Human emotion response to typographic design

A DISSERTATION
SUBMITTED TO THE FACULTY OF THE GRADUATE SCHOOL
OF THE UNIVERSITY OF MINNESOTA
BY

Beth Elynn Koch

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

Dr. Brad Hokanson
Dr. Sauman Chu

December 2011
Acknowledgements

It seems appropriate that as I write this it is nearly Thanksgiving. With deepest gratitude I would like to acknowledge those who have walked with me and sustained me through the dark times and light of this journey.

*Proverbs 3:6 In all thy ways acknowledge him, and he shall direct thy paths.*

How did I fall onto this path of inquiry? How was it that you blessed and cursed me with insatiable curiosity, fortitude, and tenacity? And how did I ever accomplish this work without you, God? Thank you God, for carrying me from beginning to end.

Writing for me when I could not, serendipitously supplying literature, and people, inspiration, and energy, when I was thoroughly spent. I give you thanks.

Thank you to my advisors, Dr. Brad Hokanson and Dr. Sauman ‘Sue’ Chu.

Thank you to my external committee member, Dr. Patricia Avery, and to the chair of my committee, Dr. Barbara Martinson. By your lives, passion, and creativity, you have inspired me academically, professionally, and personally.

Dr. Brad Hokanson has been my North Star. He has thrown me into the ocean of my own interests and expected me to Tango. When I haven’t danced, he’s known how to motivate. When I’ve come close to drowning in my own questions, he’s known when to make me swim and when to redirected my attention. I hope one day to be half the advisor to my students that he has been to me. Thank you, Brad.

I greatly appreciate the support of Dr. Sauman ‘Sue’ Chu, who propelled my writing and academic criticism to new levels. When I grew tired, your energy and enthusiasm for my research lifted me. Thank you, Sue.

Without the support, spirit, and smile of Charleen Klarquist, I would not have been able to complete my degree—thank you Char, for your brilliance, support and generosity.

As a sometimes reluctant student, I owe thanks to my teachers: to my first typography teacher, Rolf F. Rehe, whose love of typography kept blossoming in me years after university; to Dr. Ron Regal, for patiently tutoring me in statistics; and to Jeff Suaro for pointing me to select the right statistical methods, watching my syntax, and helping me explain it to myself.

I would like to acknowledge my students: Thank you, Ivana Savic, MFA. You encouraged me in ways that no one else could. And to my students Scott Roby, BFA and Monique Rogers, MFA-to-be, who through their own curiosity were inspired to contribute to this dissertation by using my findings to develop information graphics, which I have included in the Appendix. Thank you for your inspiring design.
For these last five years, I have had the unerring support of James L. Youngbauer, without whom my goals could not have been accomplished. My deepest thanks for your support and patience, Jim.

Finally, I want to thank my family.

My parents, Neal and Ruth Ann Koch have been endlessly encouraging and loving, helping me to fight back the demons of discouragement and providing financial aid critical to accomplish my graduate studies. Thank you.

To my sister Jayne: Thank you Jaynie for being my eternal sunshine, and helping me find balance in chaos.

To our beloved sister Laura:
You did not know how curious I was about your one-eyed view of the world. You couldn’t know that your passing would throw fuel on my curiosity about the brain and create an urgency about finishing my study and about my life. I felt your love and presence urging me onward to find out more about this thing called visual literacy. Happy Birthday.

It has been said that we can only live our lives forward, but we understand our lives in retrospect. So, in retrospect, several people actively discouraged me from finishing the Ph.D., and for you I give thanks! for by your action, I redoubled my efforts with greater enthusiasm and tenacity than before.

Surely this is part of the work God intended for my life.

With deep appreciation and gratitude, I thank each and every one of you all.

Beth Elynn Koch
November 6, 2011
Dedication

for Mom and Dad
Abstract

Graphic designers apply the traditional elements of art and principles of design to create visual communications, yet it is not known how people interpret the meaning of visual messages. Forty-two participants answered a questionnaire to discover “Are certain emotions predominantly associated with the formative design features of typefaces—differences in classification (serif or sans serif), terminal construction (angular or rounded), character width (condensed or extended), and weight (light or bold)?” Even though people have individual aesthetic preferences, statistical analysis found that many participants reported comparable emotional responses to typestyle examples. Those feelings, in turn, varied according to the formative design features of the typeface. The design examples consisted of six similar typefaces with visible differences in form. Because people reported the same emotion response to the same design features, this study suggests that design’s underlying features represent a common visual language.
Table of Contents

Acknowledgements ........................................................................................................ i
Dedication ....................................................................................................................... ii
Abstract ......................................................................................................................... iv
Table of Contents ......................................................................................................... v
List of Tables ................................................................................................................... vi
List of Figures ................................................................................................................ vii

CHAPTER 1: Introduction ................................................................................................. 1
CHAPTER 2: Literature Review ....................................................................................... 15
CHAPTER 3: Methods ...................................................................................................... 68
CHAPTER 4: Findings ...................................................................................................... 90
CHAPTER 5: Discussion .................................................................................................. 114
CHAPTER 6: Implications ............................................................................................... 126
References ...................................................................................................................... 130

APPENDIX A: Descriptive statistics ............................................................................ 147
APPENDIX B: IRB Clearance ......................................................................................... 156
APPENDIX C: Email invitations to participants ............................................................. 167
APPENDIX D: Questionnaire ......................................................................................... 168
APPENDIX E: Statistical Information Graphics ............................................................. 181
List of Tables

Table 1. Areas of the brain involved in visual processing.

From Schmolesky (2000) and Wikipedia (2009)...........................................21

Table 2. Research questions and objectives.........................................................69

Table 3. Typographic design attributes of typeface stimuli.................................84

Table 4. Research questions, objectives, and results...........................................112

Table 5. Summary of significant findings.............................................................113
List of Figures

Figure 1. Sagittal section of the adult human eye (image from Schmolesky, 2000. Downloaded 12-31-08 at http://www.webvision.med.utah.edu/VisualCortex.html) ......................................................... 18

Figure 2. Visual input to the brain goes from eye to LGN and then to primary visual cortex, or area V1, which is located in the posterior of the occipital lobe. Adapted from Polyak (1957). ..........20

Figure 3. The Dover Bible. By Unknown Miniaturist, English (active c. 1150 in Canterbury) (Web Gallery of Art (#15730):) [Public domain], via Wikimedia Commons Creative Commons, Wikimedia Foundation, Inc. .................................................................51

Figure 4. Gutenberg Bible. Creative Commons, Wikimedia Foundation, Inc. .................................52

Figure 5. Jikji. Oldest known book printed with moveable type. Creative Commons, Wikimedia Foundation, Inc. ...........................................................................................................53

Figure 6. Moveable type case from Jikji. Creative Commons, Wikimedia Foundation, Inc. ..........53

Figure 7. Major historical classifications of type. Thinking with type by Ellen Lupton. Copyright © 2004, 2010, Princeton Architectural Press. Reprinted with permission. ..............................56

Figure 8. Multiple Master matrix. Copyright ©2010 Enfocus NV. Reprinted with permission......57

Figure 9. Terminal (here, called ‘serif’) construction. Copyright © 2005, John Wiley & Sons. Reprinted with permission.................................................................59

Figure 10. “Notes on Type” interactive typography learning game, weight module. As a user presses the small diamonds, the music becomes progressively louder, the letterform appears progressively bolder, and the background becomes progressively brighter and darker. Copyright © 2006, Beth E. Koch........60

Figure 11. “Notes on Type” interactive typography learning game, x-height module. As a user uses the slider to increase the volume by increasing the x-heights. The height of capital letters remains the same. Each typeface shows increasingly taller x-height, and the background becomes increasingly brighter and darker. Copyright © 2006, Beth E. Koch........60

Figure 12. Typeface name: Glypha Bold.................................................................................76

Figure 13. Typeface name: Helvetica Bold ..............................................................................76

Figure 14. Typeface name: Helvetica Condensed Bold .............................................................77

Figure 15. Typeface name: Helvetica Heavy Extended .............................................................77

Figure 16. Typeface name: Helvetica Ultra Light .......................................................................77

Figure 17. Typeface name: Helvetica Rounded Bold .................................................................78

Figure 18. PrEmo™ interactive animated characters
Figure 19. Paired comparison chart for positive emotions responses for weight.

Figure 20. Paired comparison chart for negative emotions responses for weight.

Figure 21. Paired comparison chart for positive emotions responses for classification.

Figure 22. Paired comparison chart for negative emotions responses for classification.

Figure 23. Paired comparison chart for positive emotions responses for terminal shape.

Figure 24. Paired comparison chart for negative emotions responses for terminal shape.

Figure 25. Paired comparison chart for positive emotions responses for character width.

Figure 26. Paired comparison chart for negative emotions responses for character width.

Figure 27. Glypha Medium—Count of responses by arousal selection.

Figure 28. Helvetica Bold—Count of responses by arousal selection.

Figure 29. Helvetica Ultra Light—Count of responses by arousal selection.

Figure 30. Helvetica Bold Condensed—Count of responses by arousal selection.

Figure 31. Helvetica Extended Bold—Count of responses by arousal selection.

Figure 32. Helvetica Rounded—Count of responses by arousal selection.
INTRODUCTION

“Why, in the visual arts, all of them, have we fallen heir to an unspoken devotion to nonintellectualism? ... Why, when we want it and need it so much, does visual literacy elude us? ... We must search for visual literacy in many places and many ways, in methods for training artists, in the technical training of craftsmen and artisans, in psychological theory, in nature, and in the physiological workings of the human organism itself” (Dondis, 1973).

While much effort has been aimed at understanding language and the psychological underpinnings of written and verbal communication, research to characterize important laws of visual language has received little attention (Changizi, 2009). Not much is empirically known about how people comprehend visual systems such as graphic design and typography.

The field of graphic design has much to offer people in terms of organizing, shaping, and prioritizing information. By understanding how to command visual language, graphic designers can effectively influence human behavior.

Typography is a key subject in the study of graphic design. Typographic design is used and understood as a method to impart emphasis, hierarchy, and give meaning to communications, however, there are no research-based rules to guide designing or interpreting typographic meaning.
One of the most difficult tasks for beginning students in typography is to understand how to interpret the meaning of typefaces. Many first year typography students view typographic semantics as complex and ambiguous—not unlike a foreign language that they will struggle to master.

People seem to intuitively decipher the meaning of typefaces (Van Leeuwen, 2005), even though research about the meaning of visual marks has been inconsistent. The aim of this study was to understand the underpinnings of visual language. This study was an inquiry into how people perceive different typestyles.

Graphic designers use typography (1) to communicate, support, or reinforce the primary message in a work of design through the connotative meaning of typefaces, (2) to introduce new or differing connotations to the message, (3) to provide neutral or minimal meaning in addition to the message (Harrison & Morris, 1967, in Morrison, 1986), (4) to contradict the message portrayed by the imagery (Morrison, 1986), (5) to produce the entirety of emotional tone in the message; (6) to function as an illustration that contains the message; (7) to imbue the message with additional layers of meaning through typographic animation or interactivity; or (8) to express values and attitudes (Spitzmuller, 2007).

That technology has flourished and proliferated in American society is an indisputable fact.

During the 1980s, personal computing technology displaced all but a few professional typesetters, resulting in the closing of many businesses dedicated to the practice. Graphic designers were faced with the daunting task of learning to set type
themselves with new software, and former typesetters were challenged to learn computerized printing production methods in order to find new employment within the field.

A similar shift is happening today: The democratization of the practices of graphic design and typography.

Professional software for design and tools for styling type are widely available. Everyone, with or without education, artistic talent, or professional expertise, can participate in making creative choices about the design of their communications. Aesthetic taste is individual—just as Subburamu, Lee, & Pelli (2010) found that people show aesthetic preferences among typefaces—yet there is evidence for the existence of some universal aesthetics (Ramachandran & Rogers–Ramachandran, 2006) and emotions (Clore, Ortony & Collins, 1998; Redies, 2007). While this democracy of design is a needed advance, it has created problems as well.

