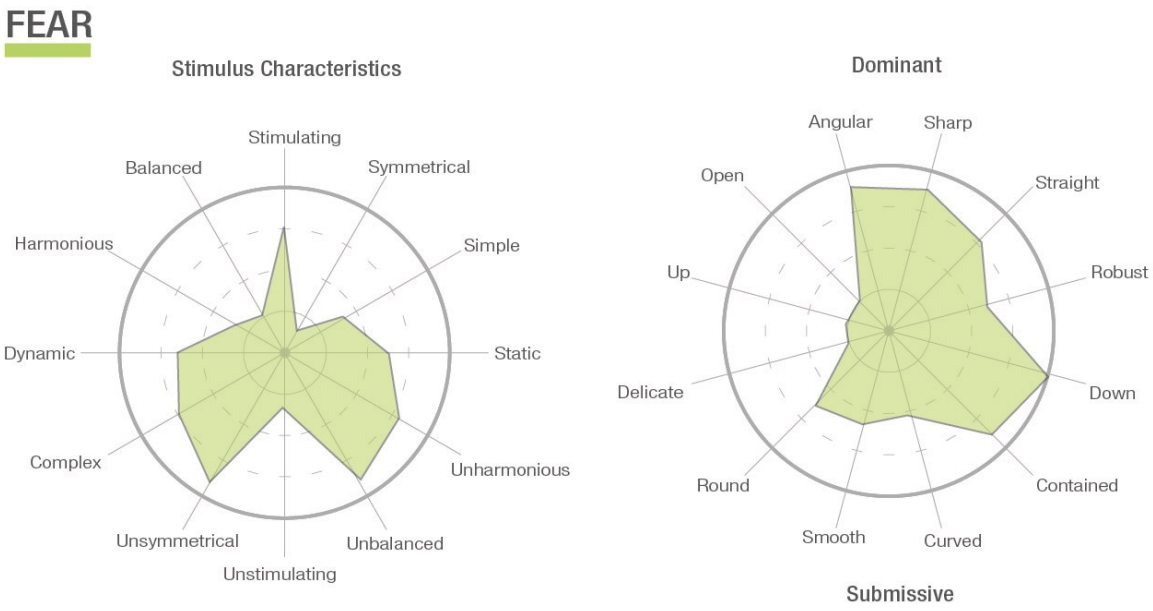

Figure 52. Fear Aesthetic MM Content Map

4.4.5. Disgust

Figure 53. Disgust MM Cluster

The teapots in disgust have a broad range of pieces, design elements, combinations, and alignments. In comparison to the other emotions, this group has the most varied amount of aesthetic attributes and stimuli criteria. Cones are the most common with four in total and three with a “flipped” substandard orientation. Three conical lids are also visible as the top with the highest frequency for this emotion. Thus, angularity is associated with disgust. This fact is also supported by the offset angles of five handles and spouts. One might question if the edges of the

spouts were the perpetrator, but in actuality these elements were made even more angular with the use of a nub. The angularity differs between the handles and spouts greatly which suggests imbalance. The long straight spout occurs most often in designs, followed closely by the curved spout. The use of the curved spout is often combined with a curved handle which depicts some minor cohesion. This amount is lessened by the flipped orientation of one of the curved spouts and the combination with angular elements. For the majority, these models have both curvilinear and rectilinear attributes and inconsistent styling. Moreover, the many angular elements provide a larger presence and the disharmonious piece combinations draw attention and express dominance.

The one round sphere as a base was created through an anthropomorphized view of disgust as the aestheticist compared disgust to a fat, wealthy, Chinese man often seen in old movies. A functionalist also anthropomorphized the spout of one of the teapots in order to depict someone looking down at the observer. Some variance in the designs is also due to five of the seven participants (4 functionalists, 1 conceptualist) wanting the teapot to be difficult to wield. All of the participants expressed that the teapot should have a combination of aesthetic attributes to make the teapot confusing, undesirable, ugly, or dysfunctional.

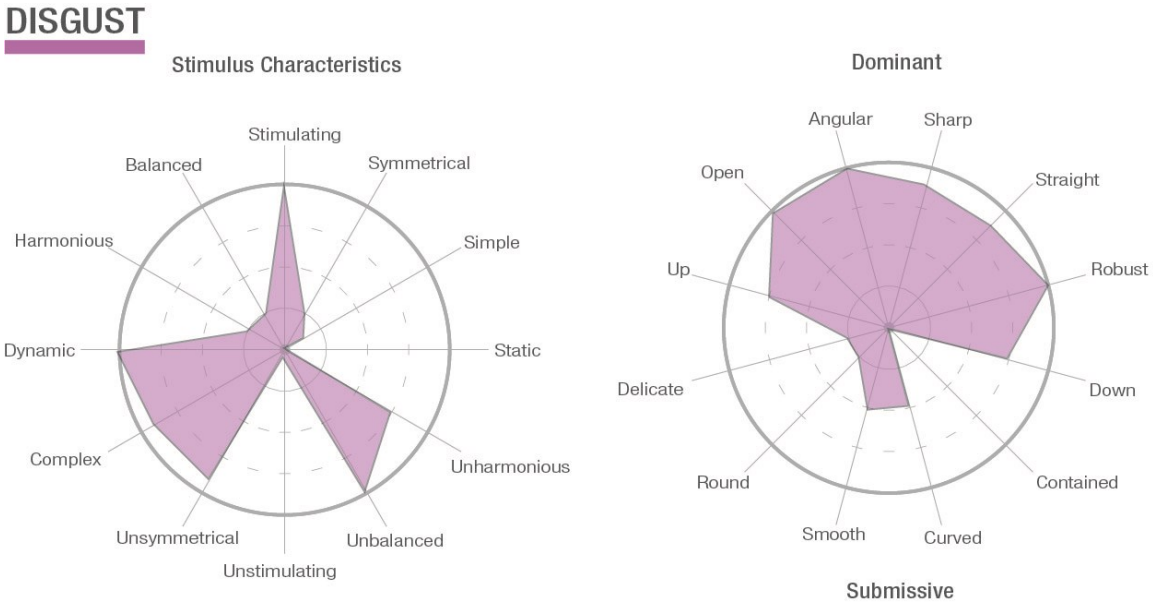

Figure 54. Disgust Aesthetic MM Content Map

4.4.6. Sadness

Figure 55. Sadness MM Cluster

The sadness models are attributed with a high rate of curvilinear forms and a downward visual presence. The first comparison one makes are the two almost identical models. Interestingly, these were made by a functionalist and an emotionalist which are two personas with little in common. This confirms that the similarities in these models are definitive of sadness. Sadness was described as “soft” by these two participants. These two images contain a spherical base, and the curved handle and spout, along with the dome lid. These same elements can be seen in the other images as well. The other popular base appears to be the cone, with a secondary feature that directs the eye downward. Moreover, the angle of the cone is affected by the directions of the handle and spout. Both cone models also display a mixed combination of elements. These two individuals actually expressed that sadness should have pieces that don’t fit or match because that is how one feels. They both stated that their model was of a strong interpretation of sadness. The conceptualist teapot (in purple) has an anthropomorphized spout that acts as a drooping head. The spout on the emotionalists cone and the two spheres also have a drooping spout and/or handle. There are some aesthetic inconsistencies as rectilinear and curvilinear forms are combined in three of the models. The aestheticist cubed teapot was designed using what she felt was the most negative aesthetic base and added a “soft” lid as sadness is “not that bad.” This teapot, and the two cones all have contained secondary features that do not extend far away from the base. In total, these teapots portray more submissive

characteristics such as roundedness, a downward presence, and a moderate amount of both disharmony and harmony depending on the perspective of the individual.

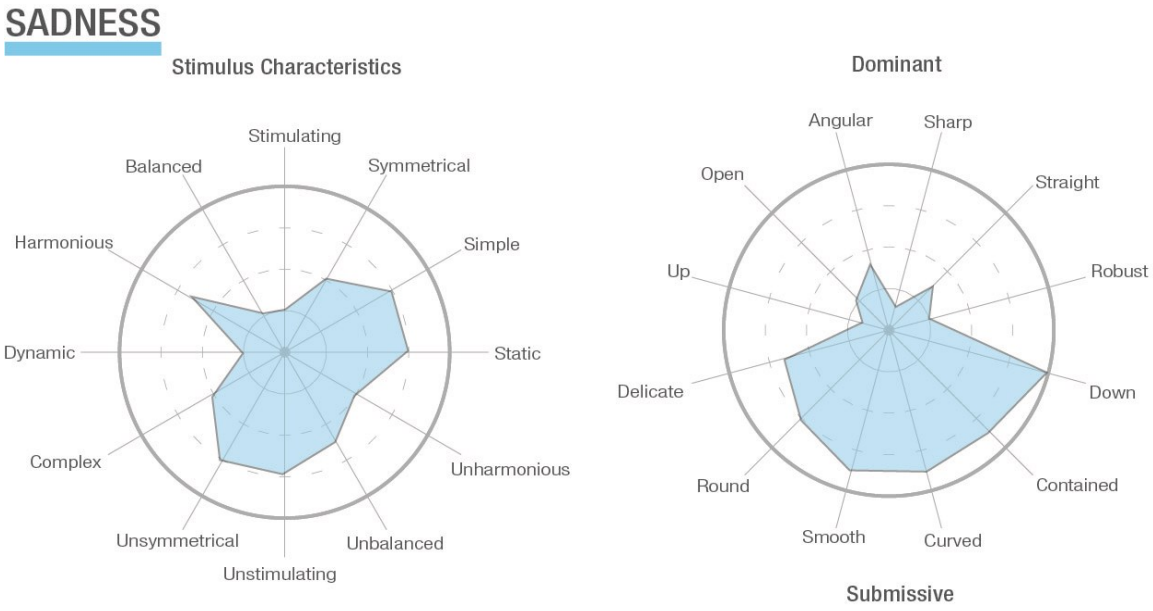

Figure 56. Sadness Aesthetic MM Content Map

4.4.7. Anticipation

Figure 57. Anticipation MM Cluster

All of the models in the anticipation cluster are distinct and have a variety of aesthetic attributes. Nearly all of the available pieces are depicted in this group and there is a variety of form combinations as well. The straight spout does occur three times, making it the most

common piece. The squared handle, the cylinder, the post handle, and the cone lid are all visible twice within the set. The horizontal alignment as seen in the handle and spout relationships is distinctly diagonal. This is a result of the spout placement being high and the handle placement being in a standard position or lower than the spout. This directional flow draws the eye up and across the object providing a sense of movement. In addition, rectilinear and curvilinear shapes are combined in each of the models. For example, the sphere base has a conical lid, a long straight spout, and a squared handle. The cone and cylinder bases both have a curved surface, but are paired with the straight spout and post handle. There are also two models with cohesive aesthetic elements as there is a cube with rectilinear secondary pieces and a cylinder with curvilinear secondary pieces. The inclusion of both harmonious and unharmonious combinations of aesthetic attributes indicates that this emotion may have a different meaning per individual.

Anticipation on a whole was considered difficult to model by all of the participants. They each paused for a moment after reading the card. Four of the participants openly expressed difficulty in modeling the emotion at the beginning of the task. Once the participants found a theme it became easier to model. Both Chinese participants selected the emotion of anticipation, but declined to model the emotion and selected another card instead. This emotion cluster was only modeled by two personas, but both groups suggested motion as a rational for their placements. The functionalists refer to the physical motion of the teapot, whereas the emotionalists describe a feeling of movement in a forward direction. This theoretical directionality and the placements of the pieces suggest that anticipation is viewed as a dynamic emotion with a combination of aesthetic attributes.

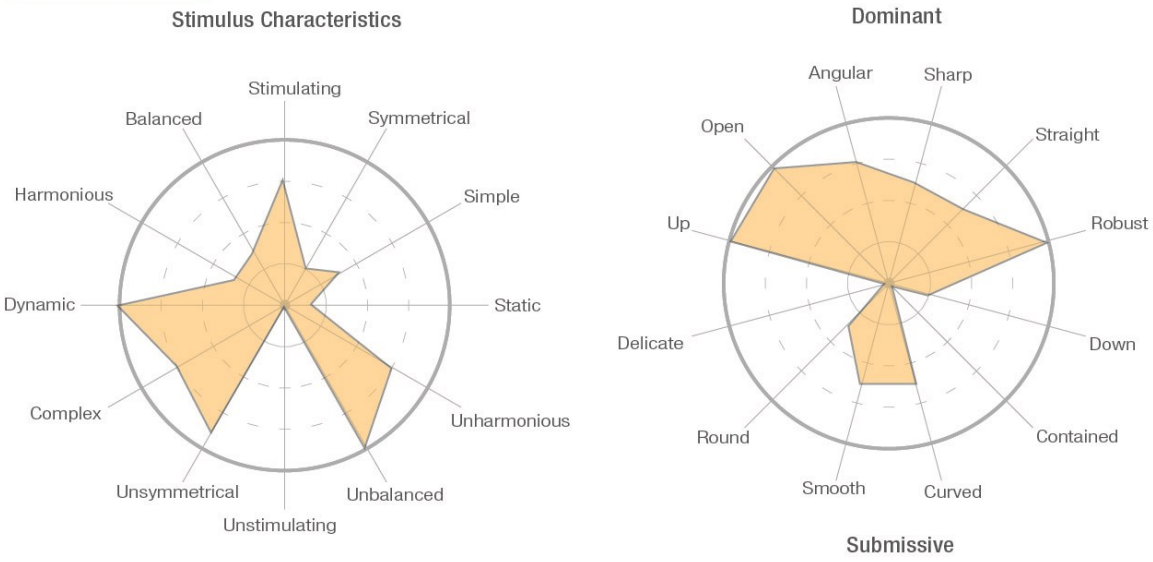

Figure 58. Anticipation Aesthetic MM Concept Map

4.4.8. Joy

Figure 59. Joy MM Cluster

The joy cluster for the magnetic modeling task is depicted by spherical bases, rounded elements, and anthropomorphized themes. All of the bases are spherical and the most common secondary elements are the standard curved spout and the dome lid. There is a high degree of cohesion in this group as many of the bases are curved and the handles, spouts, and lids are

generally curved as well. The half handle and the conical lids are also apparent in this emotion which provides variety from a completely rounded model. Five of the six combinations have at least one piece that is rectilinear. This suggests there is overall cohesion with a small amount of distinct aesthetic variation in the secondary elements. Most of the features on the base point upward, with two exceptions (one spout and one handle). Many of the participants also added wide nubs to extend the pieces away from the base. The general movement for this cluster is upward and outward. Two of the images also have a diagonal relationship between the handle and spout. Curved forms with a lesser amount of rectilinear elements and directional movement presented by the piece placements define a joy inspired model.

This emotion has a high amount of similarity in its models despite the fact that each of the personas are present. An aestheticist, functionalist, and emotionalist each remarked on their curved spout as depicting an elephant's trunk. The functionalist expanded this theme by stating the lid was also an ear of an elephant or mouse. The conceptualist with the curved handle also stated that piece reminded him of an ear. Both emotionalists commented that their models looked like birds after the task was complete. The two participants with the nub spout said their teapots were cute. Therefore, a high degree of anthropomorphizing is associated with the joy cluster.

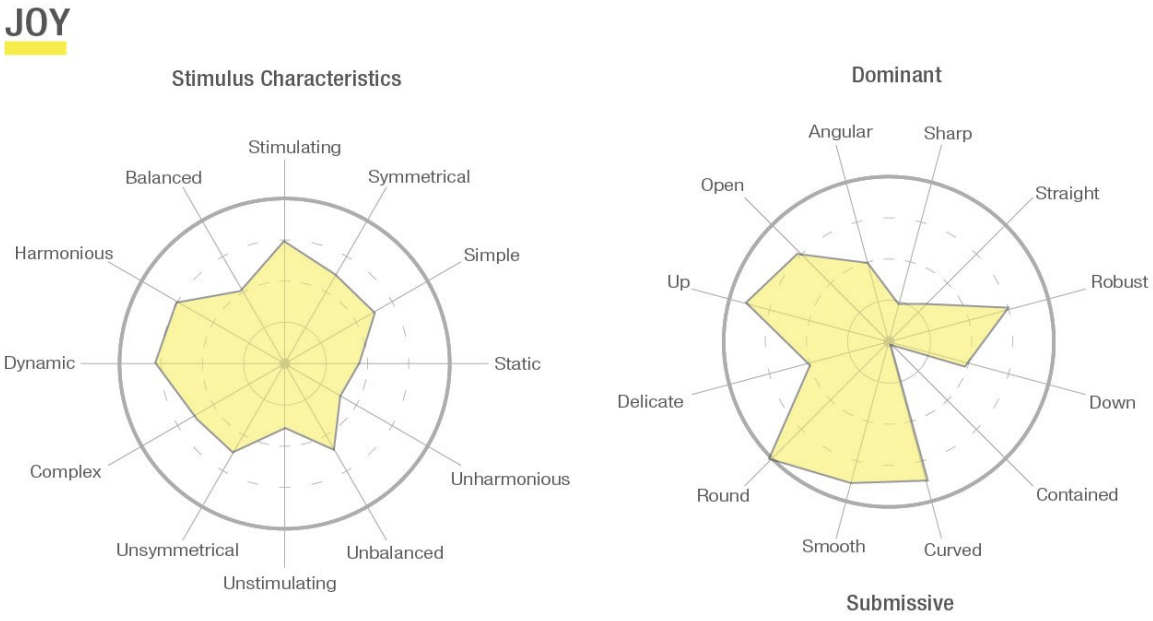

Figure 60. Joy Aesthetic MM Concept Map

4.4.9. Trust

Figure 61. Trust MM Cluster

Models in the trust cluster have a balanced degree of stimuli and a combination of both submissive and dominant aesthetic traits. While the sphere occurs most often, the cylinder is another base with multiple repetitions in the set. Two spherical bases are paired with the half handle and one curvilinear secondary attribute and one rectilinear attribute. Thus, the combinations of these forms tend to be more rounded with a minor amount of angular details. The two cylinder combinations both have tall elements on the top of the form, making these objects appear taller or larger. The handles and spouts appear open and are either placed in the middle or upper half of the base. The open and tall presence makes the form appear dominant, but the curvilinear and softer bases make this group more submissive.

All of the participants in this category either use the word stable or traditional (or both) to describe their inspiration for trust. Familiarity, functionality, and ease of recognition were mentioned as attributes associated with trust. As opposed to some emotions, trust has the most models that reflect the perception in the context of a teapot. Moreover, the pieces were used to depict a trustworthy teapot than trust alone. Two of the conceptualists and all of the functionalist focused on the context of the emotion. The conceptualist who constructed the cylinder base teapot with the handle on top designed his model after the white columns seen in classic architecture. After he finished his model, he too remarked that his teapot looked like an industrial “pressed silver teakettle.” The cone shaped model was described as a tea kettle versus a tea pot.

The cubed teapot with the rectilinear handle, nub spout, and flat square lid was designed by a functionalist who emphasized that sturdiness was the most important attribute of trust. There is a slight range of interpretation related to trust, but for the majority these models represent traditional forms of teapots and teakettles.

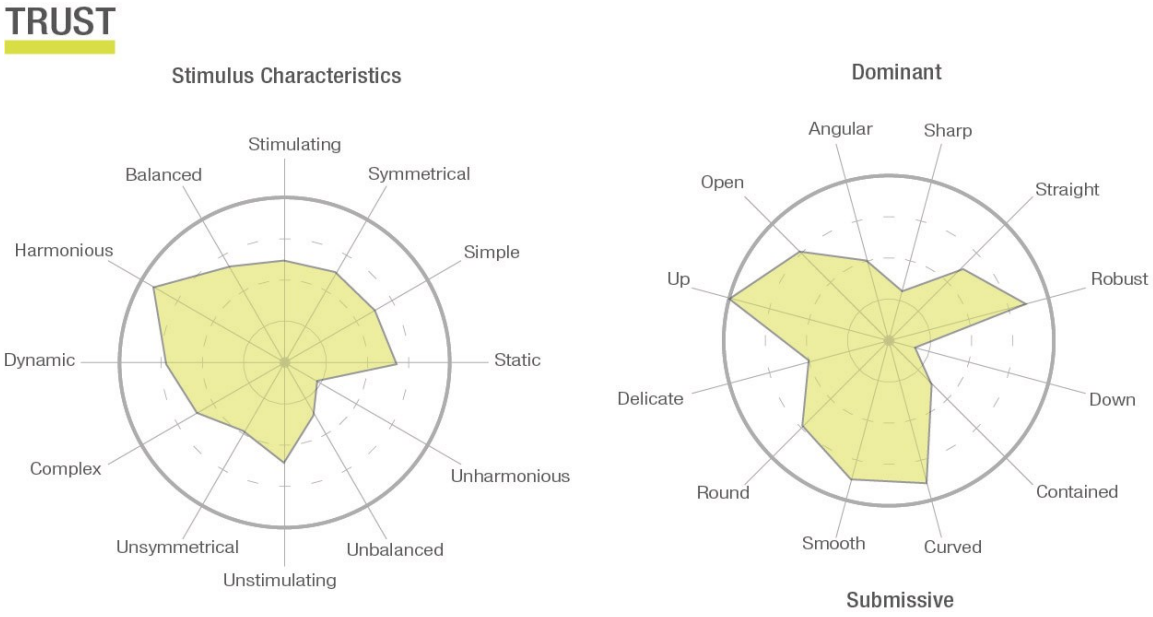

Figure 62. Trust Aesthetic MM Content Map

4.5.0. Surprise

Figure 63. Surprise MM Cluster

The surprise cluster depicts the most cone bases out of any emotion. These bases are presented in both available orientations. The secondary features of the handles and spouts are

also placed in upward and outward orientations. The spouts extend from a higher placement than the handles and at times over the top of the base. This increases the overall size of the models making this a dominant aesthetic. Thus, three visual displays of movement are shown as the eye is drawn straight through, straight up, or at a diagonal through the models. A mixed combination of curvilinear and rectilinear forms is seen in this cluster as curved handles are paired with strait spouts and curved spouts are paired with the post and squared handles. A combination with the post handle and the nub spout is shown with a converging diagonal relationship; both pieces are pointing up on the outside tip. The cone lid is the most common lid choice as it is displayed in five images. Unique alignments and positions are visible in the image with an lifted handle, an offset spout and handle relationship, and a diagonal setting of the handle on the cube base. Therefore, the surprise group has a high amount of dominant aesthetic traits, and a mixture of stimuli.

Surprise is referred to as a generally positive emotion by most of the participants. Two participants mentioned that surprises could be bad, but they often thought of it as a positive emotion. The one cube base in this cluster was modeled by a conceptualist to depict a jack in the box. An emotionalist also referred to their reversed cone base as potentially having something popping out of it similar to a jack in the box. This interview and four others mentioned the word “out” when describing one of the features. Comments regarding the models as unique, explosive, and untraditional were also mentioned. Therefore, surprise is connected to upward and outward shapes with unique, yet pleasant aesthetic combinations.

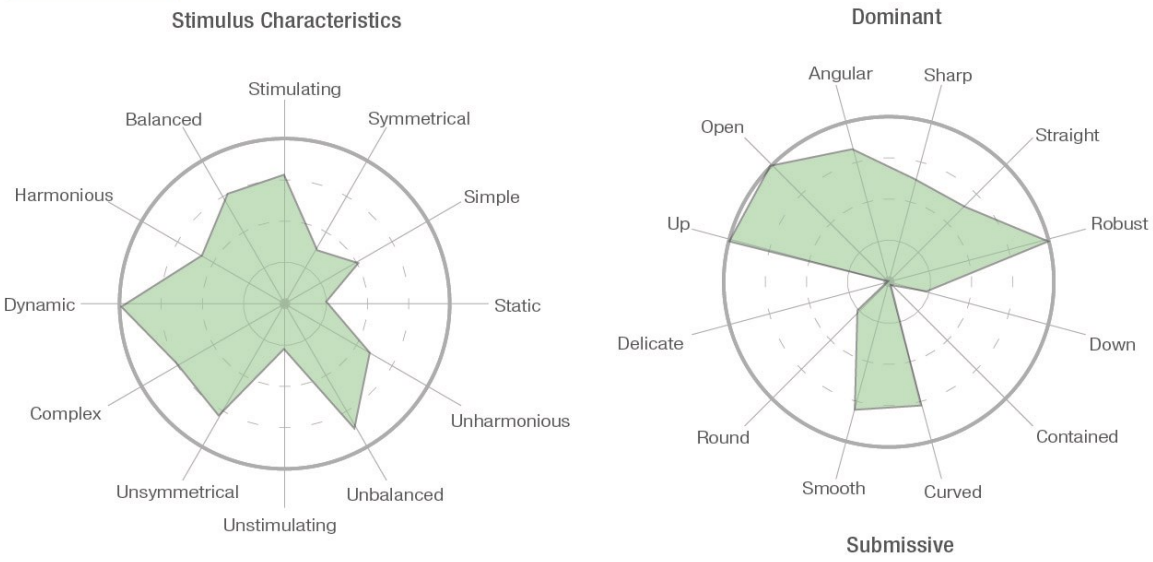

Figure 64. Surprise Aesthetic MM Content Map

4.6. Closing

Through the data collection, thematic trends, and content analysis the results divulged the relationships existing between the aesthetic attributes and the emotions. Four personas were identified in the magnetic modeling interviews which presented the perceptual biases of the participants. Each method revealed a variety of results that explored the nature between the forms, emotions, and people. The following images represent the combined thematic content maps regarding aesthetic traits within each emotion.