Non-professional designers and amateur typographers have eagerly engaged in the democratization of design. Typical free font web sites, for example DaFont.com, are showcases for amateur-created free downloadable typefaces, many of which do not meet accepted quality standards of typeface design. For example, amateur type designs may have unbalanced letter spacing, variable word spacing, a limited range of sizes, variable stroke weights, or limited design sophistication. Many users of free font web sites like DaFont.com cannot decipher whether a font is well designed, and even more problematic is the fact that amateur designs often depict cliché concepts or caricatures and lack emotional depth.
People need some degree of design understanding, not only to decipher incoming messages but to reciprocate with visually appropriate responses. Technology advances have changed communication and commerce.

Medicine too has taken wide leaps forward as a result of technology, producing important research to advance the practice of design, typography, and our understanding of visual language.

Psychologists and vision researchers have developed advanced medical imaging methods including, among others, functional Magnetic Resonance Imaging (fMRI), a method of medical imaging that records blood flow in the body. Medical imaging techniques have led to a new understanding of the routes of vision processing in the brain.

Findings from vision research revealed that emotion initiates the processing of vision (Barry, 2006). Working together, the eyes and emotion quickly evaluate the environment for danger.

In 1974, Rudolph Arnheim, a German-born author, art and film theorist, and perceptual psychologist, had already theorized that “Every aspect of a visual experience has its physiological counterpart in the nervous system” (p. 17). Since the most recent vision research suggests that design affects humans emotionally, it would be valuable to understand how the process works—not only to make design more appealing, but to discover the means of its influence on behavior.

Designers have long understood that their work influenced people’s choices and actions, but even today most designers cannot explain how or why. Graphic designers use
the traditional elements of art, principles of design, and employ a largely intuitive process (Thangaraj, 2004) when they create visual communications for clients. For artists or designers to verbalize what they do or describe how they do it is difficult at best. Many designers describe their practice using the word ‘intuition’ or they may report that they ‘follow their gut instincts’. They describe an internal process. When designers refer to ‘intuition’ to describe what they do, what they may really be trying to explain is their ability to create and manipulate the human ‘visual language’. Visual language exists alongside verbal language: it has its own meaning and cannot easily be verbalized.

The research findings that explain how the brain processes the visual world have the potential to explain why designers can’t seem to identify the methods of their own practice: Designing is visceral visual language, difficult to express in words, and driven by emotion, yet people decipher art and design emotionally. At its core, the basic knowledge domain of design may be the ‘command of visual literacy’.

Psychology research in vision and emotion has presented a whole new range of problems and opportunities for designers and researchers. Emotion negotiates vision. When people see, they experience emotion about the stimulus before they become consciously aware of the stimulus itself. Emotion operates unconsciously to preemptively assess a visual situation. After a full half-second of evaluation, emotion re-directs the visual signal, sending it on to other parts of the brain for autonomic response and conscious processing (Vuilleumier & Driver, 2007).
Karjaluoto (2008) and others maintain that a designer makes empathic connections between people and products; “Most practitioners of design remain unaware that what they are really selling to clients is indeed emotion” (Karjaluoto, 2008).

Research shows that “affective significance can influence conscious appraisals, all without the direct involvement of conscious perceptions” (Bernat, Bunce & Shevrin, 2001, p. 31). Gazzaniga (1998) reports that one of the primary uses of human cognition is to rationalize what has already been emotionally decided.

Researchers understand that emotion can help people quickly judge the importance of a message and ignore the irrelevant. If graphic designers understood how people would react to their designs, they could improve the efficiency, efficacy, and memorability of their work. Understanding psychological concepts such as the connection between emotion and decision-making might well enable designers to assure clients of the impact of their work; yet taken together, these conclusions also indicate that designers have a new and important ethical challenge: to communicate and motivate without manipulating audiences and consumers through unconscious means.

In light of the findings from this study, designer-client relationships should change. In the past, designers stood between the client’s needs for profits and the audience’s usability needs, yet if there were conflicts, clients wielded the greatest influence on the designer’s decisions. With the revelation that design can exert an unconscious influence on audiences via the neural channels of vision and emotion, designers must become greater advocates for their audiences to ensure that consumers are protected from potential manipulation.
The method of emotion’s influence on vision needs careful investigation since the means of its influence is primarily unconscious.

There are two primary problems in locating previous studies about this subject. First, most design research is inconclusive due to the many design variables confounding studies (Stemler, 1997). Often design variables cannot be isolated sufficiently to make generalizations. But due to specific construction features for letterforms, typography could be used effectively as a design stimulus with succinct variables.

Second, most graphic design researchers have focused on evaluations of the designed object rather than studying the impact of design on people.

This study takes its first assumption from neurological medical imaging studies. It assumes, as research in vision studies in psychology have shown, that human visual responses are intertwined with emotion responses.

Third, the stimuli for this study were selected and categorized by the researcher, rather than a panel of experts, which may have an effect on the outcome; however, the researcher is an expert graphic designer with over 30 years practicing as a typesetter experienced with an extensive range of typographic production media including metal typesetting, photo typositors, photo-based typesetting machines, and PC computerized typesetting methods plus 10 years concurrently teaching typography in higher education. Therefore, the researcher performed the selections and pairings of the stimuli. The typestyles were evaluated according to construction features: typefaces were analyzed according to design features (see Table 3), and typeface pairs were selected so that each pair had all the same construction features, save one difference between them. The
pairings were produced in this way in order to maximize the validity and reliability of the results.

In order to begin to understand whether the underpinning of visual language is based in human emotion responses, this study investigated subject’s responses to different typestyle designs. Then the study compared responses to pairs of typestyle designs in order to begin to map the connection between design and emotion.

Three research questions were formed: Q1: Does viewing specific typefaces produce emotional responses? Q2: When viewing typestyle designs, do all people feel the same emotions? Q3: Are certain emotions predominantly associated with the formative design features of typefaces—differences in classification (serif or sans serif), terminal construction (angular or rounded), character width (condensed or extended), and weight (light or bold)?

**Significance of the study**

One of the objectives of this study is to identify which visual references designers might consistently utilize to influence behavioral responses. With this knowledge designers can purposefully aim to moderate response and behavior, increase effectiveness of learning designs, improve the effectiveness and results of advertising, or boost the aesthetic richness of a brand for example.

Graphic designers need to know how visual design affects people through emotion. By appealing to the emotions through design, designers can improve the communication effectiveness for their clients and their products and services. So it is imperative for designers to learn about emotion.
This study examines four basic typographic design elements and so has implications for a range of visual design disciplines, from print to products and experiences to information and safety.

This study seeks to establish the relation between the visual elements of design and the human response of emotion. It is important to note that several questions will be left unanswered: Are these results affected by gender or design experience? This study collected information about gender, eyesight, and design experience. In order to limit the size of this study and focus on key questions, data collected about gender and design experience will be left for further studies. Another good question for future research is whether there are fashion or time effects. Are these results affected by changing aesthetic trends? Are these results universal?; it would be interesting to do a cross-cultural comprehension study in the future. And last a question concerning design education: What is the moral and ethical responsibility of this research?

This study, like studies that have explored subliminal advertising, may be controversial. Still, whether or not controversies result from this and similar studies, the primary purpose of design, whether overtly or covertly, has always been to influence behavior.

Findings from this study could result in the production of a new human-ecological framework for design problem solving and design experience making that includes emotion as a key consideration. Using focused design components such as typographic features may lead to a better understanding of the general relationship between emotion and graphic design.
Studies that help researchers explain how design influences behavior may lead us to understand how people ‘read’ and interpret all visual language.

Definitions

The following definitions are used to understand context and undertake this study. (Note: medical terminology is defined within the text.)

*Aesthetics (Esthetics)*—The classical definition is attributed to the Greeks, who referred to sensory–perceptual knowledge as ‘aisthēsis’ and its opposite ‘noêsis’ was referred to as intellectual–linguistic knowledge (Whitfield, 2005). Beauty might be the most common corollary.

*Affect*—“A pattern of observable behaviors that is the expression of a subjectively experienced feeling state. Common examples of affect are sadness, elation, and anger. In contrast to mood which refers to a more pervasive and sustained emotional ‘climate’, affect refers to more fluctuating changes in emotional ‘weather’” (Diagnostic and Statistical Manual of Mental Disorders DSM-IV)

*Arousal*—Refers to the strength of a response. Becoming aware of something, someone, or some idea, such that physiological measures rise in response to its perception.

*Congeniality*—is those properties of a typeface that arouse feelings with the individual (Ovink, 1938 in Morrison, 1986).

*Conscious*—The brain and body exhibit a full awareness and interaction in the environment and the person can report the experience in response.
Connotation—“correspondence between content and visual form” (Zachrisson, 1965, pg. 76, in Morrison, 1986).

Design—1. A system of representation consisting of symbol–like elements and principled methods for their application. 2. The practice of communicating, planning, arranging, and applying concepts to solve a problem or shape an experience. 3. The field of design.

Emotion—Emotion is an appraisal process. “Emotion is defined as an episode of interrelated, synchronized changes in the states of all or most of the five organismic subsystems [central nervous system, neuro-endocrine system, autonomic nervous system, somatic nervous system that process information, support and regulate, perform executive functions, produce behavioral action, and monitor the organism] in response to the evaluation of an external or internal stimulus event [cognitive appraisal, neurophysiological symptoms, motivational action tendencies, motor expression, subjective feeling experience] as relevant to major concerns of the organism [evaluation of objects and events, system regulation, preparation and direction of action, communication of reaction and behavioral intention, monitoring of internal state, and organism-environment interaction]. … [emotion is] a process of coordinated changes over time” (Scherer, 1987, 2001, p. 697).

Perception—Awareness, whether conscious or preconscious.

Physiological measures—Heart rate, pulse, respiration, and sweat arousal responses that can be physically measured. “The autonomic nervous system (ANS) (or
visceral nervous system) is the part of the peripheral nervous system that acts as a control system, maintaining homeostasis in the body. These activities are generally performed without conscious control.[1] The ANS affects heart rate, digestion, respiration rate, salivation, perspiration, diameter of the pupils, micturition (urination), and sexual arousal. Whereas most of its actions are involuntary, some, such as breathing, work in tandem with the conscious mind” (downloaded from http://en.wikipedia.org/wiki/Autonomic_nervous_system on April 12, 2009).

**Preconscious**—certain biophysical and neurological systems are activated without a person’s awareness. These systems include breathing, heartbeat and circulation, and the sensory systems. The sensory systems direct sensory inputs through the brain from the unconscious receptors to conscious awareness.

**Representation**—The act of using marks to convey an idea. Representation is best understood as recreating what is seen in the three–dimensional world on a two–dimensional or four–dimensional media (such as paper or a website) although representation need not be realistic or pictorial. Representation is both the design that is created and the process of creating it.

**Typography**—“endowing language with a visible form” and “an independent existence” (Brighurst, 2005 in Spitzmuller, 2007).

**Unconscious**—A physical state where there is a total lack of awareness. Sensory systems do not respond to stimulus, however the sympathetic nervous system continues to keep the person alive. The body is prone and resembles a sleeping state though the
person cannot be aroused. The sleeping state is not a form of unconsciousness, but it is considered a conscious state since the brain is still communicating via the senses.

*Valence*—“pop-out.” In a group of objects or in a scene, one thing grabs attention or stands out more than others.

**Summary**

Typography and the meaning of typeface connotations is an area of interest to many disciplines and an escalating number of computer users. While there have been a number of studies trying to understand how typography communicates meaning, few studies were contributed by the primary disciplines of type design and graphic design. This may be the first study produced in the field of graphic design. Its methods and approach differ significantly from other research efforts.

Forty-two participants were surveyed, using an interactive online questionnaire to determine Q1: Does viewing specific typefaces produce emotional responses? Q2: When viewing typestyle designs, do all people feel the same emotions? Q3: Are certain emotions predominantly associated with the formative design features of typefaces—differences in classification (serif or sans serif), terminal construction (angular or rounded), character width (condensed or extended), and weight (light or bold)? Results showed that all participants reported emotion responses to typefaces, there was substantial general agreement about the emotions felt, and there were significant differences in the emotion responses to the different typeface designs.
Organization of the Dissertation

This dissertation begins with an introductory overview and summary consisting of description of the problem, discussion of the reasons for the study, its theoretical underpinning, methodology, definitions, and assumptions. The research questions on which this study was focused and a brief description of the study conclude the introduction.

Chapter two contains the review of the literature. It provides a brief background about vision, emotion, and the brain. Studies about the meaning of typography follow.

In chapter three, methods of the study are presented.

In chapter four the findings and observations from the study are presented.

The research findings are addressed in the discussion in chapter five.

And chapter six concludes the main body of the dissertation with a discussion of the implications of the study, which is followed by appendices.
CHAPTER 2: LITERATURE REVIEW

Introduction

Graphic design influences society and shapes cultures through visual language. It helps people organize and prioritize information, yet not much is empirically known about how people comprehend visual systems such as graphic design or typography.

Typography is a key component in visual communication and graphic design. It is used and understood as a method to impart emphasis, hierarchy, and give meaning to communications. While much effort has been aimed at understanding the psychology of communication, research to characterize important laws of visual language has received little attention (Changizi, 2009). Graphic designers have no research-based understanding of how typographic meaning is conveyed or interpreted, nor any structural taxonomy of typography that might guide designers in constructing meaningful and effective communications.

Contributing to this problem is a general reluctance of designers to discover whether there is any science to design. While this study may provide some answers in that regard, the primary research examined the interpretation of typographic designs in a quantitative approach. This study examined human emotion responses to typestyles.

As with much design, this study required a broad understanding of literature from diverse disciplines. Presented in this review are topics pertinent to the study of humans—the brain, visual processing, and emotion—and the extant research on the meaning of typestyle designs. Surprisingly little typographic research has originated from graphic
design researchers, but rather, research about the meaning of typestyles has been generated from a wide variety of disciplines.

Typography is a specialty within the field of graphic design, but thirty years ago, typography was a discipline and craft separate from graphic design, with materials, methods, processes and reproduction techniques unique unto itself. Typesetting was a thriving field, filled with expert professional craftspeople. Today, those that refer to themselves as typographers design typefaces for a living. They do not typeset copy and apply stylistic treatments and expert spacing, as typographers once did.

**Coverage of the literature review**

Nearly all of the research in typography investigates issues of legibility and readability, while nearly all of the studies about the meaning of typestyles have been produced by researchers outside the field.

Where there have been studies of typographic meaning produced in other fields, results and discussion will be included in this literature review. Most studies of typographic meaning have been delivered from the perspectives of consumer studies, business and marketing, linguistics, rhetoric, writing, communication studies, curriculum and instruction. Typographic studies that examine reading ease, speed, legibility, readability, and likeability of texts are covered elsewhere in the literature. Further, the reader is directed to typography textbooks to learn specific terminology, history, methods of typographic construction, and page composition. Where professional terminology is used, it will be explained in the text.
It was necessary to survey a wide body of literature to form a composite picture of the state of knowledge that affected this and other typographic studies. Before addressing typography, which is the primary focus of this literature review, the researcher presents an overview of the physiology of vision and emotion, a synthesis of the theoretical underpinning of the study, followed by the analysis of research about typography and its interpretation.

Vision, emotion, and the brain, are difficult subjects to grasp, with dense medical terminology and advancing theoretical and methodological debate. In order to understand what researchers know about design and the brain, it is necessary to understand how the eyes work to process a scene and to understand how the parts of the brain are explicated in the vision process. In order to understand human visual perception as it applies to typographic design, it was necessary to also understand the role of emotion in neural processing. Following this introduction, the reader will find overviews of the current state of scientific understanding for these subjects. The reader is further directed to seek depth in these knowledge areas from sources in scientific literature.

**Vision**

Sight occurs through the eyes, but vision occurs deep within the brain. Humans derive meaning about what they see through a system of visual perception. Many parts of the brain are involved in vision. Neurological research has identified the specific anatomical mechanisms of visual perception and revealed how images and information are processed in the brain.
“During the first half of the 20th century, the study of visual perception resulted in the definition of the laws of human vision (for reviews, see Reid, 2003; Wurtz and Kandel, 2000b). During the second half of the 20th century, these laws have been related to the function of nerve cells and of specialized (visual) regions of the brain” (Redies, 2007).

**How vision works.** As light enters the eye, the retina detects an image and converts it into signals that activate an array of photoreceptors. The retina has specialized cells to detect specific features of a scene, including color, size, and direction or orientation, spatial frequency, and speed of motion. Findings from neurophysiologic experiments indicate that the visual system processes statistical properties of natural stimuli using an efficient (sparse) code (Redies, 2007). The brain processes visual data in a chain of ever-increasing complexity; it eliminates redundancy, accentuates detail, and integrates the visual parts into wholes.

*Fig. 1. Sagittal section of the adult human eye* (image from Schmolesky, 2000. Downloaded 12-31-08 at http://www.webvision.med.utah.edu/VisualCortex.html)
On its way through the cortex, visual information takes one of two routes. The first route, called the thalamo-amygdala pathway, is a crude network of fast pre-conscious processing. Electrical impulses are sent immediately to the thalamus.

The thalamus responds pre-consciously in milliseconds to relay the signals on to other parts of the brain, calling needed systems into action. If the situation calls for an emergency response, a “fight or flight” behavioral response is initiated. In non-emergency situations a feeling is generated that shapes our responses. “Neurological research reveals that visuals may be processed and form the basis of future action without passing through consciousness at all” (Barry, 2005).

The second route along the cortical pathway is slower. Information is sent to the visual cortex and then on the amygdala (located deep within the temporal lobe), where emotion is attached to incoming data and a feeling is generated.

When an individual senses something visually in the environment, the brain attaches emotion. The signal is sent across the neural networks, beginning in the left hemisphere, stretching across to the right hemisphere, where the brain attaches the experience to a radiating network of other semantic connections. It attaches emotion to events, personal interactions, or objects, and reinforces recollection (Phelps & Sharot, 2008), influencing memory.
Both the right and the left sides of the brain are involved in visual processing. The process of attaching emotional responses to information happens primarily in the right–brain and occurs a full half-second before the information is processed and reaches consciousness (Gazzaniga, 1998 in Barry, 2004). “Recognizing faces, finding your way around in space, discerning shapes in camouflage, and seeing patterns at a glance are right-brain activities; breaking down complex patterns into component parts, focusing on detail, and intense analysis are left-brain activities” (Barry, 2004, p. 54). In this way our immediate emotional responses are out of our conscious control.

Each of the five major visual structures of the brain (V1, V2, V3, V4, and V5) are responsible for interpreting specific parts of the visual signal (Schmolesky, 2000).
Area V1 processes orientation, spatial frequency, and color. V2 also processes orientation, spatial frequency, and color and in addition it processes figure and ground relationships, orientation of illusory contours in space, and moderately complex patterns. V3 plays a role in processing global motion, patterns in motion, and it forms a representation of the entire visual field. V5 processes motion. Vision researchers are still trying to fully map the functions of Area V4. The prelunate gyrus (or V4) is tuned for orientation, spatial frequency, and color, like V1 and V2, but it is also involved in form recognition and processes object features of intermediate complexity (e.g. geometric shapes).

The functions of V4 represent areas of tremendous implication for graphic design research and provide stimulating subject matter for further research:

V4 encodes stimulus valence, modulates visual attention, and exhibits long-term plasticity.

Visual perception is negotiated through emotion.

<table>
<thead>
<tr>
<th>NAME</th>
<th>BRAIN ANATOMY</th>
<th>FUNCTION</th>
<th>CONDITION OF CONSCIOUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1</td>
<td>Striate cortex.</td>
<td>Registers small changes in visual orientations, spatial frequencies, and colors.</td>
<td>Preconscious: Individual neurons detect stimuli in under 40ms. Neuronal response changes over time.</td>
</tr>
<tr>
<td>V2</td>
<td>Prestriate cortex. Split into 4 quadrants; dorsal and ventral of both left and right hemispheres</td>
<td>Visual association; orientation, spatial frequency, and color; orientation of illusory contours, figure and ground; moderately complex patterns; a single receptive field may be driven by multiple orientations at different subregions</td>
<td>Conscious: Shows small amount of attention modulation</td>
</tr>
<tr>
<td>V3 / V3A</td>
<td>Some consider dorsal V3 part of a larger area, the dorsomedial area (DM)</td>
<td>May play a part in the processing of global motion. Neurons in DM respond to motion of large patterns covering the visual field</td>
<td>Conscious</td>
</tr>
<tr>
<td>V4</td>
<td>Prelunate gyrus</td>
<td>Orientation, spatial frequency, color, objects with intermediate complexity (geometric shapes), directly involved in form recognition, exhibits long-term plasticity, encodes stimulus salience. Complex objects (faces) not processed by V4, but in areas of the inferotemporal cortex</td>
<td>Conscious; Strong attention modulation</td>
</tr>
<tr>
<td>------</td>
<td>----------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td>V5 (or MT)</td>
<td>Middle temporal region of the extrastriate visual cortex</td>
<td>Plays a major role in motion perception, integrates local motion signals into global percepts, guidance of some eye movements, large number of neurons tuned to speed and direction of moving visual stimuli.</td>
<td>Conscious</td>
</tr>
</tbody>
</table>

Table 1. Areas of the brain involved in visual processing. From Schmolesky (2000) and Wikipedia (2009; entry for ‘Eye’)

Up until now, physiology has not been considered a part of graphic design and visual communications research (Barry, 2005). Researchers of visual literacy have not employed the methods that could connect participant responses to physiological and neurological processing. The hypotheses in this study are grounded in knowledge of neurological processing of vision and emotion.

Design, both creative application and individual interpretation, begins with vision.

Visual literacy researches have focused mainly on cognition, but the process of seeing the world begins with a pre-conscious visual assessment of the environment. Preconscious processes are ancient evolutionary responses to the environment (Barry, 2004).

The eye is a complex structure, converting light waves in conjunction with the brain into the conscious experience of sight (see Fig. 1). The process of vision is initiated with light. When light bounces off an object it is focused by the cornea and lens within
the eye and transmitted onto the retina. “Much of the construction of an image takes place in the retina itself through the use of specialized neural circuits” (Kolb, 2003).

The eye gathers information about light and converts it into electrochemical signals via the retina. Once an image has passed through the retina, information is transformed from light signals into electrical impulses and transmitted from the optic nerve within each eye to the brain.

The signals travel through the optic nerve to unconscious processing structures along the thalmo-amygdala pathway. “As we look at the world around us, the right hemisphere of the brain scans the environment and the left hemisphere jumps in when conscious attention is needed. Both cognitive and emotional systems work in parallel, and both store separate memories of the experience” (Barry, 2002, p. 93).

As Barry notes, the thalmo-amygdala pathway is the ancient connection of the visual pathway to the brain stem. This is a pre-conscious process. Its purpose is to provide a self-preservation reflex response known as the “fight or flight” response.

“The retinal image is converted into the activity of an array of photoreceptors. Neural activity is conveyed along specific neuronal channels to higher visual centers in the brain, for example to the visual cortex, where the different dimensions of visual information (for example, contrast, color or movement) are processed and visual experience reaches consciousness (for reviews, see Reid, 2003; Wurtz and Kandel, 2000a, 2000c)” (Redies, 2007).