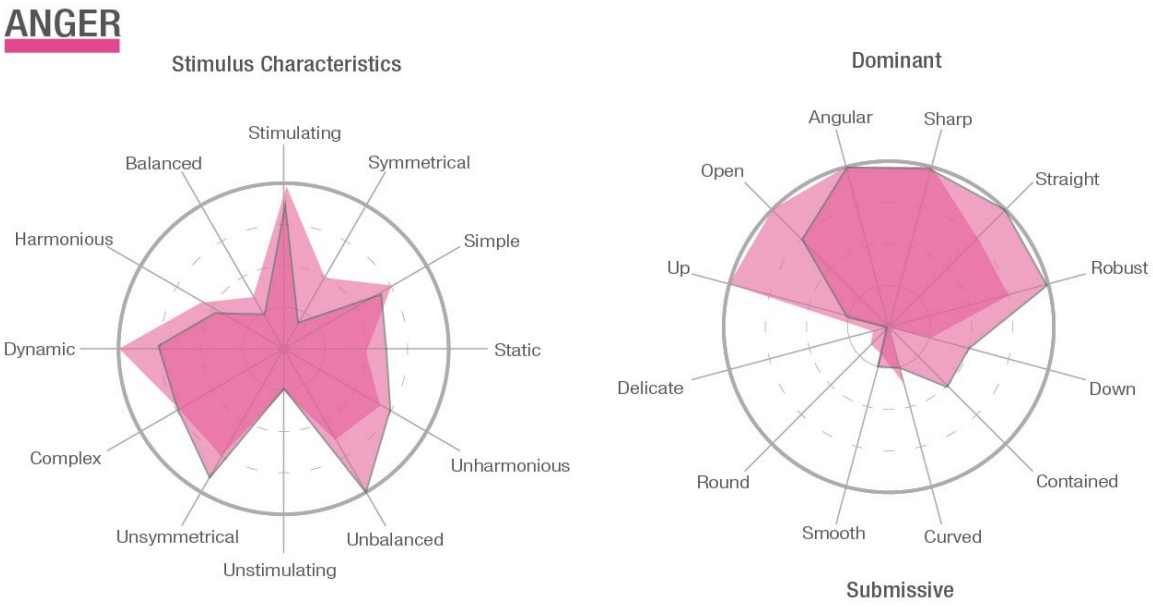

Figure 65. Anger Combination Content Map

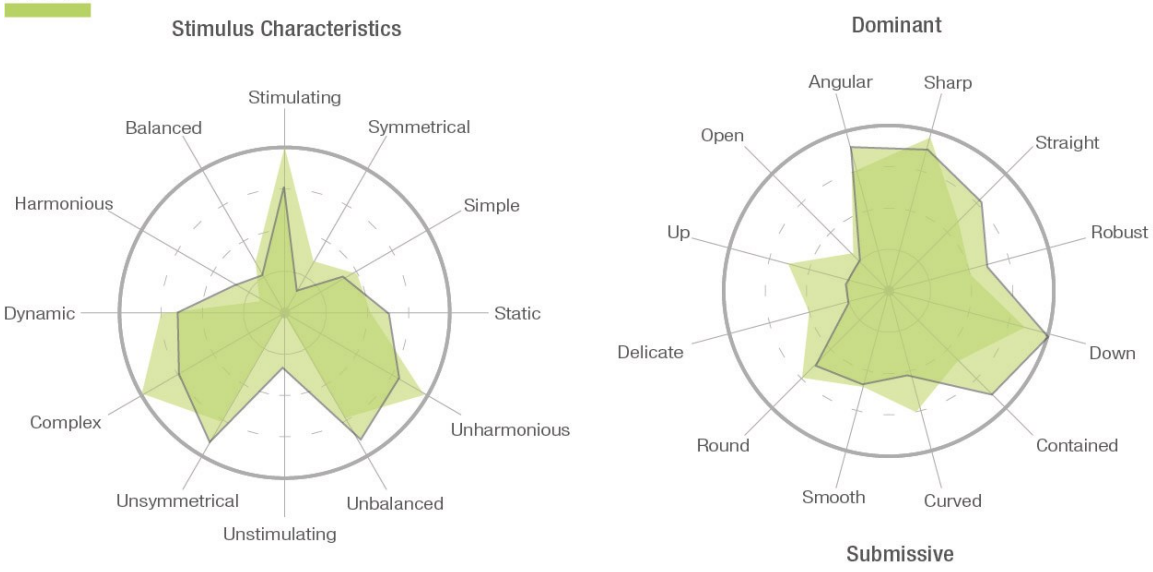

Figure 66. Fear Combination Content Map

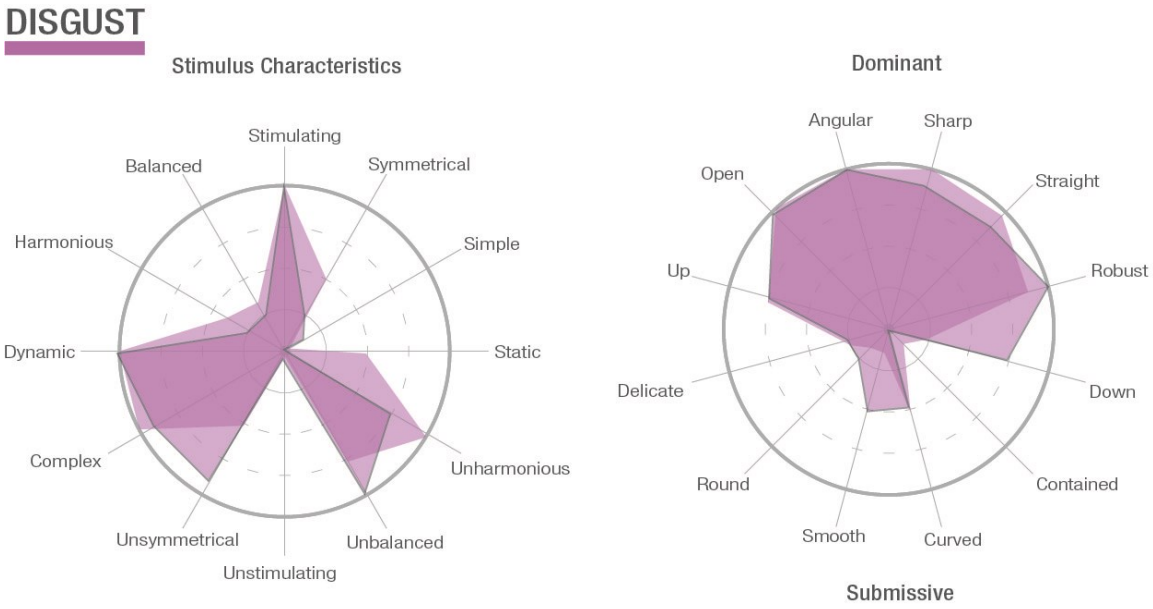

Figure 67. Disgust Combination Content Map

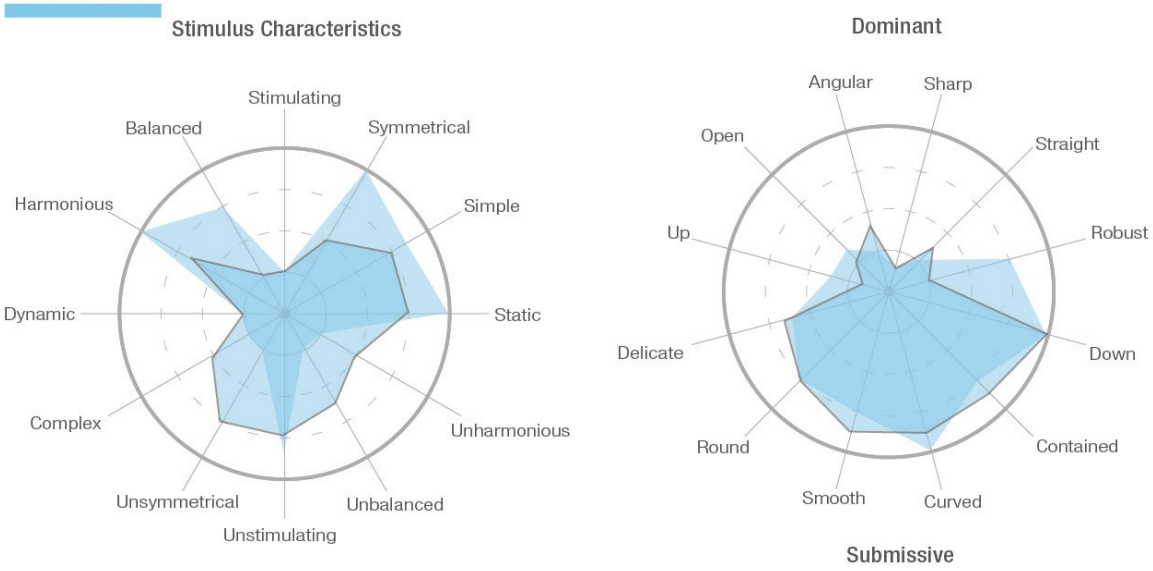

Figure 68. Sadness Combination Content Map

Anticipation

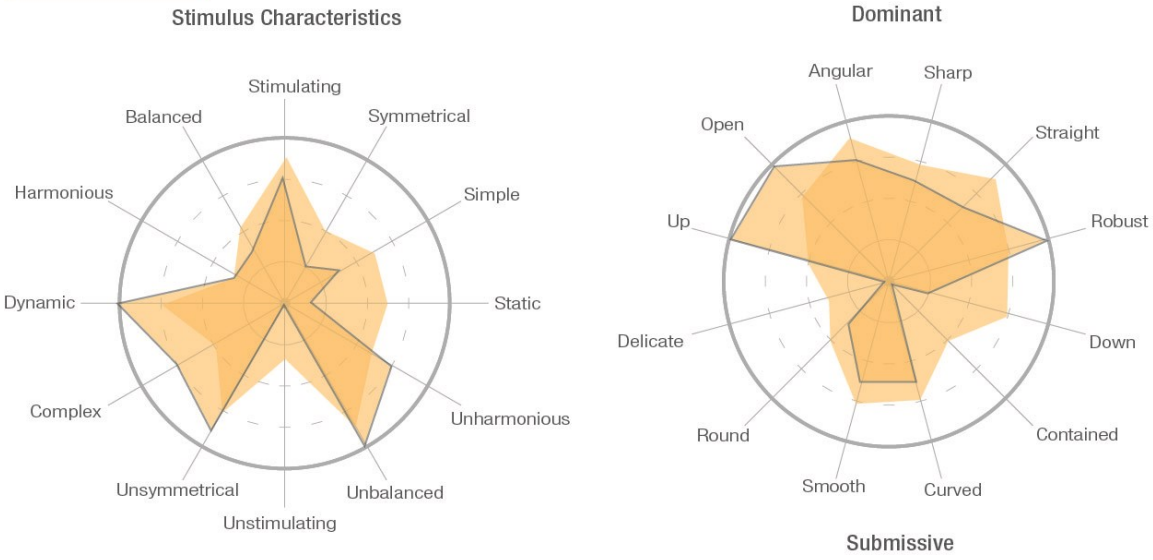

Figure 69. Anticipation Combination Content Map

JOY

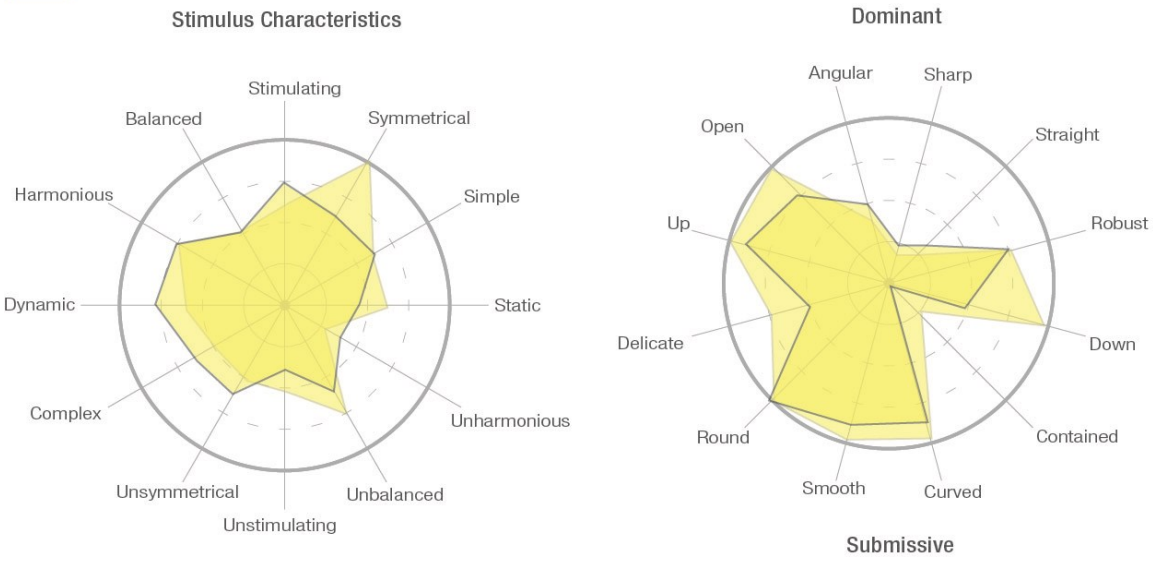

Figure 70. Joy Combination Content Map

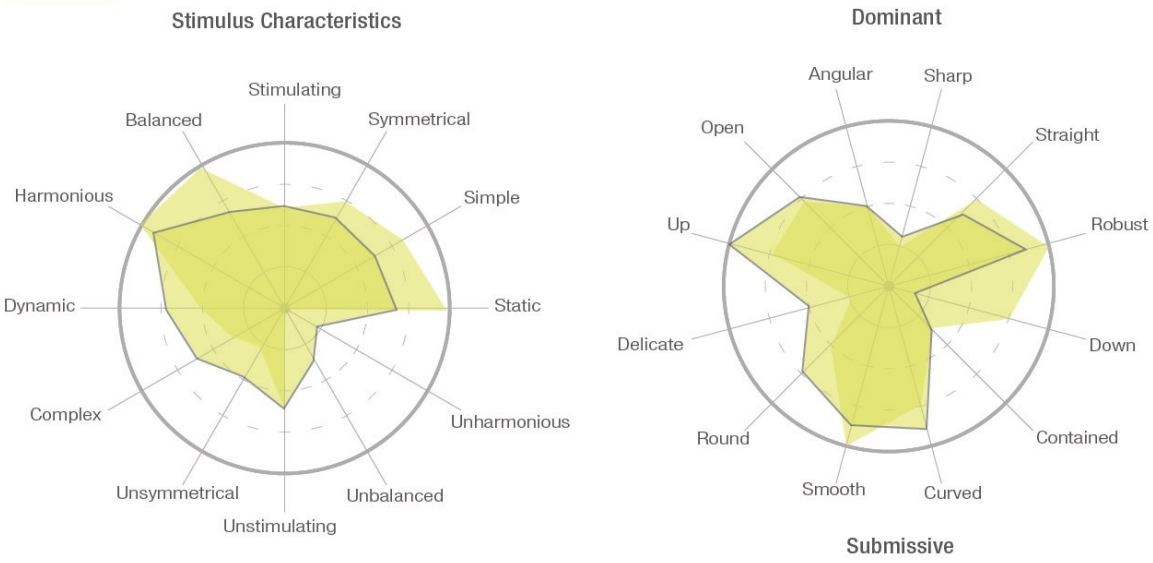

Figure 71. Trust Combination Content Map

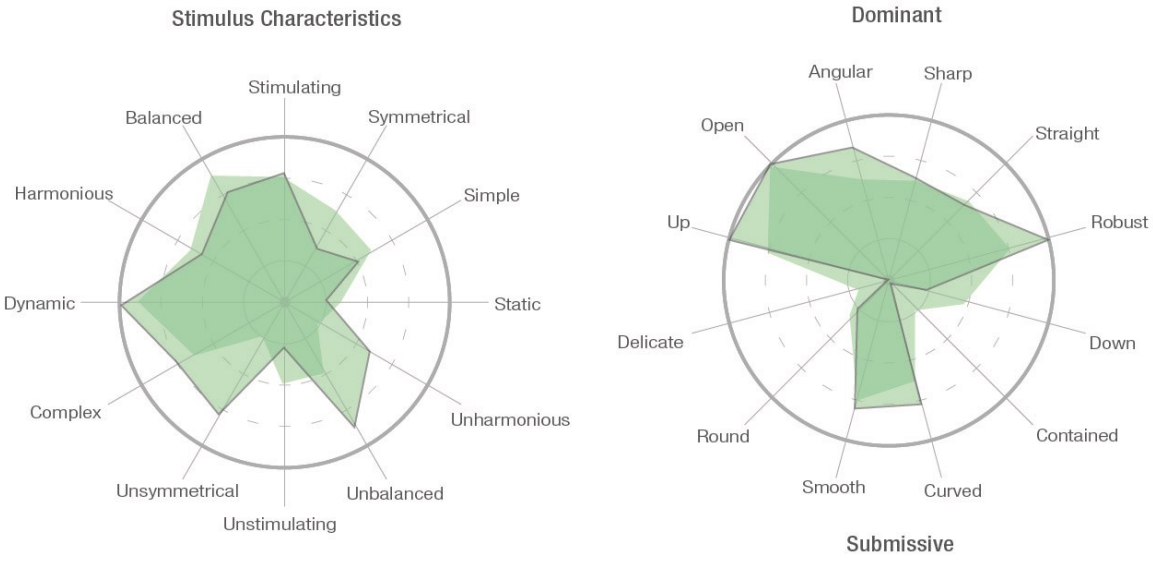

Figure 72. Surprise Combination Content Map

CHAPTER 5

DISCUSSION AND CONCLUSION

5.0 Introduction

In this study, the relationships between the aesthetic characteristics of a form and the emotional perceptions of an individual were investigated. Through the findings, several definitive aesthetic aspects of emotional perceptions have been identified. These relationships underwent multiple phases of scrutiny including an analysis of the piece-frequencies, a card-sorting task (CS), and the novel co-creation method of magnetic modeling (MM). The perceptual biases created by the participants were also addressed in relation to the findings from the MM task in order to understand any variability in the data. Thematic trends were acknowledged throughout each singular phase of this study in order to repetitiously validate the findings. Graphic content maps with topics from the aesthetics portion of the literature review were created to organize and present the thematic data in a simplistic format. The literature review served as a foundation of knowledge on product experience with the intent of establishing seminal theories and current trends in the research. The specific sects of emotion, product experience, the human and product interaction, and aesthetics provided a prescient setting to the formation and analysis of this study. Prior to advancing the study, six research questions were developed from the disparate portions of the literature review and their interconnections. Several comparisons are substantiated between the results of the study, the literature review and the research questions. Unique conclusions are also harnessed within the results themselves including the relationships found between the aesthetic qualities, the teapot pieces, the emotion categories, the personas, and the use of multiple methods.

5.1. Methods Review

A unique quality of the research design of this study is the use of methods that are atypical to industrial design. As such, conclusions in relation to the strengths of each method for determining the answers to the research questions and the ease of use in general are addressed for future applications in the field. This comparison also answers the following research question:

Is there a difference between the use of 2D and 3D methods when evaluating emotional perception?

5.1.1. Image Collection. The image collection procedure and analysis of the research was a lengthy and arduous process. In order to create the teapot taxonomy and piece characteristics for the remaining methods, several hours of familiarizing the researcher with the product across three centuries and multiple countries of origin were required. Attempting to provide multiple materials and styles while also maintaining the guidelines of the piece characteristics was difficult as some of the pieces simply did not exist in great numbers or across all timeframes. The benefit of this process was that it provided more consistency and potentially more variability in the pieces and teapots themselves. If, for instance, the first 300 images of teapots found online or in a book were used, it is likely that these teapots would have had similar pieces as teapots tend to have similar traits in general. That being said, limiting the teapots to the characteristics removed many styles that were distinct in their own right such as pyramid or disc shaped bases. If this tactic is to be employed in the future, it is suggested that the aim be focused on attempting to provide as much variability in the shapes as possible while removing the lengthy process of coding. Coding the variety of forms takes an excessive amount of time and is potentially unnecessary as the images themselves should be used in the analysis of form aesthetics. Additionally, more unique trends would reveal themselves if used in a network. If a piece taxonomy is constructed, it should be done so after using the results of a network as inspiration.

5.1.2. Digital Card-Sorting task and Optimalsort. The digital CS task for sorting the images into categories was easy to use for both the participants and the researcher and had the potential to access a larger data set with a variety of demographics and locations simultaneously. The digital aspect of the program allowed more anonymity to the participants while answering potentially sensitive demographic questions such as gross annual income or age. Anonymity may have also increased the participants' ability to provide honest answers, as the researcher was "kept at a greater physical and emotional distance" from the participants (Robson, 2011, p. 84).

The analysis tools provided by Optimalsort were easy to view, download, and apply to other existing analysis tools.

Participant bias is still a concern as a large portion of the CS task participants were students. This was a downside of the necessity to repeatedly promote the study online. The initial timeframe for the study was one month, but this was increased to two months as only a small portion of individuals completed the task. At two months, the test was opened to students attending the University. Thus, if using a similar task in the future requiring a large number of participants, many months of availability and promotion are suggested. The use of students may limit the applicability of this research to other demographics. The inaccessibility to interact with the participants is also a concern as the average completion time of 5.6 minutes may be as a result of the participants not taking the task seriously, not understanding the task fully, or the task simply did not require an extensive amount of consideration and time.

The use of the tool to discern emotional perception was, by itself, very limited. The images had to be coded first, as Optimalsort does not have the capability to have the images initially sorted by the researcher. Thus, the pictures could not be evenly displayed with five images from each base type. This resulted in a slightly uneven display of the number of bases to the participants. The images were also presented in various sizes as the proportions were altered by the width of the image collection band in the software program. Additionally, distance methods do not allow the participants and researcher to interact and expand upon the choices of the participant. Thus, only general patterns and themes are drawn from these results.

5.1.2.1. Frequencies. The frequencies were able to portray a broad depiction of the emotional qualities of the individual pieces; how they placed comparatively in each emotion. Themes regarding the pieces' influence in the emotion were taken at a glance as stronger associations were readily apparent with high frequencies. However, the individual pieces could not be dissected from the other pieces in the image and thus their specific perceptions distinctly associated to those pieces could not be derived. In truth, the selection rate of the individual pieces comingled with the perception of all of the pieces in that image. Upon reflection of the network, some of the spouts and handles may have existed more in the image set than were

initially coded. Thus, the images should always be referenced for insights regarding aesthetic qualities rather than the frequencies alone.

5.1.2.2. Network. The greatest benefit of the networks was the ability to control the degree of the relationships between objects. When converted back to an image format, the visual links could portray how close the selection rates were for specific images in relation to an emotion. This tactic provided more substantiated validity in the content analysis of the image clusters as content analysis is prone to the subjectivity of the researcher and requires external corroboration and structure (Robson, 2011, p. 349). The function of the Pathfinder software did have the limitation of the code relationships being projected first in 3D and then flattened to a 2D image. This may result in a change of the distance relationships. The greatest limitation of the networks is that an excessive number of images is needed to gather a broad range of insights for this product. Teapots in general were associated more with positive emotions and the results for negative emotions often had small clusters with a limited number of images from which to draw thematic qualities. Many participants were needed as well to complete the CS task in order to group the large number of images into the network. Specific conclusions regarding the aesthetic patterns had to be composed by the researcher as this test of the data only organized the relationships and could not provide a rationale for why they occurred. This had to be inferred by the researcher.

5.1.3. Magnetic Modeling and Interviews

5.1.3.1. Interviews. The advantage of the interviews persisted in the ability to evaluate and reevaluate the video recordings and transcripts for consistencies in the participant's statements and body language. Questions could be asked by the participant and researcher at will in order to provide more clarity on any topic in question. However, the length of time to both perform and analyze the interviews was intensive and required a great of amount patience and objectivity from the researcher. The quality of the interview and analysis are also dependent on the quality of the researcher. Transcribing the interviews by hand did allow the researcher to become more involved with the data, but limits replication and future analysis of the same transcripts.

5.1.3.2. Magnetic Modeling Method. The function of the method itself is deemed successful as many of the same aesthetic traits were discovered in both the CM and MM tasks. The amount of pieces and range of piece combinations was acceptable as all of the participants felt they were able to complete the task at hand. The inclusion of another spout was the only consistent suggestion as the other piece categories contained four pieces and the spouts only had three pieces. Ten of the thirteen participants remarked that the task was enjoyable, simple and intriguing. The functionality of exchanging the different pieces and nubs was considered easy to understand by all of the participants especially after being shown an example. Combining the magnetic modeling task with the interviews offered depth into the evaluation of the aesthetic content, the product, the perceptions, and the rationales as seen through the lens of the participants. Allowing the participants to create the objects themselves revealed new combinations and insights unique to this method. Analysis of images was also shorter as each image only referenced one emotion at a time and a network was unnecessary.

However, an extensive amount of time was needed to produce the models in a CAD program, to test the functionality of the varying materials, and to prepare the final models for participant testing. It was discovered through material testing that the weight and content of the first series of models reduced the maneuverability and thus an additional plastic set was printed. In addition, a limited number of models and pieces were printed due to cost and the variability in the surface structure. The addition of the nubs was essential to the modeling process as the curvature of forms can alter the receptivity of the magnets and the extension of the handles and spouts. Therefore, this method may not be applicable to all forms of products. For example, the pear shaped base was not included as a set of nubs would have to be constructed for this base alone. The construction of the magnets inside of the teapots was challenging and the quality of the models is dependent on the skills of the researcher.

5.1.4. 2D Network and 3D Magnetic Modeling Comparison. The 3D method provided a realistic view of the product and the pieces in question as every element of the pieces were examined. The use of images limits the perception to the angle, lighting, and exposure of the photograph. Moreover, the 2D method only engaged the sense of sight. The use of multiple

senses allowed a deeper quality of perception as each sense provides an additional facet of product experience (Desmet & Hekkert, 2007). The use of individual pieces offered more variability in orientation and alignment than seen in the 2D method. Functionality and aesthetics were manipulated at the will of the participant. Additionally, the co-creation activity allowed for an instant view of the order in which the pieces were placed on all of the teapots. All of the pieces that were considered, but not selected for the emotion were also visible. Individual pieces could be analyzed apart from other pieces, which is unique to this method alone. Thus, detailed information regarding specificities of the pieces was discussed.

The perceptual biases were derived from the statements and behaviors of the participants. A comprehensive amount of information regarding the participant's reasoning for piece placement and preference of qualities was gathered from the participants. Certain traits could be explained by the participants who produced more verbal associations to the emotions and their aesthetic qualities. During the CS task, no rationales were provided regarding participant perception.

During MM, limiting the extraneous stimuli in the models enabled the participants to focus on the aesthetic qualities in question rather than being distracted by irrelevant stimuli. This granted the participants focus while determining the emotional qualities of the form during MM. Any extraneous attributes that could not be controlled in the card sorting task were reduced by the consistency of the piece surface, texture, and color. As the extraneous stimuli are controlled, this method is more applicable for testing specific design languages and metaphors. For example, if a designer would like to test if their styling of a product communicates the aesthetic message that was intended during its initial stages of design, MM is most applicable. Hence, this method is more useful for testing specific aesthetic traits.

The 2D method of using existing images and forms is more applicable to interpreting general themes of existing products in the marketplace. Analysis of the images revealed relationships between forms, materials, and details that that had not been coded. More extreme versions of the aesthetics and numerous aesthetic patterns were depicted in the CS task which displays a substantial number of insights relating to each emotion. This method did offer an

expansive range of unique insights relating to each emotion as extreme versions of the teapot aesthetic and a variety of details could be viewed. However, the amount of visual information is almost excessive as some aspects of the products could not be controlled. Analyzing the various aesthetic qualities thoroughly could be problematic as the researcher or designer could be quickly overwhelmed. Nevertheless, some unique combinations and form details were only visible in this method. The narrowed amount of pieces and stimuli in MM reduced the presence of some traits found through analyzing the photographs. As the use of existing products offers a wide variety of forms and general themes regarding the aesthetic, this method is applicable for inspiration and informing the researcher or designer on relative trends.

The researchers suggest employing both methods for a thorough analysis of emotional perception and aesthetics. Depending on the goal of the research, one method can provide a significant amount of information. If the research in question is concerned with the perception of the aesthetics, then magnetic modeling offers the most insight into the actions of the participants and the details of the pieces.

5.2. Aesthetic Emotional Perception

Through comparing and discussing the results of the emotion and aesthetic combinations found in the card-sorting task and the magnetic modeling interaction, the two following questions are addressed:

1. How do certain combinations of 2D and 3D aesthetic forms influence the perception of an emotion?

2. What are the aesthetic elements that communicate particular emotions in form?

The selection of a teapot as an existing and well-established product provided a contextual evaluation of these questions. Each emotion resulted in its own set of conclusions through the comparison of the entirety of the data. Certain pieces and aesthetic qualities acted as indicators for each emotion. Thus, the answer to these questions will discuss each emotion in turn in regards to the piece combinations, prominent pieces, and thematic aesthetic qualities most often displayed. Two prevailing piece combinations are provided in images accompanying the explanations.

5.2.1. Anger. When the teapots were selected or modeled for anger, themes of dominant aesthetic qualities were consistently found. A comparison of all the themes and conceptual maps revealed that anger is strongly associated with sharpness and angularity most often. The presence of angles for anger is consistent with the literature on angularity (Achiche & Ahmed, 2010.) The two participant led methods resulted in a shift of the dominant features from up and open in the card-sorting task to straight and robust in the magnetic modeling task. Nevertheless, all of these attributes were apparent in both of the methods. In comparison to the other emotions, anger displayed aesthetic trends similar to disgust and fear. Surprise and anticipation also share "open" and "upward" as dominant traits. Anger differs from disgust and fear with plain styling and piece combinations. This opposes the study by Achiche and Ahmed (2010) which revealed that aggression had a lower degree of symmetry. The teapots forms tended to be more harmonious than other negative emotions with standard piece alignments, orientations, and limited detail. Thus, although anger is a negative emotion, the forms also promote a sense of clarity and control. The aspect of control was expanded upon through the participant interviews.

The teapots for anger may be dominant and aggressive, but they are also easily interpreted. Unyielding forms with strict, angular features resulted from the use of sharp and straight objects with little surface filleting or curvature. In the card sorting task, these features were often picked for using distinctly sharp details within the points of the handles or spouts. During magnetic modeling, the concept of sharpness was displayed through the combinations of the handles and spouts extending through the base or selecting the pieces with the sharpest edges.

Cubed bases were chosen most often during magnetic modeling because of their pointed edges as well. Technically, the cube has the most volume which makes it appear larger and more dominant than the cone. This finding corresponds with the existing research done by Rompay et. al (2005) which correlated height in water jugs with the terms prideful, dominant, and impressive. Comparative to the other available bases, the participants perceived the cube as the most angular and sharp. However, the card-sorting task held the strongest relationships with

cone shaped bases. This difference suggests that the perception of anger can result from the combination of the other aesthetic qualities.

The half-handle and the straight spout were found in both the card-sorting task and the magnetic modeling interaction, but not necessarily as a pair. As the participants were allowed total creative freedom while magnetic modeling, the creation of the “stabbing” combination of the nub spout and post handle was actually novel in comparison to the image analysis. Allowing co-creation resulted in a novel piece pairing that is possibly more aggressive than the currently available combinations.

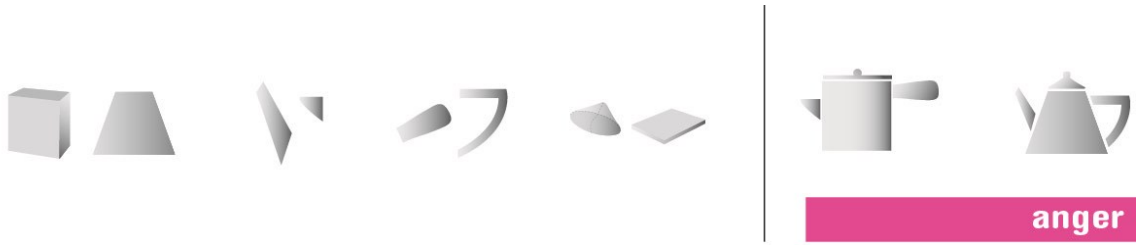

Figure 73. Prevailing Anger Piece Combinations

5.2.2. Fear. Similar to anger, fear is displayed with a high amount of stimuli. Fear is unique in that it has the broadest display of both dominant and submissive traits. Pieces were found to have round and straight elements, sharp and smooth details, and angular and curved pieces. Both methods showed that contained forms were most often apparent as the teapot’s secondary pieces were close to the base. The broad amount of stimuli suggests that these teapots may be difficult to interpret as the styling is not cohesive. This point also reflects that there may be two interpretations of fear, one being a teapot that is fearful and the other being a teapot that causes fear. This variety was shown in both the card-sorting task and the magnetic modeling as a general theme of submissive containment was seen with some outlying characteristics or teapots that were dominant. The contained teapot corresponds with the existing literature for closure and security, whereas the qualities like sharpness and robustness correspond with dominant, prideful, and impressive terms (Rompay et. al, 2005; Achiche & Ahmed, 2010). For the most part, the forms in fear can considered contained with a downward presence paired with sharp or angular details.

The pieces and combinations that were indicative of fear were often rectilinear or pointed. The nub spout and post handle were a prominent combination seen in both methods of analysis. Another handle and spout combination displayed was a rectilinear form paired with a curvilinear form. This variety in the shapes increases the amount of varying stimuli that the individual must cognitively process (see section 2.3). Alignments in the secondary pieces were also nonstandard, dysfunctional, and pointed in a downward direction. The bases for both methods resulted in a broad use of all available pieces. This provides that the shape of the base is not indicative of fear, but rather the context in which it is presented. In fear, the bases appear smaller and the object is more contained on a whole, but the additive pieces are dynamic and dominant.

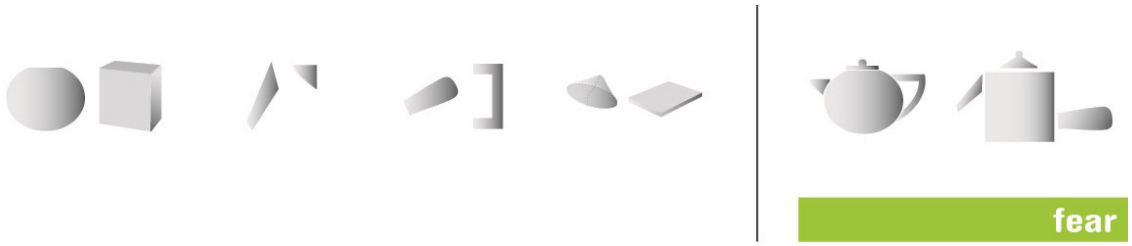

Figure 74. Prevailing Fear Piece Combinations

5.2.3. Disgust. Disgust is another negative emotion with a strong association to dominant aesthetic qualities like angularity, openness, upward movement, and robustness. Disgust is also the emotion that is the most stimulating as it has many dynamic features, but lacks cohesion, balance, and symmetry. The current research on balance suggests that imbalance results in objects being perceived as restless, unstable, and uncontrolled (Rompay et. al, 2005). Unlike fear or anger, it has limited submissive traits or qualities that help to lessen its high amount of variation in its styling. This follows through with the aesthetic concept concerning complexity as a moderate amount of complexity is preferred (Wickens & Hollands, 2000). The large degree of varied piece combinations and unsymmetrical or substandard alignments increases the complexity of the form making it disgusting.

Angular cubes and cones were revealed as the most common bases in both methods. The cubes were often flipped with the small side down which is regarded as nonstandard to a traditional kettle by the participants. Both forms are associated as being angular. The common

secondary traits consisted of the post handle and the nub spout. These were often used in conjunction with each other in magnetic modeling, but were presented alone in the card-sorting task. These two forms combined are more representative of disgust. Unique and unharmonious combinations of rectilinear and curvilinear forms were also present in both methods. Again, this is definitive of a higher level of stimuli and complexity in the form.