Vuillumier & Driver (2007) compiled behavioral evidence and imaging technology studies from animals and humans and found that vision is modulated by
attention and emotion; no single neural structure is responsible for processing vision, rather many parts of the brain are co-involved. In fact, over thirty neural structures are involved in processing vision (Ramachandran, 2001).

Studies have revealed that specific neurons in the brain respond specifically and only to individual elements of a scene (for example line, depth, pattern, or motion, etc.) (Schmolesky, 2000). Eventually, the neurochemical signals converge together to produce conscious visual perception. Barry (2002) and Ramachandran (1998) stress that though the end result of neurological processing is the emotional and conscious awareness called “seeing,” many parts of visual processing, including vision itself happens unconsciously.

The process of visual perception begins in the emotion responses, the pre-conscious reflex that forms the basis of ‘seeing.’ What humans respond to through the visual senses begins not in the “now” but in the past (Barry, 2002). The elementary parts of the brain, those that operate at an pre-conscious level, make decisions that establish attitudes, determine options among choices, and direct appropriate action. The brain acts on visual information quickly, about three hundred fifty milliseconds before taking a conscious action. (Libet, 1997; Barry, 2002).

People regularly make unconscious choices based upon their emotions. At the same time, designers regularly make unconscious choices in creating design. Both viewing design and making design involve the conscious and unconscious internal process of seeing.
Viewers relate to visual concepts through neurological means, just as the works have been created through neurological means. Understood in this way, designed communications should be able to evoke emotion responses in an audience that parallel those emotions communicated by the designer.

According to Neuroscientist Dr. David Eagleman of Baylor University, “…the visual world is not exactly what you think it is. Instead, it’s a construction of the brain.”

Visual language exists alongside verbal language: it has its own meaning and cannot easily be verbalized. Designers have long understood that their work influenced people’s choices and actions, but even today most designers cannot explain how or why.

Graphic designers use the traditional elements of art, principles of design, and employ a largely intuitive process (Thangaraj, 2004) when they create visual communications for clients. For artists or designers to verbalize what they do or describe how they do it is difficult at best. Many designers describe their practice using the word ‘intuition’ or they may report that they ‘follow their gut instincts’. When designers refer to ‘intuition’ to describe what they do, what they may really be trying to explain is an internal process—an ability to create and manipulate the human ‘visual language’ that originates in the visual brain.

“The brain’s job is to optimize actions so that the conscious mind does not need to be activated… Through repetition of a task, let’s say, riding a bicycle, as we learn the set of complex actions, they get burned into the unconscious so that eventually we can do the task unconsciously without thinking about it, but this
occurs at the cost of consciousness — you can no longer explain how you do the task” (Eagleman, 2011).

Most of the psychology research about visual interpretation has used photographic faces or words as stimuli for vision research. Creating design involves a complex network of internalized and therefore non-conscious actions, as does interpreting visual designs. This study observes and documents human emotion response to visual designs.

The Brain

“Ultimately the key to understanding all visual communication lies in the neurological workings of the brain” (Barry, 2005).

Researchers in neuroscience have found that all senses produce connections in the brain. Information detected by the senses is processed pre-cognitively, that is, without expending attention resources. Once detected, the left hemisphere of the brain performs a precognitive appraisal. Then chemical signals are sent across to the right hemisphere, disseminating throughout the brain creating patterns of recognition. The right hemisphere makes associative connections while the left makes logical and factual connections.

While the two hemispheres of the brain process entirely different kinds of information, both halves share emotional information. The brain transmits emotion fluidly across the corpus callosum, a bridge connecting the two hemispheres. The limbic system carries unconscious emotional information easily from one side to the other.

Each side of the brain is similar to the other, but they function and perform tasks differently. The right hemisphere processes images and emotion, operating holistically in
a branching fashion, making numerous connections between information, prior experiences, and emotions. The left hemisphere works in a linear, logical fashion, analyzing, and processing words.

A part of the midbrain, the amygdala, detects information faster than the conscious mind can recognize it (LeDoux, 2000). The amygdala has been associated as the emotion center of the brain. It attaches emotion to incoming information, positive and negative, and directing the signal on to conscious awareness and further processing by other structures in the brain. The amygdala modulates cognition with emotion. It is strongly linked to fear and pleasure.

“The from an evolutionary standpoint, the emotion system has features that alert the organism for swift action. To be subject to introspective analysis was clearly irrelevant: the trade-off for accessibility was speed. Detailed processing is time-consuming” (Whitfield, 2005).

**Emotion**

Years of psychological studies in emotion provide direction for this study regarding the selection of criteria and stimuli, and the accurate formulation for questionnaires used to gather emotion responses to stimuli. This brief introduction reports the most recent findings regarding the nature of emotion and the interconnection between eyes and brain, vision and emotion. The reader is invited to further explore these subjects and their historical contexts through the scientific literature.
Advertising and graphic design are concerned with influencing human decisions, and therefore rely on aesthetics and emotion to appeal to audiences. Yet the method of how design becomes influential, suggests an aesthetic, or makes an emotional impact, has not been quantified or articulated. While emotion is currently a ‘hot topic,’ (Evans, 2001, in Yagou, 2006) this study is the first graphic design study to apply singular emotions to typography.

Although there are many valuable avenues for emotion research, this study excludes sensory perception systems other than vision. Neither mood nor memory is included in this study. Here, data will show whether typefaces can influence feelings of emotion in viewers and whether individual visual elements of type design can be linked to specific emotion responses.

Studying emotions can be tricky. Emotions are multi-dimensional, that is we can experience more than one emotion at a time. They are experienced in different strengths from mild to strong. Emotions affect people pre-consciously, unconsciously, and consciously. And people tend to exaggerate, deny, suppress, or even lie about emotions.

The brain processes emotions pre-attentively and pre-cognitively (Zajonc, 1980, Damasio, 1994, 2000, 2003, LaDoux, 1998). This happens because for biological reasons, the brain works faster subconsciously than it does to consciously process rational thought. Recent scientific imaging has provided physical evidence that emotion is linked to primordial instincts: Together with the sensory systems, emotion helps detect danger to ensure survival of the individual.

Emotion radiates through the brain before we consciously sense or see anything in the physical realm. Emotion focuses our senses, guides our attention, and in cases where
danger exists, emotion sends signals to flood the body with adrenalin to initiate the
fight-or-flight response to ensure our survival. Design can appeal to the emotions
consciously and influence choices, yet unconscious influences also have important
effects on human behavior.

Thinking can influence emotion, perception, and action. Cognitions can both
influence and be influenced by emotions (e.g., Bower, 1981; Isen, Shalker, Clark, &
Karp, 1978; Johnson & Tversky, 1983; Ortony, Turner, & Antos, 1983; Schwartz &
Clore, 1983, Ortony, Clore, & Collins, 1988/1994). This study provided further evidence
of the connection between visual perception and emotion and substantiated the
hypothetical link between emotion, typography, and design features.

Diverse design disciplines are engaged in studying the effects of emotion:
industrial design, product design, package design, advertising and marketing,
instructional design, and website design. Research in design and emotion is very young,
beginning only in 1999. Psychology is the primary discipline for emotion research, and
definitions for this study have been gleaned from that research.

Does everyone have the same emotional responses, regardless of their cultural
background? The answer is that a few emotions appear to be evolutinal, and therefore
are thought to be common to all cultures. Various researches have identified these
“basic” emotions: anger, disgust, fear, happiness, sadness, and surprise (Clore,

“Contrary to popular belief, conscious feelings are not required to produce
emotional responses, which, like cognitive processes, involve unconscious processing

Even though some emotions are pre-conscious, many emotional responses are learned. Pre-cognitive emotions require no thought. In order for emotions to reach conscious awareness, they require further processing in the cerebral cortex. “One of the ways by which emotions work is through neurochemicals that bathe particular brain centers and modify perception, decision making, and behavior. These neurochemicals change the parameters of thought” (Norman, 2004, pg. 10).

Researchers organize emotion into categories belonging to one of two conditions: internal or external. Ortony, Clore & Collins’ now classic book The Cognitive Structure of Emotions (1988) examined the interaction of cognition and emotion. They found that there were three types (or classes) of emotions: reactions to events, to agents, and reactions to objects. The emotions within each class have a particular pattern of eliciting conditions as well as variables affecting their intensity (goals, standards, and attitudes). Emotion dimensions vary: one can talk about emotions in terms of individual object characteristics as well as context– and domain–dependent emotions (Kim, Lee, & Choi, 2003).

Emotion can be positive or negative. “Those situations and objects that, throughout evolutionary history, offer food, warmth, or protection, give rise to positive affect” (Norman, 2004, p. 29).
Some emotions are learned and some are bound by cultural beliefs and by the natural environment. Emotion helps us trust others as well as functions in forming bonds to ensure survival of the species (Whitfield, 2005).

In addition to researching the vocabulary of 25,000 emotion words, Doost, Tagahavi, Yule, and Dalglesh (1999) found that emotional dimensions change as people age. Developmental psychology indicates that children develop their emotional capabilities as they grow, according to their chronological age, their genetics, and their environment. Children are influenced by the people, events, communities, and cultures to which they belong.

**Defining emotion.** Emotion research has been plagued by disagreements in definition, theory, and methodology since 1884 when William James asked, “What is an emotion?” (Izard, 2006 and Panksepp, 2003a, in Izard, 2009).

Emotion is a system and process of appraisal. Emotion acts as a thermometer for the human organism, gauging the salience of people, events, memories or imaginary situations. Emotion processes allow people to quickly evaluate and adjust to changing circumstances. Emotion helps humans to quickly make judgments about danger or safety, trustworthiness, valence, and arousal. Emotion changes rapidly, varies in intensity and duration, and impacts behavior.

People generally think that emotions and feelings are interchangeable, and this fallacy has caused considerable trouble in emotion research. According to researchers, there are only a few basic emotions, but a large variety of feelings arise out of these basic emotions. Feelings and emotions are not the same thing.
Emotion is a process of appraisal of anger, disgust, fear, happiness, sadness, and surprise. The experience of emotion is individual, social, and cultural. Feeling proceeds from the initial emotion appraisal and affect is the manifestation of the feeling.

Feeling is a behavioral response (neurological and physical) to the primary emotion states (anger, fear, joy, disgust, sadness, shame, and guilt).

Affect is the outward display of feelings or emotion (facial expression, body language, and behavior) coupled with how one feels (fuming, annoyed, etc.). Affect expresses an individual’s personal preferences, attitudes, moods, general disposition, and affective style.

For the sake of clarity, this study will rely in part on the definition of emotion established by Scherer (2005) as follows:

“Emotion is defined as an episode of interrelated, synchronized changes in the states of all or most of the five organismic subsystems [central nervous system, neuro-endocrine system, autonomic nervous system, somatic nervous system that process information, support and regulate, perform executive functions, produce behavioral action, and monitor the organism] in response to the evaluation of an external or internal stimulus event [cognitive appraisal, neurophysiological symptoms, motivational action tendencies, motor expression, subjective feeling experience] as relevant to major concerns of the organism [evaluation of objects and events, system regulation, preparation and direction of action, communication of reaction and behavioral intention, monitoring of internal state, and organism–
environment interaction]. … [emotion is] a process of coordinated changes over time” (Scherer, 1987, 2001, p.697).

Although no studies have combined vision, emotion, and unconscious processes with design, a few studies have examined neurological imaging of conscious visual attention and responses to emotionally-weighted pictorial stimuli. Ó-Miranda, Volchan, Moll, de Oliveira Souza, Oliviera, Bramati, Gattass & Pesso (2003) found that the visual cortex is involved in processing emotional stimuli. Their neuroimaging experiments revealed that the brain showed greater activity when processing emotional pictures. The study of affective picture processing by Peyk, Schupp, Keil, Elbert, and Junghofer (2009) found evidence for an impressive capacity of parallel affective discrimination in rapid picture presentation. Their findings demonstrated that subjects were able to discriminate pleasant from neutral image content. Further they concluded, “the emotion discrimination at the level of perceptual processing is a robust phenomenon” Peyk, et al. (2009).