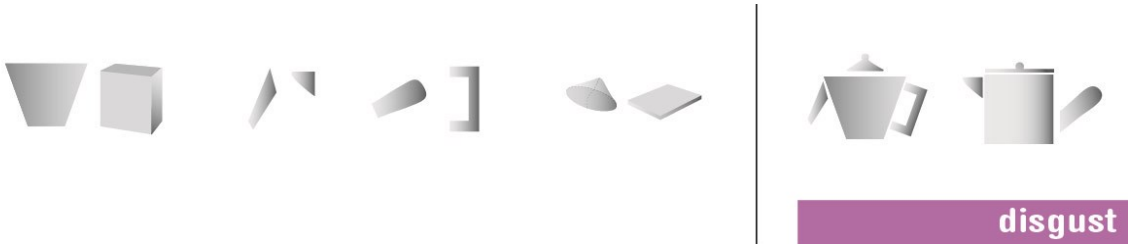

Figure 75. Prevailing Disgust Piece Combinations

5.2.4. Sadness. Sadness is the emotion with the most submissive traits overall. It is arguably the most contained emotion as this theme was presented in both methods of analysis. As in the literature, containment is a sign of security (Rompay, 2005). The smooth curvilinear shapes and downward motion reduce the amount presence these objects have in comparison to the other emotions. There were differences in the perception of sadness from the card sorting task to the magnetic modeling task. The main difference was the lack of symmetry in the magnetic modeling teapots. This also made them more complex and unharmonious. The differences in these results imply some variability in the perception of sadness in the magnetic modeling participants. As two participants described their models as strong versions of sadness, lack of harmony could be indicative of grief. According to Plutchik (1965), grief is in the same stream of core affect as sadness, but has a more intense arousal state. Imbalance is associated with instability in the literature, which also promotes these renditions as stronger interpretations of sadness (Rompay, 2005). What aesthetic attributes qualify as grief would have to be validated with further research.

The piece frequencies of the bases suggested that the cylinder was most strongly associated with sadness. Both the card sorting task and the magnetic modeling task had a variety of bases, but the cylinder was not used in the magnetic modeling task. The type of base

was not an important indicator for this emotion, but bases with a larger bottom or downward motion were established throughout the process. Rounded lids were common for this emotion, but not necessarily definitive as they are seen in other emotions more often. The strongest indicator in the secondary pieces presented itself in the tilt of the spout. The card-sorting frequency data indicated curved spouts, but on further inspection in the network, the emersion points of the spouts were lower and the tips of the spouts were also pointed lower than the other emotions. Reversed or flipped spouts were also found in the magnetic modeling as people portrayed “sad elephants.” This implies that even slight directional shifts can suggest a downward sense of movement resulting in a submissive trait.

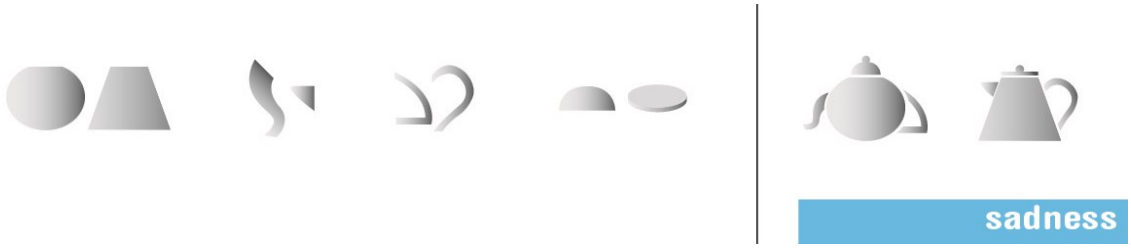

Figure 76. Prevailing Sadness Piece Combinations

5.2.5 Anticipation. The results for anticipation had a mixture of dominant traits combined with the submissive traits of “smoothness” and “curved.” This set of aesthetic attributes is also definitive of surprise. Surprise and anticipation are considered complimentary according to Plutchik (1965), but they are not the same emotion. Anticipation is derived from vigilance and suggests an expectation for an event to occur, whereas surprise implies there is no expectation for an event to occur (Plutchik, 1965). The results for anticipation in the card-sorting task showed a significantly well-rounded degree of aesthetic attributes which included more contained and downward oriented pieces. However, the magnetic modeling task revealed more similarity to surprise with only slight variations in the overall aesthetic qualities of the emotion. This provides that either the participants in magnetic modeling interpreted the emotions in the same manner, or there is little distinction in the emotions in an applied context. Fortunately, the slight variations in the emotions are more prominent when comparing the piece selections.

Anticipation has a mixture of bases within both types of methods. Cubes are not commonly associated with anticipation; some curvature to the overall form is required for an appropriate depiction of the emotion. These submissive traits of curvature distinguish this otherwise dominant emotion as having more balanced aesthetics. That being said, anticipation was repeatedly shown to have unique size and placement height differences between the handles and spouts throughout all phases of the study. Often, this combination resulted in a diagonal movement within the forms making them more dynamic and stimulating.

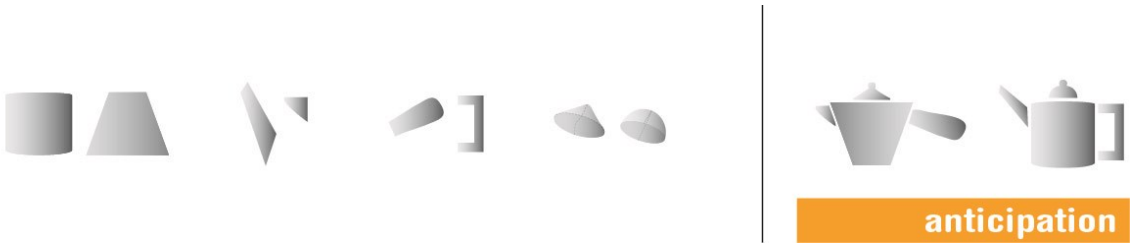

Figure 77. Prevailing Anticipation Piece Combinations

5.2.6. Joy. Joy resulted in a combination of dominant and submissive aesthetic attributes with rounded bases, curved details, and a robust presence. Open and upward features were depicted in both of the participant led methods. The teapots in joy are the most rounded of any emotion, even more so than sadness or trust. Commonly anthropomorphized in the magnetic modeling study, these teapots often have more character. This can result in less balance between the spout and handle, but this is often mitigated with curvilinear bases and details. Imbalance has a negative outlook in the literature, but its prevalence in Joy shows that imbalance may be subject to context. This nub and spout combination has a positive association in Joy, but may also translate a negative association in other emotions. This reveals that certain pieces can alter their perception when paired with the right aesthetic elements. Harmony is the most important stimulus factor for joy as it weighs the differences in the curvilinear and rectilinear forms and delivers a cohesive style. Thus, even if one feature is rectilinear or sharp, the presence of more curvilinear traits outweighs the distinct piece.

This combination of having mostly rounded, curved, and smooth objects accompanied by a singularly rectilinear or angular feature is common in joy. An entirely round object with little variation may present a limited amount of complexity and draw less attention. The presence of one unique piece helps to increase the variety in the object without having a demanding presence. The pieces that are associated with more negative emotions, such the post handle or nub spout, are also aligned in an upward arrangement which makes them appear dynamic and positive. The curved handle and spout pieces were also commonly seen in this emotion and often viewed together as a set. Although lids rarely revealed a strong association to any one emotion, the dome lid was repeatedly presented for joy throughout the entire process. Thus, joy balances its attributes and piece combinations so as to invoke attention while also remaining curved and rounded.

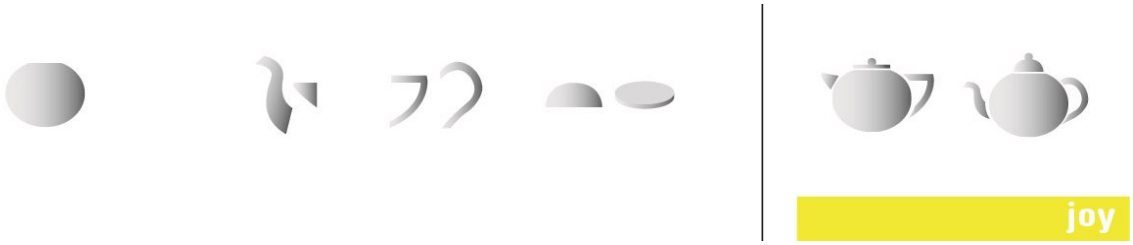

Figure 78. Prevailing Joy Piece Combinations

5.2.7. Trust. Similar to joy, trust also manages to display a range of dominant and submissive traits. The aesthetic qualities collectively seen in trust included openness, upward movement, and robustness. The submissive traits included rounded, smooth, and curved forms. Again, this poses some similarity to joy. Trust differs in that it often has more “straight” features and fewer “round” elements. The concept of sturdiness was strongly regarded as a quality of trust to the magnetic modeling participants. This ideal was also relevant to the network results as the materials and robust frames of these teapots were also considered sturdy. While sturdy, the details and edges of the teapots appeared rounded. Comparatively, the results from magnetic modeling showed less robust teapots and more traditional teapots. Effectively, this may result from the participants not being able to alter the size of the teapot or provide wider bases. It also

presents a different view of trust. Therefore, trust can be sturdy and/or traditional depending on the participant and the available teapot options.

The trust teapots commonly displayed a range of bases in both methods. For this particular emotion, the card sorting network actually produced a more developed understanding of the aesthetic qualities related to trust. One of these is the bottom-heaviness that was apparent. The magnetic modeling teapots resulted in a majority of the trust models resembling the models in joy. In this sense, a trust teapot may have been easier to select than to model. However, the magnetic modeling presented combinations associated with traditional teapots. Spherical bases were most common, but cylinders and cubes were also apparent. The curved spout was paired with the half-handle or the curved handle to form a balanced relationship. The dome lid was also prevalent in trust, which is an additional similarity to joy. Trust differs than joy in its relationships of its secondary attributes. These are less distinctive and stimulating in trust. Thus, trust has balanced aesthetic attributes that can be perceived as traditional and expected.

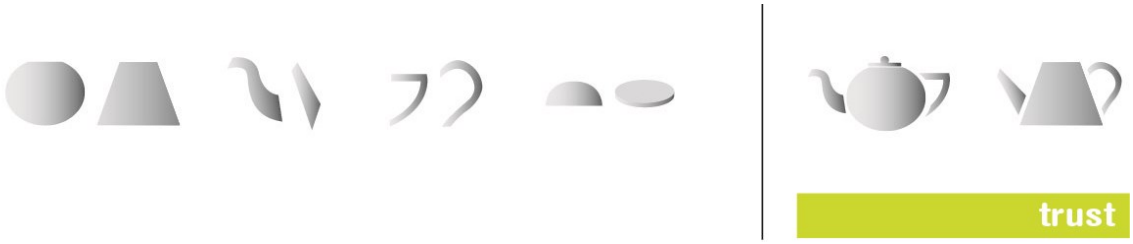

Figure 79. Prevailing Trust Piece Combinations

5.2.8. Surprise. As discussed before, surprise and anticipation resulted in similar aesthetic attributes in the card sorting network. Nevertheless, surprise was more dynamic on average especially when considering the distinctions between those emotions in the network. Whereas anticipation rated as dynamic due to odd proportions in the handle/spout relationship, surprise was recognized as dynamic as it had an increase of unique attributes. This was also supported by the findings in the magnetic modeling study as surprise was often associated with untraditional forms and three varying dynamic directions of visual movement: straight through,

straight up, and diagonal. Anticipation was only associated with one visual direction of movement: diagonal.

As far as combinations are concerned, cubes and cones have a strong presence as well as harmonious handle/spout relationships. Thus, if the spout is curvilinear, the handle is as well. Conical lids and extremely high placements of the spouts were two traits found in the magnetic modeling study, but remain unconfirmed by the card sorting network. High handle placement can be seen in the network surprise cluster. In addition, surprise tends to reveal more balanced weight between its handles and spouts. Thus, the sizes of these features are similar. Cohesion in styling while accompanying unique attributes is the general trend of surprise. Thus, many different combinations can exist in this emotion.

Figure 80. Prevailing Surprise Piece Combinations

5.2.9. Conclusion. As shown, certain piece combinations and aesthetic qualities are associated with the perception of particular emotions. In general, an abundance of extremely dominant or extremely submissive features results in a negative emotion. Anger and sadness are two respective examples. If the aesthetic attributes are balanced between dominant and submissive traits, positive emotion associations are made by the individual. Joy, trust, anticipation, and surprise all revealed a mixture of dominant and submissive traits. Additionally, certain pieces and piece combinations were shown to have negative or positive associations. For example, the spherical base was considered mostly positive throughout the frequency evaluation, the network, and the magnetic modeling task. The cube was also considered generally negative in each method. However, both of these forms displayed the ability to cross-over into an opposing affective state as a result of the other pieces in the combination. Spheres were regarded as projecting sadness when accompanying a lilting or downward facing spout. Cubes

depicted trust when combined with soft edges and rounded handles, spouts, or lids. Therefore, the perception of aesthetics is reliant on all of the forms and their collective expression.

5.3. Guiding Decisions: Personas and Perceptual Bias

Four personas were gleaned from the interviews during the magnetic modeling task in order to determine the answer to the following research question:

How do the perceptual biases of individuals alter the emotional perception of aesthetics?

According to Jordan's pleasure principle, functionality rests at the base of a pyramid which then leads to usability and is topped with pleasure. He posed that products could be designed for pleasure without meeting the other two levels, but this would result in an unsatisfactory experience. This idea was reconfirmed as many of the teapots in the positive emotions were considered more functional than those in negative emotions. During the magnetic modeling task, participants found it difficult to make dysfunctional teapots even while modeling negative emotions. There were negative emotions that were still functional, such as anger or fear, but this did not make them positive and possibly did not make them pleasurable. All things considered, what makes a product pleasurable? Jordan listed four different types of pleasure; the most abstract of the types, ideo, navigates what the individual views as correlating with their personal values.

The creation of the four personas unveiled these ideo-pleasures in the participants to some degree. The aestheticist, for example, sought to define the negative emotions as ugly and the positive emotions as attractive. The aesthetic quality of the teapot was what defined the object as positive or negative, good or bad. Modern and cohesive designs were regarded as attractive and traditional teapots were seen as unattractive. Similar to our core affect, certain aesthetic traits became signifiers of goodness or badness to the other participants as well. This may be difficult to apply to some personas, like the conceptualist, but if one considers that these individuals make constant associations to other objects this creates a rule of goodness or badness with these individuals as well; it is simply more complex to discern. A general rule to cater to this persona would be to attempt to either illicit positive associations with purposely stereotypical or characterized objects, such as a "happy elephant" shaped teapot, or to take

precaution while creating abstract forms so as not to trigger overtly negative associations to existing objects.

This reliance on what is good or bad is also married with Norman's visceral level during the processing of product experiences. He projects that the visceral level helps determine the purpose of the form as well as the goodness or badness of the object. He claims that the behavioral level, resulting from interaction, is what determines the functionality of the form. However, if the perceptual bias of the individual is the functionality of the object, this may be the frame of their visceral attunement. This was shown by the functionalist persona as these individuals thought they could easily discern the functionality of the teapot pieces simply from quick glances. This is also supported by their lack of manipulation of the pieces while modeling. Based off the individuals' value system, the personas reflect what is most important to that individual. As a result, it defines what is instinctually good or bad in regards to the aesthetic attributes of the forms. In essence, the perceptual bias identifies needs, frames interactions, and generates first impressions of the product's aesthetic features.

When applying the personas, the emotionalist may be the most sensitive to the identified aesthetic traits. Attuned to the empathetic signals of objects, these individuals rely on their intuition to determine the qualities of an object. The emotionalist Serena recalled a time when she bought the round plastic balls of Coke that are available during the Christmas season. She reflected that she bought them because they were cute, even though she refrained from drinking them. Upon completion of her spherical joy teapot, she ecstatically stated that she would buy it "especially if it was my favorite color…if it had paisley on it, I'd be like "take my money, shut up and take my money!" And I don't even make tea!" The advantage of considering the perceptual bias of the individual is the ability to cater to and fulfill the instinctual communication needs for that person through the aesthetic attributes of the object.

Cruesen (1999) identified several aspects of a person's character and demographics that defines their orientation to product qualities. Women in general have a strong tendency to consider functionality in purchase decisions, but a completely functioning product may not aesthetically communicate that it is functional (Norman, 2004). More extensively, the advantage

of acknowledging a perceptual bias is to aesthetically communicate to the user that the product fulfills the concern of their visceral responses.

As shown in the literature, it has become more apparent that an individual's personal history, culture, and personality all influence how information is processed. For example, the two aestheticists and their Chinese cultural background had a distinct viewpoint separate from the other participants. Yanmei continuously referred to positive emotions as "soft," whereas the American participants often commented about these same emotions as "big" or "out" indicating extroversion. In addition, the other aestheticist described her spherical disgust teapot as a "fat Chinese man" from classic films. This offers a different perspective than seen in the other personas. Further research comparing the cultural influences on perception may offer more depth into these distinctions.

Regardless, the evidence of cultural influence as well as the varying differences in the respondents gender or age only further support the concept that perceptual biases exist. Where one sees a highly traditional, functional, and rounded teapot, another may view it as a symbol of an oppressive class. The distinctions that define the individual become part of their cognitive processing system further influencing decisions and mental constructs by which objects are judged.

5.4 Communicating Aesthetic Emotions

The final research question from the literature review regards enveloping emotional qualities into aesthetics:

What is the process of interpreting and applying emotional qualities within aesthetics?

As discussed in the emotions section of the literature review, basic emotions are considered the adaptive and evolutionary responses that guide the behavior of the individual. In a similar way, the aesthetic attributes of a form can also result in analogous behaviors. For instance, disgust is the evolutionary response to poison. The high levels of aesthetic variation seen in this cluster of the CS network may act as the stimuli that produces the behavioral response of repulsion. As displayed by Desmet's Appraisal Model, an individual attributes an emotion to a product once a concern is cognitively compared to the qualities of that product. The resulting emotion is positive

if the qualities of the product meet the concern. In order for the product to result in disgust, it would not meet the concern of the individual. The individual would then be repulsed by the product. When applying this situation to aesthetics, the same principles exist; aesthetics communicate via their semiotic qualities whether the product is distasteful.

According to Clarkson's (2008) product interaction model, the user engages perception in order to gather information regarding the object. As Chang and Wu (2009) revealed, the visual and tactile senses offer the most information regarding a product during perception. Thus, the aesthetics act as a way to communicate general information. Communication theory suggests that an individual's personal experiences, values, and personality impact how they perceive and process information regarding an object (Keller,2004, p. 69). This was exemplified by the personas and their perceptual biases.

The results of the CS network and the MM cluster revealed which aesthetic attributes of the teapots communicated basic emotions. The content of these aesthetic traits were organized thematically as to coordinate which ones were deemed as positive, negative, dominant, or submissive. Below is a graphic depicting the thematic conclusions of the aesthetic content.

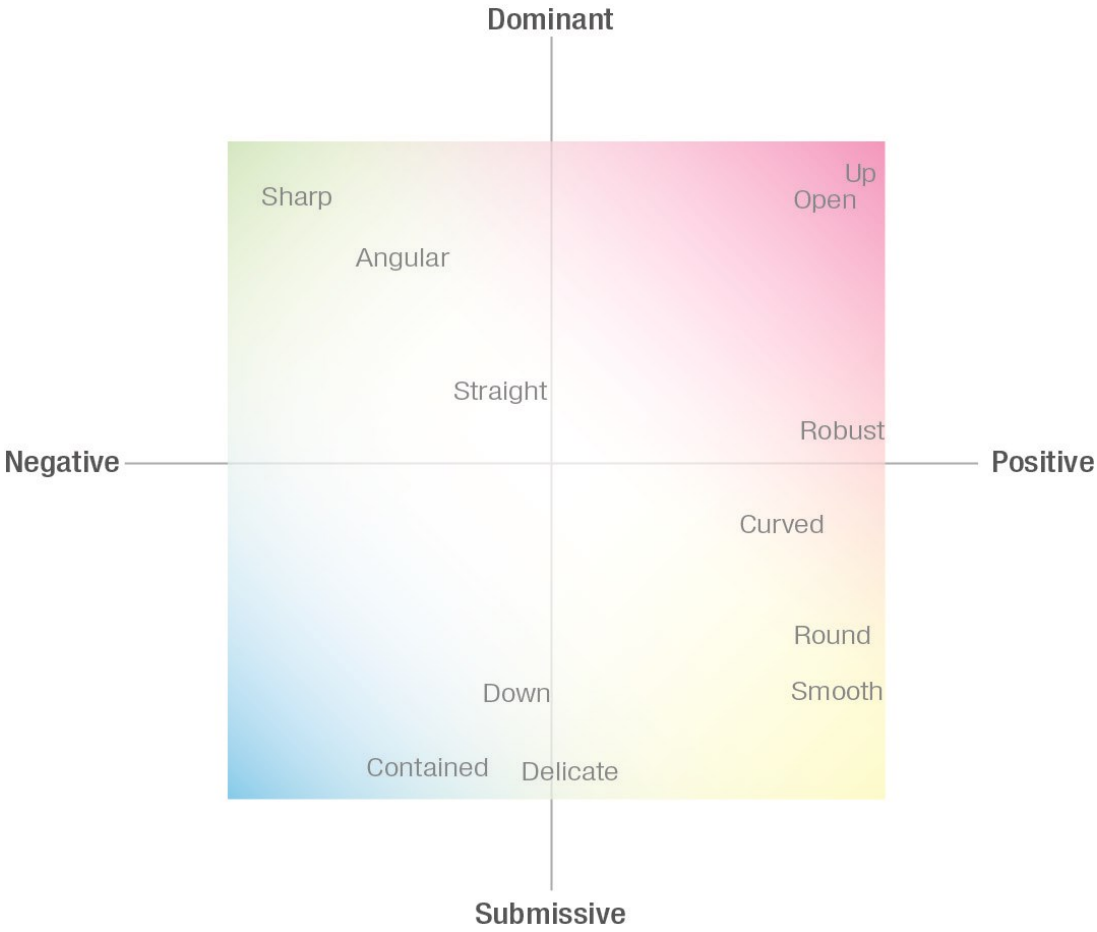

Figure 81. The Emotional Perception of Aesthetic Traits

As one can see, sharp and angular are considered the most negative and dominant traits. Moreover, round and smooth are considered the most positive and submissive traits. However, simply because an aesthetic trait was considered positive or negative, submissive or dominant, does not determine exactly how amicably it is to be perceived. Balance, symmetry, harmony are all stimulus related themes that did not necessarily determine if a teapot was considered a positive or negative emotion. In general, the results showed that if a teapot had a moderate amount of balanced stimulus related attributes it would be considered positive. The image below depicts this as the red triangles are stimulating and the blue triangles are unstimulating.

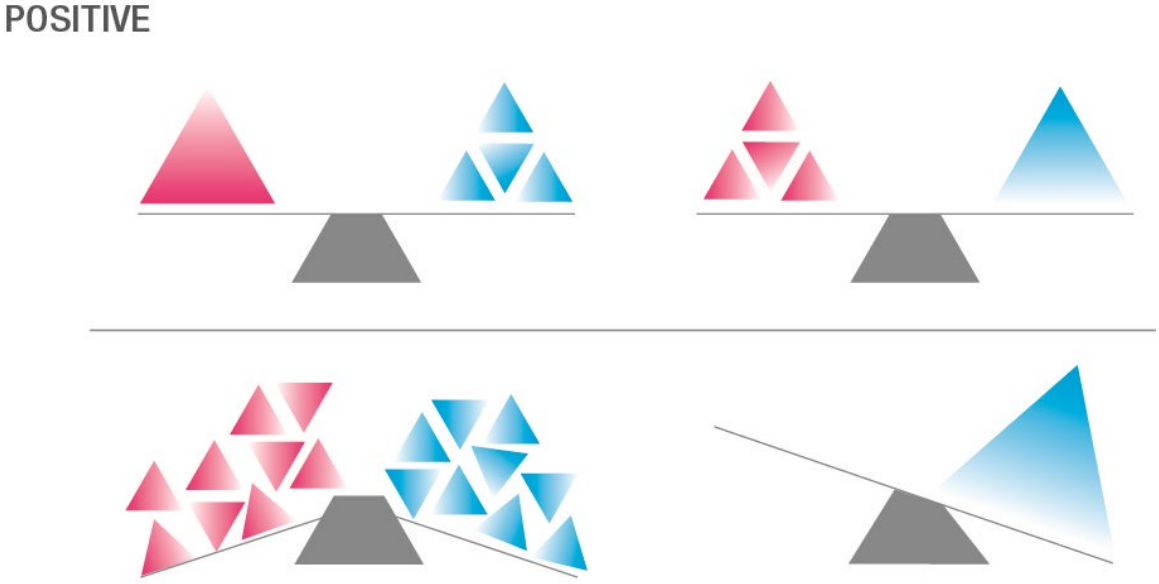

Figure 82. Balancing Stimuli

The negative emotions such as fear or disgust often displayed an abundant amount of stimulating and unstimulating, dominant and submissive traits. This creates confusion during perception and results in a negative emotional connection. If an object is unstimulating, as in the sad teapots, it also results in an unsatisfactory perception. Balance is necessary even in the positive emotions. Joy, trust, anticipation, and surprise all exhibited some stimulating aspects correlating with some unstimulating pieces. This is not a hard and fast rule as some attributes, such as symmetry, have more weight when being perceived and are regarded as more valuable. This concept of balancing aesthetic stimuli would have to be explored further in future research. It does offer a different point of view than seen in the current research as rounded forms are generally considered positive regardless of their overt simplicity (Chou, 2011). Products may need to include minimal amounts of variation and intriguing stimuli in order to be perceived positively.

The magnetic modeling method was well-equipped to determine the process of interpreting and applying emotional qualities as the individuals had to construct the teapots piece by piece. The interviews provided the opportunity to ask questions while they were doing this as

well. What was discovered is that the participants initiated modeling with the most dominant piece of the teapot, the base, and then used the remaining pieces to support their concept of the emotion. As seen below, the most dominant feature is the first that is considered during this application process.

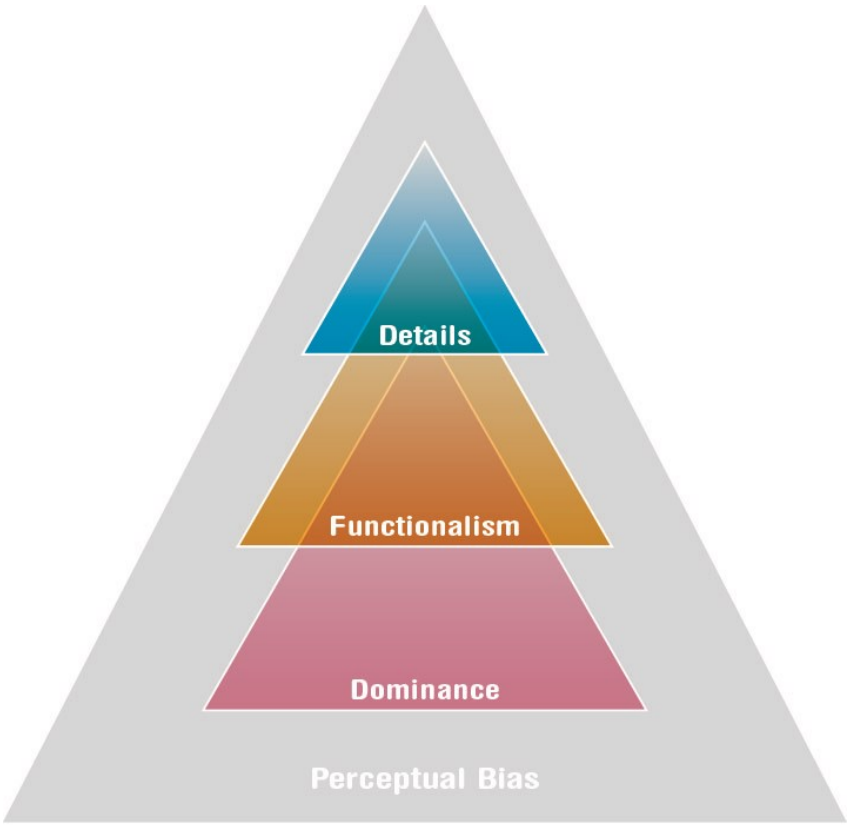

Figure 83. Applying Emotional Aesthetics

The base was also the piece which was reflected upon first during the post-interaction questions. This suggests that the dominant feature, rather the largest in the set, is considered first during perception. The CS network also collaborates this as many of the emotion clusters had the same bases as the magnetic modeling task. Despite whether the base is spherical, cubed, or conical, it is still considered the most dominant in comparison to the other pieces due to its large size. However, if the piece is particularly sharp or angular, despite its size it will be considered as the most dominant and will set the stage for the remaining interpretation of the form. This was revealed by some of the teapots in the CS network's anger cluster.

The next pieces that were applied during modeling were the handles and spouts. These pieces were referred to as the most “functional” of all of the elements by the participants. The direct contact they had with these pieces made them want to hold them, manipulate them, and exchanged them for other versions most often. During the interviews, the participants were asked what piece was most important for portraying the emotion in question. Regardless of the emotion, the base was selected most often followed by the spout. The handle was stated almost the same amount of times as the spout and the lid was never mentioned. Participants often referred to the lid as a detail or a nice addition if it suited their concept well. As a result, the pieces that require the most physical contact or will become a functional aspect of the product’s experience are deemed as key to the portrayal of the emotional message. Small details, such as the lid or the edges of the pieces are considered last when applying the emotional aesthetic.

As shown in the figure, all of these elements layer upon each other to develop the emotional aesthetic. Piece selections occur within the individual’s perceptual bias which infuses the idealistic quality of the piece. Each layer of perception can add or subtract from the one before it and the larger layers project through all of the layers placed on top of them. Therefore, while applying emotional aesthetics, dominant features are considered first, followed by functional elements, and then topped with less significant details. The overall process is additive and collectively communicates the emotional qualities of the form.

5.5. Limitations and Suggested Improvements

5.5.1. Product Selection. As this study only evaluates the perceptual variance in one household object, the applicability of the results is limited as well. This especially concerns the conjectures regarding the thematic aesthetic elements. The emotional and aesthetic experience differs between kitchen objects alone, let alone between furniture, outdoor equipment, or automobiles. Even within the distinct sect of kitchenware, the experience one deems as anger may change from the aesthetics presented in a kitchen knife to those in a kettle. As such, the perception of the different emotions may be altered by the context of use and experience related expectations of the participants. For example, a broad and low teapot base may project trust, but

a broad and low desk lamp might imply some other inclination. Evaluation of other products is suggested for future research to confirm the results of this study in other applications.

5.5.2. Population Samples. As both samples of the methods were limited by the research location and promotion, the demographics of the participants were fairly limited in age and race. This was especially true for the magnetic modeling study. This sample was relatively small and composed of convenient participants. The identified personas would need to be confirmed with future research to explore their applicability to the general population. The results revealed that a fifth persona, referred to as an intuitionist, may become more present in the general population upon further review. Additionally, the aestheticists were both design students and of Chinese decent. This raises the question of applicability to other individuals in alternative career paths or cultures. In general, the limitations of the participant sample reduce the generalizability of the results to the general populace. This includes the types of perceptual aesthetic associations that were drawn. Varying ages, careers, and cultures can provide more insights into the validity of the findings of this study.