**Anatomy of emotion.** Recent advances in medical imaging and brain physiology research have mapped the specific regions and anatomical structures of human and animal brains that are involved in processing emotion (Schmolesky, 2000).

Several neural structures process emotion including the amygdala, insula, anterior cingulate, orbito-frontal cortices, and the brain stem (Damasio, 2003; Lane et al., 1997; Panksepp, 2003a, 2003b, in Izard, 2009). The amygdala has been implicated in preconscious emotion processing, while involvement of the orbito frontal cortices is correlated with conscious perception of emotion and experience of feelings. Preliminary results from an fMRI study of emotional stimuli conducted by Risinger, Garavan, Kelley,
Ross, Salmeron, & Stein (1999) suggested that amygdala activation was significantly associated with stimulus arousal, but not with emotional content of stimuli.

The amygdala is one of five major brain structures involved in processing emotion. In the brain emotion travels through the amygdala, insula, anterior cingulated, orbito-frontal cortices, and the brain stem (Damasio, 2003; Lane et al., 1997; Panksepp, 2003a, 2003b, in Izard, 2009). The amygdala has been implicated in preconscious emotion processing, while involvement of the orbito frontal cortices is correlated with conscious perception of emotion and the experience of feelings.

Preliminary results from an fMRI study of emotional stimuli conducted by Risinger, et al. (1999) suggested that amygdala activation was significantly associated with stimulus arousal, but not with emotional content of stimuli. Within the limbic system the role of the amygdala was “perhaps functioning more as a preconscious salience detection network than processing strong emotional stimuli” (Risinger et al., 1999).

“A small bundle of neurons has been identified that lead directly from the thalamus to the amygdala across a single synapse (Damasio 2000, p. 70; LeDoux 1992), allowing the amygdala to receive direct inputs from the sensory organs and initiate a response before the stimuli have been interpreted by the neocortex (LeDoux 1994)” (in Lindgaard, Fernandes, G., Dudek, C., & Browñ, 2006).

Affective states (e.g. fear, anger, sadness, and joy) produce different physiological effects by altering the blood flow patterns in the brain (Lane, Reiman, Bradley, Lang, Ahern, Davidson, & Schwartz, 1997; Damasio et al., 2000).
**Measuring Emotion.** The influence of emotion is broad and powerful; yet emotion is difficult to quantify and even harder to measure.

Emotion is a complex process involving many body systems, constantly readjusting to changing circumstances. Systems involved in the emotion process include the appraisal process, neuro-endocrine, autonomic, and somatic nervous system response patterns, motivational changes, facial and bodily expression and movement, and the nature and content of the experience (Scherer, 2005). Measures of arousal differ among autonomic, somatic, and cortical systems.

Human emotion is experienced on a physical level as arousal of cardiorespiratory activity, as measured by heart rate variability (HRV) and respiratory sinus arrhythmia (RSA). Dynamic changes in cardiorespiratory activity produce changes in somatic states that have been associated with basic emotions (Rainville, Bechara, Naqvi, & Damasio, 2006).

Emotion research frequently examines participants’ perception of emotional valence and arousal. Russell (2003) concluded that core affect continuously evaluates the arousal value and pleasure or displeasure of a stimulus. “The central emotion mechanism proposed by these theories is appraisal, based on the pioneering work of Arnold (1960) and Lazarus (1966, 1991): the continuous, recursive evaluation of an event for criteria such as novelty, intrinsic pleasantness, goal conduciveness, coping potential, and normative significance” (Granjean & Scherer, 2008).
Emotion responses have been measured by participants’ self-report of feelings, heart rate, or through recording the amount of electrical conductance present in sweat on the skin.

One can measure the duration of emotion: transient emotions vs. longer-lasting moods. One can differentiate specific behavior associated with emotions: affective states—like/dislike; approach/avoid; or specific emotions such as joy, pride, sadness, fear, shame, or anger.

One can measure the degree of cognitive involvement and the myriad of individual variations reported by persons experiencing complex emotions such as pride, shame, jealousy, or guilt. Basic emotions such as fear, sadness, happiness, and anger typically show fewer variations than complex emotions. Finally, there are a number of additional factors that can be measured, such as triggers, manifestations, and degree of voluntary control. (For further reading see Ekman & Davidson, 1994; Lewis & Haviland, 1993; Forgas, 2000, 2001a).

Paul Ekman and colleagues classic research on facial expression of emotion in the 1960s inspired the development of a field known as affective computing. Pioneered by Picard (2004), the goal of affective computing is to perfect human-to-computer communication, harnessing artificial intelligence to improve the emotional experience of using a computer. According to Hudlicka (2003) the ultimate reason to address affect in HCI is to understand the range of user affective states and their effects and in so doing, to decide whether or not the system should respond to the user affective state, how, when, and what behavior should be displayed. Studies of affective computing at MIT are aimed
at facial emotion recognition, a detection method aimed at getting computers to intervene during the learning process to help students and relieve frustration. The research on affective HCI is organized in five categories: affect sensing; affect recognition; affect appraisal and generation; dimensions; and affect expression. Once researchers identify the distinct physiological patterns of emotions, scientists can develop multivariate analysis computer systems to recognize emotions in real-time (Picard, R.W., Vyzas, E., Healey, J., 2001). Affective computing research suggests promising new methodologies to advance graphic design and visual literacy research.

**Emotion types.** According to psychologist Donald Norman (2004), humans process information at three different psychological levels: reflective; behavioral; and visceral. At the visceral level, humans process sensory information by “pattern matching”. Operating in the primitive part of the brain, the visceral level can neither reason nor compare situations to past experiences. It is preconscious. Visceral design is concerned with reactions and can be studied quite simply by placing users in front of a design and waiting for their reactions (Norman, 2004). According to Norman (2011, personal correspondence), “Not all emotions are fast. In my book *Emotional Design*, I distinguished three levels. …The two lowest levels are indeed faster than conscious cognition. The lowest level is very fast. But the top level, reflective, can be very slow. Emotions of jealousy and hate, blame and regret, pride and love can take minutes or even hours.”

Scherer (2005) proposed that emotions have “design features” that distinguish a specific type of affect: preferences, attitudes, moods, affect dispositions, aesthetic
emotions, and utilitarian emotions. The intensity of each category can be ranked according to event focus, intrinsic appraisal, transactional appraisal, synchronization, rate of rapid change, behavioral impact, intensity, and duration.

Utilitarian emotions (anger, fear, joy, disgust, sadness, shame, and guilt) facilitate adaptation with significant consequences for wellbeing; they change quickly, are intense, and have a very high impact on behavior.

Aesthetic emotions (awe, wonder, admiration, bliss, fascination, harmony, rapture, ecstasy, and solemnity) equate to the evaluation and appreciation of beauty, art, music, etc. Aesthetic emotions are unrelated to environment monitoring or survival responses, and though they change quickly, they score medium to low intensity with low behavioral impact.

The findings from this study will provide evidence suggesting (1) whether participants respond with emotion to typographic design features, (2) whether those design features are associated with aesthetic (awe, wonder, admiration, bliss, fascination, harmony, rapture, ecstasy, and solemnity) or utilitarian emotions (anger, fear, joy, disgust, sadness, shame, and guilt) according to Scherer’s definitions; and (3) whether design elements produce low intensity responses according to Scherer’s explication of design features of affective phenomena.
Emotion effects

Most researchers categorize emotion effects into four categories: somatic–physiological; cognitive–interpretive; motivational–behavioral; and experiential–subjective (Clore & Ortony, 2002). Hudlicka (2003) surveyed the various categorical emotion researches:

“An alternative method of characterizing affective states and emotions, most often applied to moods and basic emotions, is to focus on the underlying, often physiologically correlated factors (e.g. arousal) and map these onto distinct dimensions. Several such two- or three-dimensional sets have been proposed, including positive and negative affect (Watson & Clark, 1992), energetic and tense arousal (Thayer, 1996), hedonic tone, energy and tension (Matthews, Jones, & Chamberlain, 1990), and valence and arousal (Watson & Tellegen, 1985; Russell, 1979)”.

Many disciplines are involved in studying the effects of emotion. Several disciplines have tried to articulate the specific elements of good design that involve emotion, or more accurately, adjectives that describe emotions (but not the basic emotions).

Emotional design theory in industrial design implicates color and movement in attracting and sustaining attention; Perceptual aesthetics theory in visual communication, mass communication, and advertising considers the role of sensory perception, emotion, and physiological brain function; and experience design theory of Human Computer
Interaction (HCI) considers context and the individual’s past experience in forming emotional connections necessary for effective learning. Instructional design research demonstrated the effects of individual design elements on learning (e.g. text and animation).

Emotion can greatly affect learning by limiting or strengthening attention and cognitive processes. Some of those effects include:

“…changes in attention capacity, speed and bias; …perceptual and cognitive schemas that enhance (or limit) the perception of processing certain stimuli. These include the following: perceptual categorization and biases towards threats; memory encoding and recall effectiveness and biases; and a variety of additional influences on reasoning, judgment, and decision-making (LeDoux, 1992; Mineka and Sutton, 1992; Isen, 1993; Eysenck, 1942; Williams, J. M. G., Watts, F. N., MacLeod, C., Mathews, A., 1997). These emotion effects exist at both low-level (e.g. attention and working memory speed and capacity), and at higher-levels (situation assessment, decision-making, planning, learning and judgment)” (Hudlicka, 2003, p. 15, 16).

Researchers in learning psychology indicate that the basic emotions are not sufficient to explain the complex processes involved in learning and knowing. Many of the affective states seen in learning, for instance boredom or interest, are not included in Ortony, Clore, & Collins’ (1988/1994) widely accepted model of emotion. And the work on emotion theory is limited: “To date there is no comprehensive, empirically validated, theory of emotion that addresses learning” (Picard, et al., 2004).
Emotion influences learning. Affect influences cognition and learning through directions of attention. Moods and emotions effect the capacity and speed of working memory—positive moods and pleasant experiences enhance memory. When learning material designs are pleasant, learning is improved. The Broaden-and-Build Theory of Emotions in Positive Psychology says that positive emotions improve attention and broaden thought/action repertoires (Fredrickson & Branigan, 2005).

When an individual senses something in the environment, the brain attaches emotion that is sent across the neural networks, beginning in the left hemisphere, stretching across to the right hemisphere where it attaches the experience to a radiating network of connections. When emotion attaches itself to events, personal interactions, or objects, it reinforces recollection (Phelps & Sharot, 2008) and memory.

Emotion influences behavior: “An accelerated flow of findings in neuroscience, psychology, and cognitive science itself present affect as complexly intertwined with thinking, and performing important functions with respect to guiding rational behavior, memory retrieval, decision-making, creativity, and more” (Picard, Papert, Bender, Blumberg, Breazeal, Cavallo, Machover, Renick, Roy, & Strohecker, 2004, p. 253).

Emotion influences social behavior. Emotion helps to form trust and attraction, and helps ensure survival of the species (Whitfield, 2005).

Advertising design is one area where integrating emotion into design is vital. Researchers studying branding have detected the powerful influence of emotion on brand selection. Consumers are more likely to remember emotionally advertised brands (Heath, Brandt, & Nairn, 2006).
Since medical imaging advances have enabled us to pinpoint the physiological mechanisms, emotion has been implicated in cognition, attraction, trust, choice, behavior, memory, learning, and more.

**Research methods in emotion**

Psychologists employ a range of physiological techniques to gather data about emotion responses, and yet asking subjects to participate in behavioral research by reporting emotional responses to stimuli can provide a deep understanding of behavior that scientific studies cannot supply. Both quantitative and qualitative approaches in emotion research are common.

There are three behavioral approaches used by emotion researchers: the discrete approach, the dimensional approach, and the discrete-dimensional approach.