5.5.3. Researcher Perspective and Analysis. This thematic analysis is limited to the view of the researchers involved with the study. As with any use of content analysis, variability exists through the perspectives of those analyzing the data. Objectivity is difficult to maintain while comparing large sets of visual content. Saturation of visual information may reduce the acknowledgement of novel data. Thus, multiple reiterations of analysis are required to confirm results. The addition of an expert panel may provide more validity to the findings.

5.6. Theoretical Implications

The results of this study add to the body of literature as understanding how aesthetics can communicate particular emotions generates a fully developed product experience. Prior to the initiation of this study, the existing literature comprised a list of dominant and submissive traits that were observed within 24 perfume bottles. Wellmann, Bruder, and Oltersdorf (2004) examined the femininity and masculinity of perfume bottles; the question of dominance and submissiveness was not fully addressed as they were not retested. The current study confirms many of these traits and expands upon their relation to basic emotions that are defined through evolution.

Interpreting the correlation of an object's aesthetic signals is essential to recognizing the evolutionary responses one has to the objects around them. As this study implemented a different type of product, some trends of aesthetic relationships have started to present themselves in the literature as a whole. The confirmation of smooth, curve, and rounded forms being perceived as submissive was acknowledged. The angular, robust, and sharp forms being perceived as dominant were also corroborated with the evaluation of the teapot clusters.

The variation in form typicality as displayed in the aesthetic tea kettle study by Crothers, Clarke, and Montgomery (2004) revealed a significant relationship between the descriptive label of the tea kettle and a change in the form. This study furthered this concept by describing what changes occurred in the aesthetic relationships and piece combinations when a descriptive label was applied. Trends between two varieties of methods established these characteristics on multiple levels.

In general, the concept of manipulating the pieces of a product to reflect the emotion has yet to be explored extensively in the literature. Enabling participants to engage in the process of form creation provided new insights into how forms and combinations may recombine to deliver emotionally formative aesthetic relationships. In addition, this 3D process allows the participants to fully experience the product. As stated in previous research, the use of multiple senses is assistive in experiencing the "kinaesthetic" qualities of the object (Desmet & Hekkert, 2007). Moreover, this broadens the experience of the aesthetic forms providing a more accurate perception. Pre-existing research often relies on 2D representations of product concepts which lack full formation. Research that employs 3D products already in production "vary on so many dimensions that it is often difficult to ascribe effects to the relevant stimulus dimensions" (Hekkert & Leder, 2008, p. 282). Moreover, current products are laden with multiple types of stimuli that may affect the perception of the individual. This fact was supported by the aesthetic relationships that were presented in the CS network as many surface elements and prints were ascribed to respective emotions. The development and use of a co-creative method, aided in limiting the amount of stimuli the participants categorized into the emotion labels.

As this research employed qualitative research methods, it was exploratory in nature and as such was apt at unearthing a variety of untested spatial relationships. Bottom-heavy objects representing sturdiness is one example. Diagonal piece alignment depicting anticipation is another. In comparison, Rompay's (2005) study on spatial inferences showed that height promotes dominance, closure suggests security, and imbalance communicates restlessness or instability. In regards to this study, images in the fear category were rather contained and disgust images were imbalanced proportionately, which provides some support for the findings in the literature. However, imbalance was not always indicative of a negative context as surprise, anticipation, and joy each revealed some degree of imbalance in their spout and handle relationships. This unique event needs to be investigated further as it implies the context of the aesthetic quality may alter the perception of the object.

A significant conclusion is that the novel method of magnetic modeling allows for previous research to be repeated and analyzed through a 3D method. Versus only relying on subjective scaling, as seen in existing research, the participants may select and combine pieces that have controlled aesthetic qualities. This makes the use of scaling supplementary as the participant's selection is representative of their "scaled" perception. As this method was used in conjunction with an unstructured interview, insights into the participant's character and perceptual bias provided additional context into their creations. This level of depth is unseen in purely statistical methods and offers perspective into the user's latent qualities.

5.7. Implications for the Design Field.

This research is on the forefront of product experience and provides substantial evidence for aesthetic traits of a household product that are associated with emotional attributes. As such, it may provide inspiration for similarly derived metaphors or product expression in practice. As the emotion that is designed is not always the emotion that is perceived, some validation is necessary in order to portray the desired aesthetic qualities and experience. The application of a co-creative method like magnetic modeling results in an understanding of the subject's perspective of different aesthetic features in a product. This assists designers in making products

that fit the marketable aesthetic that coordinates with the desired emotional qualities. While considering these interrelationships, product expression is integrated at a basic emotional level.

During this research, the combined use of the card sorting task and the magnetic modeling interviews produced a mix media approach which can be applied in design practice. The card-sorting task and network is suggested for use during existing product exploration. The multiple images generate blanket trends within a specific product scope. In comparison, magnetic modeling is applicable for testing conceptual design languages prior to functional proto-typing. Paired with interviewing, this co-creative method offers an interpersonal connection between the users and the product that is unmet in traditional research tools. The novel method of magnetic modeling allows for a whole new menu of insights, advancing the values of product experience.

Through integrated product experience research, unconscious desires are unleashed and products are infused with latent perceptual qualities. Access to beliefs, feelings, dreams, and wants amplifies product generation, expression, and experience. Emotions are the bedrock of experience, acting as a supportive measure for communication and aesthetic projection in product design. As individuals develop dependent and attached relationships with their products, it is the designer's responsibility to facilitate this bond. Magnetic modeling is a medium that sufficiently tests aesthetic emotional qualities that may initiate the beginning stages of a prolonged relationship. As a result, an engaging product experience can elevate the currently unfulfilled products of today and raise them to the aesthetically and emotionally empathetic designs of tomorrow.

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APPENDIX A

IRB CERTIFICATE

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ASU Knowledge Enterprise Development

Office of Research Integrity and Assurance

To:	John Takamura AED
From:	Mark Roosa, Chair Soc Beh IRB
Date:	07/17/2013
Committee Action:	**Expedited Approval**
Approval Date:	07/17/2013
Review Type:	Expedited F7
IRB Protocol #:	1306009344
Study Title:	Feeling the Pull: using magnetic modeling to understand emotion in form
Expiration Date:	07/16/2014

The above-referenced protocol was approved following expedited review by the Institutional Review Board.

It is the Principal Investigator's responsibility to obtain review and continued approval before the expiration date. You may not continue any research activity beyond the expiration date without approval by the Institutional Review Board.

Adverse Reactions: If any untoward incidents or severe reactions should develop as a result of this study, you are required to notify the Soc Beh IRB immediately. If necessary a member of the IRB will be assigned to look into the matter. If the problem is serious, approval may be withdrawn pending IRB review.

Amendments: If you wish to change any aspect of this study, such as the procedures, the consent forms, or the investigators, please communicate your requested changes to the Soc Beh IRB. The new procedure is not to be initiated until the IRB approval has been given.

Please retain a copy of this letter with your approved protocol.

APPENDIX B

DIGITAL CARD-SORTING CONSENT SCRIPT AND INSTRUCTIONS

Welcome

Welcome to the study Feeling the Pull: using magnetic modeling to understand emotion in form and thank you for agreeing to participate! The activity shouldn't take longer than 15 to 20 minutes to complete. My name is Candace Horner and I am a graduate student under the direction of Professor John Takamura in the College of Design at Arizona State University. I am conducting a research study that will assess the emotional values of 3D forms through the use of a digital card sorting task; a methodological tool that allows participants to separate images into proposed emotional categories. In marketing and design research, fully understanding consumer perception aids in developing an immersive product experience which in turn can engender a lasting product relationship and lifespan through emotional attachment. Your participation in this study is voluntary. You may choose not to participate at any time before or during the research. If you choose not to participate or to withdraw from the study at any time, there will be no penalty. Approximately 100 subjects will be participating in this study. You must be 18 years old or older to participate in the study. All information obtained in this study is strictly confidential. Any identifying information about you will be withheld from all publications and presentations. The results of this research study may be used in reports, presentations, and publications, but the researchers will not identify you. In order to maintain confidentiality of your records, Candace Horner will keep all digital files on a secure remote hard drive for three years, after which they will be destroyed. If you have any questions about your rights as a subject/participant in this research or if you feel you have been at risk, you can contact the Chair of the Human Subjects Institutional Review Board, through the ASU Office of Research Integrity and Assurance, at 480-965 6788. ***Your continued participation in the study indicates your consent to participate***

Digital Card-sorting Task Instructions:

This study is intended to further our understanding of the emotional attributes of 3D forms.

Please attempt to focus primarily on the effect the form has on you emotionally rather than graphic images or minute details that may be apparent.

Nevertheless, there are no wrong answers and your initial reaction is usually the most accurate and innate.

Take a look at the list of images on the left.

We'd like you to sort those items into the groups provided on the right.

Using your mouse, drag and drop the image directly over the emotional label of your choice.

When you are done, click finished and your participation in the study will be complete.

APPENDIX C

CARD-SORTING DEMOGRAPHICS

Choice	Percentage	Count
M	39.5%	34
F	60.5%	52
I	0%	0
Unanswered	0%	0

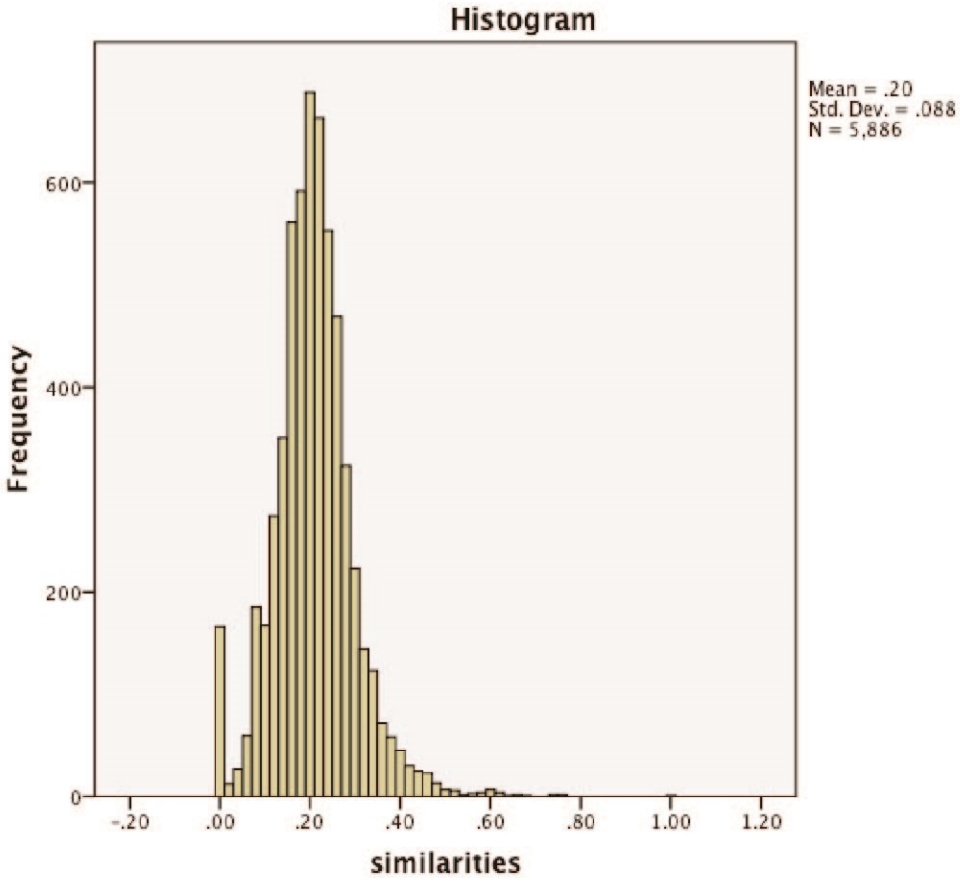
Choice	Percentage	Count
Did not graduate high-school	1.2%	1
High-school or GED graduate	7.1%	6
Some College or Associates/Technical Degree	40.0%	34
Bachelor's or Undergraduate Degree	41.2%	35
Master's Degree level Program	9.4%	8
Doctorate Degree level program	1.2%	1
Unanswered	0%	0

Choice	Percentage	Count
White/Caucasian	71.8%	61
Black/African American	2.4%	2
American Indian or Alaskan Native	2.4%	2
Asian Indian	0%	0
Chinese	3.5%	3
Filipino	0%	0
Japanese	0%	0
Korean	7.1%	6
Vietnamese	2.4%	2
Native Hawaiian	0%	0
Guamanian or Chamorro	1.2%	1
Samoan	0%	0
Other	15.3%	13
Unanswered	0%	0

Choice	Percentage	Count
Less than $10,000	16.3%	14
$10,000 to $14,999	11.6%	10
$15,000 to $19,999	3.5%	3
$20,000 to $24,999	5.8%	5
$25,000 to $29,999	3.5%	3
$30,000 to $34,999	4.7%	4
$35,000 to $39,999	3.5%	3
$40,000 to $44,999	9.3%	8
$50,000 to $59,999	5.8%	5
$60,000 to $74,999	12.8%	11
$75,000 to $99,999	4.7%	4
$100,000 to $124,999	5.8%	5
$125,000 to $149,999	2.3%	2
$150,000 to $199,999	1.2%	1
$200,000 or more	2.3%	2
Unanswered	7.0%	6

APPENDIX D

NETWORK HISTOGRAM


Histogram
Mean = .20
Std. Dev. = .088
N = 5,886
Frequency
600
400
200
0
-.20
.00
.20
.40
.60
.80
1.00
1.20
similarities

APPENDIX E

POPULAR PLACEMENTS DATA

The popular placements matrix attempts to propose the most popular groups based on each individual card's highest placement score. Each table cell shows the percentage of your partcipants who sorted that card into the corresponding category.