The discrete approach asks participants to select words from a list of affective states to indicate their emotion response.

The dimensional approach consists of a valence response (either positive or negative) and an arousal response (calm or excited), and to indicate the amount of tension (relaxed or tense).

The third approach combines the discrete and dimensional approaches, as exemplified in a study by Capota, van Hout & van der Geest (2007). Their study utilized an assessment instrument developed by Pieter Desmet, author of industrial design’s preeminent research on product design published in a book entitled *Design and Emotion*. One of the tools developed as a result of his research, the LEMtool (Layered Emotion Measurement tool, Van Hout, n.d.) was specifically developed to use in research about
websites by Capota & van Hout (2007) and marketed by SusaGroup. The other is PrEmo™, the online interactive visual questionnaire tool adopted in this study developed by Desmet (2005) and marketed by SusaGroup. Morrison (1986) advised the use of a visual report mechanism for studies where participants were asked to evaluate visual features.

A recent webpage design study (Capota et al., 2007) found that participants could judge the aesthetic appeal of a website even before the visual signal could reach the areas of the brain responsible for conscious visual perception. This study indicates that conscious decisions may be influenced by emotions that are formed preconsciously in response to visual stimuli. Emotion is at the very core of the neurological processing of vision (Vuilleumier, P. & Driver, J., 2007).

**Theoretical underpinning of the study**

The alphabet (including numerals and symbols) has been described as a written notation representing vocalized sounds. The forms are symbolic, thus suggesting that a study of typographic design and emotion is connected to semiotics (the science of signs). A study of letterforms must be informed by visual and communication theories. These theoretical ideas underpin this study: Gestalt Theory of Visual Perception, Visual Social Semiotics, and Perceptual Aesthetics Theory of Visual Communication. Next, connections will be drawn between these theories and this study, but for further information about these theories, the reader is directed to the literature in visual communication.
An essential element of communication is conveyance of emotional temperature. This idea has not received much research attention in the field of graphic design. For centuries, theoreticians have postulated that humans have a non-linguistic and universal visual language. Still, beyond anecdotal evidence, we don’t understand how or why humans respond to visual objects the way they do, nor has inquiry of this nature been applied in graphic design theory.

There is already evidence that people respond emotionally to works of art, but the goal of this study is to begin to understand what emotional meaning humans derive from graphic design and typography. The importance of this study lies in its search for a universal structure underlying vision and visual language, and the emotional basis for design’s influence on people, society, and civilization.

We rely on our visual and sensory perception in order to recognize objects in our environment. Whitfield’s (2005) Perceptualist Theory of Design says that humans understand the world by attaching emotion to sensory perception. The result is creation of affective knowledge that motivates appropriate action.

“…many have wondered whether there are some universal [aesthetic] principles. Do we have an innate "grammar" of aesthetics analogous to the syntactic universals for languages proposed by linguist Noam Chomsky of the Massachusetts Institute of Technology? The answer may be yes. We suggest that universal “laws” of aesthetics may cut across not only cultural boundaries but across species boundaries as well” (Ramachandran & Rogers–Ramachandran, 2006).
**Gestalt Theory of Visual Perception**

“In psychological studies at the beginning of the 20th century, the global structure of visual objects has been defined as a set of rules of 'Gestalt'. Interestingly, there is a close correlation between some Gestalt rules, which are used to recognize objects based on the grouping of elements in the visual scene, and the structure of natural scenes (Sigman et al., 2001). Several philosophers have invoked the Gestalt character of beauty to explain the aesthetically pleasing form of art objects (Kant, 1790; Leibniz, 1873; Nietzsche, 1888; Paul, 1988)” (Redies, 2007).

This research will connect rudiments of visual design with emotion response. Emotion has been described as a feature component of visual processing; therefore design research needs to adjust its current theories. This study introduces emotion as an important component of vision that is missing in Gestalt psychology of visual perception. Partly the importance of this study is to suggest that design researchers should either incorporate the role of emotion into the Gestalt theory, or begin to develop a parallel theory of graphic design and emotion.

**Perception Theory of Visual Communication**

According to Van Leeuwen (2005), typography is redrawing the boundaries between word and image. Typography is symbolic, and yet over time the role of the alphabet in communication has shifted from one of pure representation of sounds to a mode of meaning making, providing an integral piece of aesthetic information, which
together with image and words creates message holism. The way humans understand the visual world is through a process of internal meaning making: perception.

“[Perception] involves the acquisition, interpretation, selection, and organization of sensory information. … The importance of perception in understanding a human being's interaction with the world has been well established. Although perception is dependent on a host of physiological (e.g., age, health, hunger) and social (e.g., cultural differences, social roles, self-concept) factors, the perception of “art itself is a cultural universal”” (Dutton, 2002, in Hagtvedt, Hagtvedt & Patrick, 2008).

**Aesthetics**

Over the past twenty years, neurophysiology and brain functioning research has reasserted the primacy of emotion and along with it a resurgence of perceptualist theory (described by Whitfield) that has emerged alongside prevailing theories of psychology.

“The emerging field of research that deals with the biological basis of esthetics is called neuroesthetics. The central tenet of neuroesthetic theory is that esthetic experience is a product of brain function (Zeki, 1999a, 1999b). A similar idea that esthetic judgment has a biological (physiological) foundation was advanced by the philosopher Edmund Burke (1757). More recently, Gregor Paul (1988) maintained that biological hypotheses are imperative for any explanation of universal esthetic judgment. … esthetic judgment is thought to reflect principles that are independent of the cultural, historic, social or personal circumstances, under which a work of art is created. This classic view of universal esthetics is diametrically opposed to contemporary theories of art, which
argue that art should be explained in its historic and social context (Danto, 1981; Goodman, 1968)” (Redies, 2007).

Aesthetics and emotion, like fashion, are malleable, resulting on the one hand from engagement with everyday objects and experiences; and on the other hand resulting from unconscious visual and social values. Aesthetic judgments are diffuse; they are neither correct nor incorrect. Whitfield (2005) contends that aesthetics produces a system of categorization by attaching emotion to cognition. While neither essentially cognitive nor emotional, aesthetics “derives from a pre-linguistic-cognitive stage of human evolution—a kind of precognitive cognition” (Whitfield, 2005).

Essentially, notions about aesthetics and beauty are internal and are influenced by cultural and social norms. Aesthetic judgment relies on emotional judgments; aesthetic responses are related to multi-dimensions of emotion (Kim, J., Lee, J., & Choi, D., 2003). Experimental psychology has shown that people make aesthetic judgments about the most disembodied stimuli, such as colors, lines, and polygons. “This suggests that, for a stimulus to elicit an aesthetic response, it needs to be no more that merely taxonomic. … If such socially and cognitively impoverished stimuli can elicit aesthetic appraisal, then it is plausible to assume that all stimuli can” (Whitfield, 2004, pp. 13–14). “Artists and philosophers alike have argued that the esthetic value of art objects depends on the coherent and harmonious arrangement of the individual visual elements and features that make up the composition (Burke, 1757; Kandinsky, 1914; Matisse, 1908; Nietzsche, 1888; Paul, 1988). Consequently, the aesthetic effect of an individual feature in an art object has to be appreciated in the context of other visual features surrounding it. I refer
to this dependency as ‘contextuality’” (Redies, 2007). This study hypothesizes that some visual features (or ‘disembodied stimuli’) may have meaning and aesthetic appeal in the absence of context.

**Theory of Perceptual Aesthetics**

The Perception Theory of Visual Communications was elaborated by Ann Marie Barry (2004). The purpose of this theory is to describe “the application of neurological research and accepted psychological principles to the study of visual communication” (p. 45). Barry later refined the theory, introducing the idea of aesthetics. The theory evolved into a theory of Perceptual Aesthetics.

“Neurological research has shown that humans respond pre-consciously and consciously, logically and illogically, to visual imagery” (Barry, 2005, p. 45). Visual communication is parallel to perceptual processes; both are emotion-based systems of response.

This study provided evidence for the Perceptual Aesthetic Theory by recording participant’s emotion responses to different typestyles and extended the theory by illuminating the interdependence of the visual and emotion systems within the neurological processing system.

According to Barry (2005) if any communication theory is to be useful, it must both consider neural processing of vision and emotion and be compatible with neurological research. According to Barry’s Theory of Perceptual Aesthetics, visual communication should not be separated from the physiological processes of vision,
attention, and perception of the audience/viewer. Barry asserts that attention should be
given to the neurology of vision.

**Visual Social Semiotics**

Graphic design and typography are communication modes that are understood
through a culturally and collectively construed visual language. So, a second question
inherent in this study is, how can people interpret visuals as having the same or similar
meaning? Another theory that underpins this study is the science of Visual Social
Semiotics (Jewitt & Oyama, 2001). According to Van Leeuwen (2005), typography is an
important area of visual literacy that so far has been neglected in social semiotic theory.
However he asserts that, “Typography is a wonderful site to observe semiotic change”
(Van Leeuwen, 2005) [because] “Typography is radically changing the semiotic
landscape of our time” (p. 142).

Visual Social Semiotics accounts for the role of the designer and the role of the
audience, and therefore provides a secure underpinning for a graphic design analysis. A
visual social semiotics of typography would examine the structure of letterform features
as well as the response of the viewing audience. Though situated in linguistics rather than
graphic design, Visual Social Semiotics, primarily examines visual texts to deconstruct
the set of rules by which members collectively understand visual resources.

Social semioticians examine resources (codes) from both representation
(encoding) and interpretation (decoding) signification processes. Contemporary
semioticians study how meanings are made—the communication as well as the
construction and maintenance of reality (Chandler, 2005). The theory recognizes
the potential for makers of visual representations to constrain social meanings by emphasizing certain interpretations over others. Designer producers of visual representation change and revise the rules of visual grammar and images in mass communication. Meaning of visual representation is therefore malleable, influenced by the designer yet also socially and culturally constructed by its audience.

The alphabet in all its forms is a set of symbols and signs representing vocalizations (sounds) of a given culture. Typographic designers create alphabets to signify specific tone and thereby configure basic elemental shapes to communicate.

The present study contributes to visual communications theory, that is, the study of visual imagery and text, by positioning typographic design alongside image and text as another category of semiotics. Further, it provides what may be the first empirical support for the Theory of Perceptual Aesthetics (Barry, 2005).

**Typography**

This short overview of the history of typography presents highlights and advancements that are of particular interest to this study. Several excellent books about the history of typography are available. The reader is encouraged to consult the literature to become further informed about the rich interplay between industrialization (that is, printing technologies) and the globalization of typographic communication arts, including the growth of sophistication in typographic design expression.

Many designers would concur that typography is an art born of necessity, handwriting, industrialization, and the desire to communicate widely. In ancient texts such as the Dover Bible (Fig. 3), scribes hand-lettered (calligraphy) and illustrated with
inks, hand-rendering in order to produce manuscript copies. Calligraphic letterforms of ancient texts held no intrinsic meaning rather the typographic hand appeared to decorate text, adding, along with the illustrations, an aesthetic visual interest. The meaning of letterform shapes is closely associated with the historical time period with which they are associated (Van Leeuwen, 2005). Typestyles are divided according to similarities of design features and grouped into time periods called classifications, not unlike the division of art into stylistic movements across art history.

Fig. 3. The Dover Bible. By Unknown Miniaturist, English (active c. 1150 in Canterbury) (Web Gallery of Art (#15730):) [Public domain], via Wikimedia Commons Creative Commons, Wikimedia Foundation, Inc.
Johannes Gutenberg invented a method to reproduce many copies of a written work through a printing process composed of ‘moveable type,’ small rectangular pieces of lead upon which were cast a single letter or character of the alphabet. For centuries, the Gutenberg Bible was widely thought to have been the oldest known book printed with moveable type. UNESCO confirmed in 2001 that the earliest known book was printed with moveable type in 1377 and predated the Gutenberg Bible (Fig. 4) by 78 years. The Korean title *Jikji, Selected Teachings of Buddhist Sages and Seon Masters* (Fig. 5) and the moveable type cases that printed the book (Fig. 6) are currently in the collection of the Bibliothèque Nationale de France, in Paris.

*Fig. 4. Gutenberg Bible. Creative Commons, Wikimedia Foundation, Inc.*
Early methods of printing with raised letterforms fashioned in metal required typographers to craft single letterforms by hand, a lengthy precision process. As a result, only a few different font designs were available.
Graphic design and typography are greatly influenced by the production process. Between the invention of moveable type and the digital media platform of today’s typographic design, significant iterations of mechanical and photographic reproduction kept the industry thriving. Eventually computing and software managed to replace the skill and mechanics of typographic and printing industry. Typesetting machines and their operators were supplanted by new typesetting capabilities of the personal computer. Once the thriving domain of expert typesetters, today typography is the domain of graphic designers. Eventually designers too may be supplanted because of the availability of typeface selections in word processing software distributed worldwide.

In 1984, Apple Computer assigned 256 unique font ID’s to catalog typefaces for their computers; they thought that number of font selections would be enough (Simonsen, 2011). In a little over 20 years, the number of fonts available through Internet websites has grown exponentially. Bloggers on the well-regarded “Typophile” website estimate that there are more than 100,000 fonts distributed by reputable type foundries. An innumerable selection of fonts have been digitally designed and distributed by amateurs (Daniels, 2010) and yet new fonts are still being added every day (de Jong, 2010).

The means for typographic expression, word processing software, enables anyone, those with training and amateurs alike, to make aesthetic choices among thousands of typefaces and styles (Van Leeuwen, 2005). Spiekermann & Ginger (2003) contend that typography is not an art for a chosen few, but a powerful tool for anyone who needs to communicate, whether in print or online. A “grammar” of typography has yet to be written (Neuenschwander, 1993 in Van Leeuwen, 2005) and some practitioners fear that
if a grammar of typography were written, its prescriptive rules would stifle creativity, but this has not been proven.

**Design of type**

“What is type? Between type’s past and its future, our present understanding of type is rooted in who we are and how we communicate. Type is a living entity integrated into society’s moods and trends” (Spiekermann & Ginger, 2003).

Typography is an art and a craft that, according to Wheildon (1996, in Brumberger, 2003a), has little or no empirical evidence to support its largely intuitive practice. To date there has been no objective research on psychological aspects of typefaces (Burt, 1959; Brumberger, 2003a). Instead, graphic designers have a fully-developed method to identify typographic features. One of these methods identifies the historical classifications of typography (see Fig. 7). These design features convey meaning with respect to world history.
Fig. 7 Major historical classifications of type. “Thinking with type” by Ellen Lupton. Copyright © 2004, 2010, Princeton Architectural Press. Reprinted with permission.
With the mathematical precision of computing, designers have developed methods to mechanize design of type itself. The multiple master matrix (see Fig. 8) describes variations in weight and character width on a two-axis model. Built in to the model are variations that consider the size of reproduction. As the size increases, the letter fit (spaces in between the letters) tightens, counters become smaller (that is the space within the letter, such as the white space inside an ‘O’), serifs become finer, the overall weight becomes lighter, and the x-height gradually decreases in size (Adobe, 2011).

![Multiple Master matrix](https://via.placeholder.com/150)

**Fig. 8. Multiple Master matrix. Copyright ©2010 Enfocus NV. Reprinted with permission.**

A. Master  
B. Font property  
C. Design axis  
D. User-defined variant  
“in-between”

“Multiple master fonts are customizable PostScript fonts. The multiple master font format describes a typeface’s characteristics using linear design axes, which include weight, width, optical size, and style (that is, slab, serif [historical classification]). Each design axis has a linear range. For example, Myriad’s weight axis range is 1 to 830, and its width axis range is 1 to 700.

Typography is understood partly through context. The meaning of a typeface is a combination of letterform features, layout and composition, color, context, relationship to content, and position in history, society, and culture. Typestyles are malleable. A designer makes purposeful typestyle selections to develop an association between content
and visual form, which Zachrisson (1965) defines as emotional connotation, or typeface congeniality (in Morrison, 1986).

Some researchers have suggested that typefaces that are selected for use in a communication should convey the content of the message, however there are a number of ways that text and image can interact in a layout to convey a message.

When a designer selects a typeface, its style conveys meaning. There are four affective functions of type (Harrison & Morris, 1967, in Morrison, 1986). Designers can (1) match the style of the typeface with the connotations of the message. (2) Designers can choose typestyles that are opposite in meaning to message. (3) Designers may select typestyles that are apparently neutral in meaning from the message. (4) Typestyles can be selected to portray a meaning that is independent from the message, to add another layer of meaning to the message.

A designer achieves different styles by manipulating the parts of the letterform. Figure 9, below, shows how different styles are achieved by manipulating the type of terminals (the shape made at the ends of strokes, such as square, or round, etc.) and the fillet or bracket (different terms used to mean the same part of the letter form, the connection formed between a serif and a stem stroke). As the multiple master font example shows (Fig. 8), typographic forms may vary in weight (light or bold), character width (condensed or extended), and size. Figure 7 shows how a designer can select from historical classifications (old style, transitional, modern, slab serif, and humanist sans serif, geometric sans serif, and modern sans serif) to convey meaning.
Figure 9. Terminal (here, called ‘serif’) construction. Copyright © 2005, John Wiley & Sons. Reprinted with permission.
In attempting to convey the relationship between form and meaning, several authors (Spiekermann & Ginger, 2003; Armstrong, 2005; Koch, 2006) have written about the analogy between visual and audible semantics—music and typographic meaning. Examples of this connection: In the language of music, increasing volume and lower pitch suggests the typeface would have heavier weight (see Fig. 10) to appear bolder, or a larger x-height (see Fig. 11) to appear taller/larger. When designers apply larger weight and taller x-height, those features help contribute to viewer perceptions that those words are more important, dominant, or strong.

Fig. 10 “Notes on Type” interactive typography learning game, weight module. As a user presses the small diamonds, the music becomes progressively louder, the letterform appears progressively bolder, and the background becomes progressively brighter and darker. Copyright © 2006, Beth E. Koch.

Fig. 11 “Notes on Type” interactive typography learning game, x-height module. As a user uses the slider to increase the volume by increasing the x-heights. The height of capital letters remains the same. Each typeface shows increasingly taller x-height, and the background becomes increasingly brighter and darker. Copyright © 2006, Beth E. Koch.
Analogies may help people to understand the connection between letterform construction and meaning, but they do not provide the researcher with measurable, clearly defined variables that would allow typographic research to be generalized.

**Typographic meaning studies**

“Trying to accurately identify the intentions, connotations and associations surrounding the vast resource of typefaces is far from simple to achieve” (Cahalan, 2007). Of more than 73 studies of typographic meaning, 16 examined the connection of emotions and typestyles. Few of these studies were conducted by experts in the use and application of type. This is troubling, but perhaps of the most concern in an emotion study is the lack of attention to the proper identification, definition, application, and measurement of emotion. As a result, very few of the extant studies can be compared or generalized, even the most recent.

Of those that were noted to have studied emotion in typographic meaning research the following approaches were taken:

- Adjectives, feelings, moods, or attitudes were studied in Poffenberger & Franken, 1923; Kastl & Child, 1968; Brinton, 1961; Kostelnick, 1990; Tantillo, Di Lorenzo-Aiss, & Mathisen, 1995; Parker & Tylor, 1997; Gump, 2001; Brumberger, 2003a, 2003b; and Samara, 2006.

- Atmospheric qualities were studied by Ovink (1938) and Poffenberger & Franken (1923).

- Connotations were studied by Albers, 1963; Zachrisson, 1965; Benton, 1979; Rowe, 1982; Morrison, 1986; and McCarthy & Mothersbaugh, 2002.
• Typographic ‘dress’ was studied by Stockl, (2005).

• Semantic quality was studied by Osgood, Suci, & Tannenbaum, 1957; Brinton, 1961; Tannenbaum, Jacobson & Norris, 1964; Bartram, 1982; Rowe, 1982; and Childers & Jass, 2002.

• Multimodal features were studied by Walker, Smith & Livingston, 1986.

• Researchers Davis & Smith (1933) and Juni & Gross (2008) employed emotionally-charged content as stimuli.

• Typeface personalities was the focus of research by Seacrest, 1947; Mackiewicz & Moeller, 2004; Aaker, 1997; Bernard, Mills, Peterson, & Storrer, 2002; and Li & Suen, 2010.

• Typefaces with ‘personas’ that convey certain human characteristics were studied by Secrest, 1947; Baylis, 1955; Warde, 1956a, 1956b; Benson, 1985; White, 1988; Tschichold, 1991; Spiekermann & Ginger, 1993; Shushan & Wright, 1994; Bringhurst, 1996; Parker, 1997; and Kostelnick & Roberts, 1998, Brumberger, 2003a.

Design researchers need to question the foundations on which the foregoing research is built. None of these approaches exclusively used the terminology of emotion, in accordance with how an emotion psychologist might define emotion, and many have not used the correct terminology of typography.

Two of the older studies utilized one or two psychologically accepted emotion terms that were also used in this study: Among the responses in a study by Davis & Smith, (1933), the emotion ‘satisfaction’ was used. Kastl & Child (1968) used emotions
‘joyous’ and ‘sad’. These three are emotions, widely accepted in the psychology of emotion community, and these terms were used in this study.

A visual response tool developed and validated by Pieter Desmet for use in product design and emotion research was used to gather responses for this study. (See the appendix for more information about PrEmo™ and the questionnaire design.) The interactive online-deployed response mechanism consisted of animated characters but used no words (numbers were pictured on the arousal scale). The characters portrayed emotion terminology used in psychology emotion research. It is important to differentiate between emotion response variables, as opposed to feelings (the behavioral result from emotion), or affect (the facial and vocal expression, feelings and body language associated with emotion) or moods (feelings that persist).

Since typographic designers use design features of a typeface to communicate specific meanings, this study used established letterform construction features, typographic design conventions and that are widely used in typographic practice. The range of features can be observed and exemplified in the Adobe multiple master descriptions earlier in this chapter. Weight, character width, classification, and terminal shape were the typestyle design features selected for stimuli comparison.

Ovink (1938) concluded that weight, the light-bold dimension of a typestyle, was primarily responsible for the emotional meaning of typefaces while Davis & Smith (1933) asserted that size, slant, style [classification], and condensation were also factors.

Samara (2006) has written Type Style Finder, a book that categorized typefaces according to largely variable semantic qualities: moods, concepts, time and context, and
Response to typographic design is subjective, according to Samara (2006), is based upon personal experience and culture, and thus individual. He contends that formal features of typefaces may be the most reliable way to impart meaning (Samara, 2006).

Methodologies in typographic meaning studies

One of the disadvantages of multiple discipline research in typography is the diversity of methods that have been employed, which results in an inability to clearly build upon previous research findings. Diverse areas are involved in studying typography and its impact on humans. During a representative literature research the following disciplines had the majority of studies of typography: advertising, consumer studies, linguistics, product design, curriculum and instruction, English, rhetoric, professional communication, writing, marketing, and business.

An example is a study by Brumberger (2003) investigating participant determination of the congruency between meaning of written text and typeface persona. Brumberger’s investigation of typefaces the field of Rhetoric presented participants with a semantic differential of paired opposites by which to judge the meaning of a sample of text. This approach used characteristic personality traits that are impossible to quantify. Therefore, like many of the studies consulted herein, results are impossible to compare.

There is an unfortunate dearth of research in graphic design in general. So in making this literature review it is vital to understand which of the disciplines is engaged in typographic research since each discipline imposes its own research approaches and methods for inquiry that affect results and conclusions of a study. For example,
researchers in English and Rhetoric typically employ written questionnaires to study visual literacy, while this study employed a visual interactive method.