	Anger	Anticipation	Disgust	Fear	Joy	Sadness	Surprise	Trust	unsorted
5BH18BCHQ	29%	18%		29%		6%	12%	6%	
15CN19DHVQV	38%	15%		15%	8%		15%		8%
3CY18DGTN	20%	10%	20%	5%	15%	10%	10%	10%	
3CU17CMQ	29%	14%		29%				21%	7%
4BH18CKXQV	44%		11%	22%		11%	11%		
2S18DIN	18%	12%	12%	6%	6%	18%	18%	12%	
5CU20DGVO	19%	19%	12%	6%	6%	6%	12%	12%	6%
2CN17DMVP	27%	9%	18%	18%		18%	9%		
6BH17DMN	20%	10%		10%	20%	20%		20%	
3BH18CHN	9%	48%	4%	9%	4%		13%	13%	
1CY19FMN		44%	6%	6%	12%	12%	6%	6%	6%
1BH19DJN	7%	40%			20%		27%	7%	
9S17CTIP	7%	33%		13%	13%		7%	27%	
2CY20DKR		45%	9%			18%	9%	18%	
1PE18CMP	4%	21%		12%	21%	8%	12%	21%	
6BH19BGP	21%	26%	11%	5%		11%	11%	16%	
12BH19CGP	11%	26%	11%			26%	11%	11%	5%
10CY18UGXN	17%	22%	17%	6%		22%	11%		6%
9CY19DMN		29%	7%	7%	21%	14%	7%	14%	
9PE17CMP	17%	33%		8%				33%	8%
3PE19EMQV	6%	25%		19%	12%	19%	12%	6%	
9PE19DMVP		18%	18%	5%	18%	14%	18%	5%	5%
9BH18CHPT		36%	9%	9%	9%	18%	9%	9%	
14CN19AHVN	16%	21%	11%	16%	5%	11%	16%	5%	
1CU20DGO	11%	16%		11%	16%	16%	16%	16%	
1CN19BGQV	8%	23%		15%	23%	23%	8%		
3CN19DHVN	8%	25%	25%		25%		8%		8%
6CU17FGO	9%	9%	39%	13%	4%	9%	9%	9%	
3CU19BGO	9%		73%	9%			9%		
3S19CMP	10%		33%	14%	19%	5%	5%	14%	
5CY19CMVN	16%	16%	26%		16%	11%	5%	11%	
4CN19DHVN	14%		24%	10%	24%	5%	24%		
6CU20BHO	12%	6%	25%	12%	6%	6%	25%	6%	
4BH19BVP	11%	11%	21%	16%	11%	16%	11%		5%
7CY18BGN	6%	6%	19%	6%	19%	12%	12%	12%	6%
4CU20BMVN	14%	7%	21%	7%		21%	21%	7%	
7PE19BMP	10%		10%	30%	5%	5%	15%	25%	
6CN18DIN	14%	9%	23%	27%	5%	5%	18%		
5CN19DJQV	7%	33%	7%	40%	7%			7%	
3S20CZIN	18%	12%	6%	29%	6%	12%	12%	6%	
3BH17CMN	19%	12%	12%	31%	6%	6%	12%		
5CY17DMN	6%	6%	6%	25%		25%	19%	12%	
5PE18EMP	6%	11%	11%	22%	22%	6%	6%	17%	
1CN18AIVN	6%	6%	6%	24%	12%	24%	12%	12%	
3CU20GJO	7%	7%	13%	20%	13%	20%	20%		
7BH18AMN	14%	14%	14%	21%	14%		21%		
2PE20FLP		5%	9%		55%	5%	9%	18%	
2S20GTDP		21%	4%	8%	42%	4%	12%	8%	
3BH20DJN	4%	24%		8%	36%	4%	12%	12%	
3S18CMP	4%	16%		4%	32%	12%	12%	16%	4%
2PE19CMN	7%	7%		7%	53%		13%	13%	
8BH19CJN		13%			53%	7%	13%	13%	
1S20DLS		5%	10%		35%	20%	5%	25%	
6PE19CMP		6%		6%	39%	6%	17%	22%	6%
5BH19BMVN	5%	20%	5%	5%	35%	5%	5%	20%	
2CN20BJQV	12%	8%	8%	12%	29%	8%	17%		4%
1S17CJQV		6%	11%	11%	33%	6%	11%	22%	
4CY19EMP		6%		6%	35%	18%	12%	24%	
1PE20CMVN	5%			10%	30%	20%		30%	5%
2CN18EMP	9%				55%		18%	18%	

8S17CKP	8%	8%	8%		38%	15%	15%	8%	
7CU18FKXO	5%	16%	11%	21%	26%	5%	11%		5%
6PE18CHP	9%	18%	18%	18%	23%		14%		
2BH17AMP	9%			18%	45%	18%	9%		
6S19DKXP	12%	12%	12%	6%	24%	12%	12%	12%	
1CU18DGO	18%	18%	6%	6%	24%		24%	6%	
1PE17CMP				17%	33%		17%	33%	
6CN19DJQV		8%	15%		31%	15%	15%	15%	
8S19CMN		17%		17%	25%	17%	8%	17%	
3PE17CJP			9%	9%	27%	9%	18%	27%	
2CY19DMU	6%	17%	17%	6%		50%		6%	
2CU17AJN		21%	5%	16%	5%	42%	5%	5%	
5BH17FMVP	4%	4%	13%	13%	9%	30%		26%	
1CY17FMVN		6%	12%	19%		38%		19%	6%
3PE18CMVN	5%	26%	16%	5%		32%	5%	11%	
4S18CMVP	25%		17%	8%		33%	8%	8%	
5S19BTHXU		13%	13%	20%		27%	20%	7%	
1CY20BHN	17%	6%	11%		17%	22%	6%	22%	
7CY20BGN	7%	13%			20%	27%	7%	27%	
13CN19BLN	4%	13%	13%	4%		4%	48%	13%	
4CU19DGQ	12%	20%	12%	12%	8%		36%		
7S19CMZN		31%		6%	12%		38%	12%	
2S19AJXU	10%	15%		10%	20%	15%	25%		5%
8CY18CMP	5%	15%	5%		15%	15%	25%	20%	
5CU19DOG			8%	15%	31%	8%	38%		
7CU19BGN	7%	21%	7%	7%		14%	36%	7%	
9CN19DHVQV	12%	19%	12%	19%		6%	31%		
1CU17CGVR		7%	20%	7%	20%	7%	27%	13%	
8PE19CMVP	7%	7%	14%	14%	14%	14%	21%	7%	
8CY19EHN	8%		8%		12%	29%		42%	
1BH20BKXS		19%	5%		10%	10%	10%	43%	5%
13BH19CMN	6%	6%	12%		29%			47%	
6S17EMN	5%	5%	11%		21%	16%	5%	37%	
4CN20DHP	14%	18%		5%	9%	14%	9%	32%	
5CY20DKR		14%	24%		14%		19%	29%	
1CN17EMVP	11%	26%	11%	5%	5%	5%	5%	32%	
2CU20CGO	12%	6%	12%	12%	6%	12%	6%	31%	
4CU18CKTO		7%	7%	14%	14%	7%	21%	29%	
4PE17DMP		22%			11%	11%	11%	44%	
5PE19CMVP		12%	19%		12%	19%	6%	25%	6%
2CN19BJP	13%	7%		13%	20%	7%	13%	27%	

APPENDIX F

MAGNETIC MODELING RESEARCH MATERIAL

Feeling the Pull: using magnetic modeling to understand emotion in form.

Date

Dear _____:

I am a graduate student under the direction of Professor John Takamura in the College of Design at Arizona State University. I am conducting a research study that will assess the emotional values of 3D forms through the use of magnetic modeling; a methodological tool that allows participants to manipulate pieces of 3D forms into proposed emotional labels. Existing research supports the use of innovative methods in current design industries to quickly interpret the psychological perspectives of potential consumers. In marketing and design research, fully understanding consumer perception aids in developing an immersive product experience which in turn can engender a lasting product relationship and lifespan through emotional attachment. This study will evaluate how people will interpret the emotionality of form in order to establish a veritable method for interpreting emotional variables throughout the design development process.

I am inviting you to participate in an experiment where you will build your emotional perception of 3D forms. You will be instructed to manipulate 3D printed pieces of a teapot to represent different emotions. During this task, you will be asked to "think aloud" about your thoughts, comments, and approach to manipulating the pieces. After this task, you will be asked to participate in an informal interview which will be video recorded for later transcription purposes and visual analysis.

You have the right not to answer any question, and to stop the interview at any time.
You may choose not to participate at any time before or during the research and may choose not to answer any question during the interview. You may also choose at any time to decline being video-recorded. If you say YES, then your participation will last for approximately one hour. Approximately 25 subjects will be participating in this study from the Phoenix metropolitan area.

Your participation in this study is voluntary. If you choose not to participate or to withdraw from the study at any time, there will be no penalty. You must be 18 or older to participate in the study.

This study will be used to help researchers understand the beginning levels of emotional perception of products which may lead to long-lasting attachment. Although there may be no direct benefits to you, the possible benefit of your participation in this research is a new method for understanding emotion and improving product attachment. There are no foreseeable risks or discomforts to your participation.

All information obtained in this study is strictly confidential. Your name will be removed from all publications and documents except for signed consent documents and interview notes that will be kept by the researcher. I would like to videotape this interview. The interview will not be video-recorded without your permission. Please let me know if you do <u>not</u> want the interview to be videotaped; you also can change your mind after the interview starts, just let me know. The results of this research study may be used in reports, presentations, and publications, but the researchers will not identify you. In order to maintain confidentiality of your records, Candace Horner will keep all digital files on a secure remote hard drive for three years, after which they will be destroyed.

If you have any questions about your rights as a subject/participant in this research or if you feel you have been at risk, you can contact the Chair of the Human Subjects Institutional Review Board, through the ASU Office of Research Integrity and Assurance, at 480-965 6788.

Your signature below indicates that you consent to participate in the above study. By signing below, you are granting to the researchers the right to use your likeness, image, appearance and

performance - whether audio or video recorded on or transferred to videotape, film, slides, and photographs- for research purposes. You will not be personally identified or identifiable from the video or audio tapes and your likeness as well as identifying information about you will be withheld from all publications and presentations unless prior approval is acquired and approved by you the participant.

_____	_____	_____
Subject's Signature	Printed Name	Date
_____	_____	_____
Legal Authorized Representative (if applicable)	Printed Name	Date

INVESTIGATOR'S STATEMENT

"I certify that I have explained to the above individual the nature and purpose, the potential benefits and possible risks associated with participation in this research study, have answered any questions that have been raised, and have witnessed the above signature. These elements of Informed Consent conform to the Assurance given by Arizona State University to the Office for Human Research Protections to protect the rights of human subjects. I have provided (offered) the subject/participant a copy of this signed consent document."

Signature of Investigator_____ Date_____

Magnetic Modelinng Instructions

You will be constructing four different teapots using the pieces in front of you. The task requires that you select 4 cards randomly from the face down set of cards. Each card contains an emotion that you will be modeling using the pieces. The teapots will each be photographed once you feel the teapot is complete. After each teapot is constructed, we will discuss your rational for your chosen pieces. You may also "think aloud" while placing your pieces, but are not required to do so.

Each teapot must contain at least and only one piece from each of the following categories: base, handle, spout, lid. Feel free to position them in any way you see fit and if the pieces are unable to stay in your exact preferred position, you may hold the pieces while the picture is taken. You may start with any piece and each base may be flipped to represent your impression of the emotion.

For your convenience, there are also additional pieces provided, affectionately referred to as nubs, that may be used to further represent and assist in your preferred placement of the teapot pieces. This is especially useful with the sphere base. These pieces go between the spouts/handles and the base of the teapot. All the pieces have magnets and can stick to each other during the process. Thus, the research assistant may help you if necessary.

Take note that any of the bases may be flipped to suit your design of the selected emotion. You may pick any piece first or last, there is no required order. If one orientation does not seem to have a strong enough magnetic pull, feel free to try a different side as the internal magnets are arranged for various positions. Feel free to play around with the pieces in order to get comfortable with the process if necessary.

Please be as gentle with pieces as possible as dragging the pieces may leave marks or excessive scratches. Lastly, remember that there are no wrong answers and we encourage a fun atmosphere with this project.

Magnetic Modeling Demographic Questionaire

Principal Investigator: John Takamura

Co-Researcher: Candace Horner

Feeling the Pull: using magnetic modeling to understand emotion in form

Survey Questions:

Background:

Gender M F I

Age 18-30 31-42 42-54 55-68 69-81 82-94

Education:

Did not graduate high-school

High-school or GED graduate

Some College or Associates/Technical Degree

Bachelor's or Undergraduate Degree

Master's Degree level Program

Doctorate Degree level program

Unanswered

What state/region and country did you spend most of your childhood?

Race:

White/Caucasian

Black/African American

American Indian or Alaskan Native

Chinese

Japanese

Korean

Other

Unanswered

What is your job/career field?

Magnetic Modeling Interview Guide:

Please describe the emotional characteristics of each form you designed.
What other words do you think of when viewing each of the teapots you designed?
Describe how you went about modeling the emotion of the pieces.

What piece did you view as the most important to begin the design process?
Did the function of a teapot affect the placement of any of the pieces?

Out of the emotions that you modeled, which one is most like yourself?
What elements from your own experiences, if any, played a part in your modeling process?
At any point did you think of the teapot as animate or human?

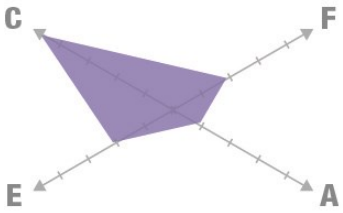
Is this a thought you had during the process or now retrospectively?
If you saw this in a store would it make you (insert emotion)?
Were the choices of the individual pieces more or less important to the overall message of the teapot as a whole?

Did your relationship with the emotion make it more or less easy to model?
Out of the emotions you picked, which emotions were positive or negative in your opinion?
Any personal attributes or general experiences that may have helped you model the pieces?

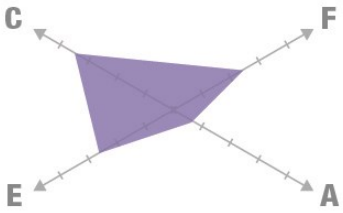
APPENDIX G

PARTICIPANT PERSONA SCALES

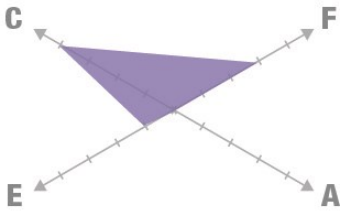
Adam



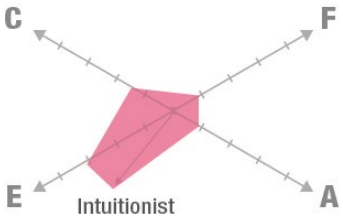
Derek



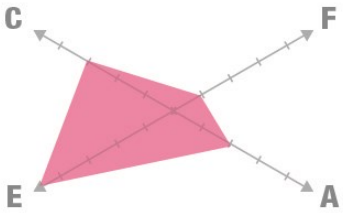
Nathan



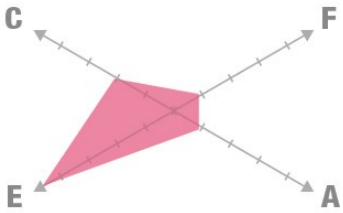
James



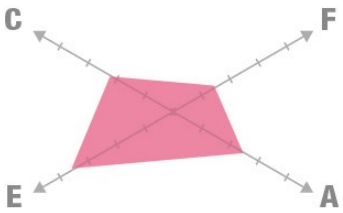
Jessica



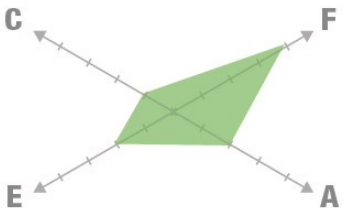
Jewel



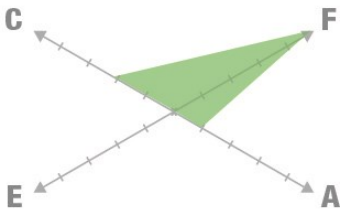
Serena



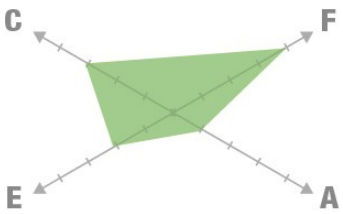
Anna



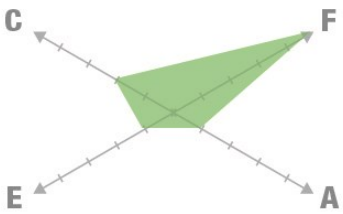
Dale



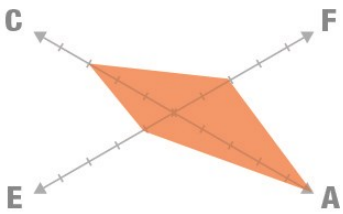
Sebastian



Thomas



Ah Cy



Yanmei