Researchers in other disciplines, for example in marketing, business, and consumer studies, have been critical of research in design, observing that designers rely upon intuition to justify creative decisions. The primary point of visual research in the field of consumer studies is to obtain scientific facts to support business expenditures on advertising and branding. But various fields in design are currently producing empirical literature, more than in the past, and designers need to be encouraged to produce evidence about design and expand studies of its social, psychological, and cultural significance, whether or not the knowledge revealed supports commercial interests.

**Stimulus format in typographic meaning studies**

Some typography studies have adopted stimuli consisting of panagram sentences, (sentences using all the letters of the alphabet, such as “The quick brown fox jumps over the lazy dog”) or entire pages of text such as the study by Poffenberger & Franken (1923) that used introduction to the Declaration of Independence, or studies that used paragraphs of ‘greek’ text (eg. Lorem ipsum). The stimulus phrase, ‘Now is the time for all good men’ was employed in a study by Davis & Smith (1933). Stimulus sizes ranged from 12-24 pt with various amounts of message displayed as result. The first line was presented in all UPPER CASE letters, second line in Upper and Lower Case. Some studies feature side-by-side pages of real text, comparing different typefaces for each text. Some studies show a single letter to participants. Other studies use an entire alphabet.
The presentation format of stimuli in a typographic design study is important because participants evaluate stimuli that are visual in nature. In order to keep subjects sustained in a right-brained task where they would attend to visual design features rather than engaging their cognitive skills by attempting to read, I chose stimuli that were simple alphabets samples with numbers.

Questionnaires normally rely upon gathering participant responses generated through speech or written language. Language requires the brain to take in visual or auditory information, generally a right-brained activity, then to switch to a left-brained logical-sequential activity in order to formulate a response.

Some studies required participants to ascertain the meaning of a typeface also a paired opposites scale known as a ‘semantic differential’ (Osgood, Suci, & Tannenbaum, 1957). This approach is problematic, since opposite pairs may not be true opposites. Even so, some researchers have found the method appropriate (Tannenbaum, Jaboson, & Norris, 1964; Wendt, 1968; Bartram, 1982; and Rowe, 1982).

The two schools of thought regarding the relationship of typography and expression are aptly demonstrated by the practical orientations of its first researchers. In his attempt to develop terminology to enable discussion of typography, Ovink (1938) called the properties of a typeface that arouse feelings, ‘congeniality.’ Warde (1956), on the other hand, felt that typography ought to be neutral in expression: She developed the analogy that like the relationship between a beautiful goblet and a good wine, a reader should not be aware of the typeface at all. This view is in line with the viewpoint born of
fine book printing and its concerns with legibility and readability, while Ovink’s view represents the advertising viewpoint with its need for design to attract attention to itself.

In eighty-eight years of typography research, there has been no attempt by researchers to use a common definition of emotion, nor to use commonly accepted emotion and typography terminology, nor have researchers seen the need to use visual methods to assess visual judgment; the appropriate form to use for stimuli has not been settled, nor have researchers agreed upon specific data collection approaches or matrices by which to measure emotion. A unified approach is essential, but each of these choices is complicated by the various viewpoints in their respective ongoing areas of research. So which should be used? For example, should researchers present stimuli formed as a passage for reading, or a passage presented in gibberish, or an alphabet (and whether in upper case, lower case, all capitals, or mixed presentation), or just single letterforms (commonly the letter “h” or “H”)?
CHAPTER 3: METHODS

Introduction

Winkielman & Berridge (2004) have proposed that people’s conscious reactions of liking and wanting are first present without a person’s awareness (Lindgaard, Fernandes, Dudek, & Brown, 2006), in unconscious biopsychological processes. Because nonconscious processes are important factors in consumer behavior, evaluation, and choice (Zajonc, 1968; Bornstein, 1989; Bornstein & D’Agostino, 1992; in Tom, Nelson, Srzentic, & King, 2006), and because design affects humans emotionally as well as visually (Norman, 2004), it would be valuable for designers to understand more specifically how people respond emotionally to elements of design. People respond emotionally to art (Wittgenstein, 2005), to design (Norman, 2004), and to products (Desmet, 2002). Certain areas of the human neuroanatomy are assigned to processes specific parts of the visual signal, such as recognition of facial expression.

So, to begin to understand how people respond emotionally to individual design features, this study investigated how people interpreted different typestyles (alphabet designs).

Research Questions

The research aims of this study were to understand whether emotion is involved in interpreting visual information (typestyles); Second, to understand whether people have the same or similar interpretation of visual information (typestyles designs); And third, to know whether there was a link between typestyle construction features and
emotion responses. The aim was to understand whether design features could be linked to emotion for purposes of interpreting visual information.

The study focused on three research questions: Q1: Does viewing specific typefaces produce emotional responses? Q2: When viewing typestyle designs, do all people feel the same emotions? Q3: Are certain emotions predominantly associated with the formative design features of typefaces—differences in classification (serif or sans serif), terminal construction (angular or rounded), character width (condensed or extended), and weight (light or bold)?

<table>
<thead>
<tr>
<th>Research Questions</th>
<th>Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1: Does viewing specific typefaces produce emotional responses?</td>
<td>Since many people (including some designers) find it difficult to select appropriate typestyles, find out whether participants can sense emotion when viewing typefaces.</td>
</tr>
<tr>
<td>Research aim is to understand whether emotion is involved in interpreting visual information/typestyles.</td>
<td></td>
</tr>
<tr>
<td>Q2: When viewing typestyle designs, do all people feel the same emotions?</td>
<td>Ask participants to rank their emotion response to the typefaces on an arousal scale from no emotion to high emotion response (0-4).</td>
</tr>
<tr>
<td>Research aim is to understand whether people have the same or similar interpretation of visual information/typestyle designs.</td>
<td></td>
</tr>
<tr>
<td>Q3: Are certain emotions predominantly associated with the formative design features of typefaces—differences in classification (serif or sans serif), terminal construction (angular or rounded), character width (condensed or extended), and weight (light or bold)?</td>
<td>After participants have responded to the six typestyles stimuli, find out if there is a relationship between type design features and people’s responses.</td>
</tr>
<tr>
<td>When people look at different typestyles, does the way they respond have anything to do with the way the design was constructed? Research aim is to understand whether design features are linked to emotion for purposes of interpreting visual information.</td>
<td></td>
</tr>
</tbody>
</table>

*Table 2. Research questions and objectives.*
Objectives

This study investigated design and emotion. The goal of the study was threefold: one, to discover whether participants report emotion when viewing typeface designs, two, to determine whether all participants reported the same emotion when viewing different typefaces, and three, to ascertain whether specific emotions could be linked to specific typographic design features. In order to answer these questions, the following objectives were developed in accordance with the literature: Objective 1—Since many people (including some designers) find it difficult to select appropriate typestyles, find out whether participants can sense emotion when viewing typefaces that, on the surface, appear to have no meaning. Objective 2 was developed to answer the second research question: Compare participants’ emotion responses to different typestyles—typestyles that on the surface appear to have no meaning. Use a visual survey methodology to collect responses to visual stimuli; keep participants attentive to visual features rather than thinking about how they feel. Ask participants to rank their emotion response to the typefaces on an arousal scale from no emotion to high emotion response (0-4). And to answer the last question, these objectives were formed: After participants have responded to the six typestyles stimuli, then group stimuli according to design feature categories (weight, character width, classification, and terminal shape). Conduct an analysis of paired comparisons of the findings to ascertain the relationship between emotions and design features.

Hypotheses

The hypotheses and null hypotheses addressed in this study were as follows:
H1: People respond emotionally to the design of typestyles.

Null H1: Viewing typeface designs produces no emotional response in participants.

H2: Subjects feel the same emotions when viewing different typestyle designs.

Null H2: Subjects do not feel the same emotions when viewing different typestyle designs.

H3: Specific emotions (desire, satisfaction, pride, hope, joy, fascination, disgust, dissatisfaction, shame, fear, sadness, and boredom) are correlated with specific typographic design features of type (sans serif classification, serif classification, angular terminals, rounded terminals, condensed character width, extended character width, light weight, and bold weight).

Null H3: There is no correlation between emotions and design features of type.

The selection of the typography subject allowed the researcher to focus on four independent design features of letterform construction. This study design easily allowed for control of the design variables.

The design variables selected for this study (weight, character width, terminal construction, and historical classification) are widely accepted concepts of typographic construction, understood and accepted among graphic design practitioners and typeface designers.

Typeface stimuli primarily from the Helvetica family of typefaces were selected because the design features were simple to compare and contrast. In this way the data could be reliably quantified, compared, and statistically correlated to subjects’ emotion responses.
First typestyle stimuli were selected for their homogeneity: that is five of the six typefaces were from the Helvetica font family, and one was Glypha Medium, chosen as the only serif typeface, as opposed to the sans serif classification of the Helvetica family.

**Participants**

In order to answer the question of whether viewing specific typefaces produces emotional responses, whether all people have the same emotion responses to the typefaces, and whether certain emotions are predominantly associated with the formative design features of typefaces, this study surveyed 100 people using an online animated interactive response mechanism. Forty-two participants fully completed the questionnaire, providing the data for this study. Gender: 18 males, 23 females, and one gay participant. Males comprised 43% of responses and females comprised 55% percent of responses.

The questionnaire also gathered demographic data about the participants’ design experience. Of 42 total study respondents, 32 reported that they were designers (76% of the 42 study participants). Of designers, 15 were males (47% of designer participants), 17 were females (53% of designer participants). Non-designers totaled 10 respondents (24% of the 42 study participants). Of non-designers, 3 were males (30% of 10 non-designers), 6 were female (60% of 10 non-designers), and one was gay (10% of non-designers).

Once the questionnaire was written, the study design was presented to the Institutional Review Board at the University of Minnesota, who issued clearance for the study to proceed. The researcher prepared instructions for the questionnaire to provide
information about informed consent to the subjects. Small adjustments were made to the instructions to satisfy the IRB (see appendix).

Invitations to participate in the study were emailed to international typography organizations and national graphic design organizations in addition to postings on the University of Minnesota graduate student listserv (see appendix).

Participants were asked to record their emotion responses to six typestyle stimuli. A convenience sample of one hundred adult volunteers responded to an interactive online questionnaire. Subjects were told that they could withdraw from the study at any time.

Subjects responded to each typestyle one at a time and responded using an interactive response mechanism. The tool, named PrEmo™, was designed, tested, and employed for product emotion design research in the Netherlands (Desmet, 2002).

The data were analyzed to determine the range and mean of the scores across all participants as a whole for each typeface. Then participant responses were used in a paired comparison to examine whether there were differences in emotion ratings arising from differences of design features between the paired typefaces. (See the appendix to view the actual questionnaire. Please note that this printed document cannot capture the sound and animations of the instrument, therefore a URL is provided so the reader may sample the instrument online.)

**Stimuli**

This study examined how participants responded emotionally to six different typeface designs—Helvetica Bold, Helvetica Ultra Light, Helvetica Bold Extended, Helvetica Condensed Bold, Helvetica Rounded Bold, and Glypha Medium.
The method of stimuli presentation was critical to this study. Former typography studies had not accounted for possible interactions between presentation form and method and several of these studies resulted in mixed findings.

Vision is a primary method that humans use to gather information about the world, yet according to Shibles (2010), many key philosophers and scientists assign epistemological primacy to language: Wittgenstein (1968), Barthes, Derrida, Dewey, Hartnack, Heidegger, Müller, Pierce, Ryle, Sapir, Shibles, Waismann, Whorf, and Winch. In this view, humans never experience pure sensation, rather sensation is conceptualized — we “see-as”, we classify, and evaluate what we see using language to express our perceptions.

The notion that ‘language has primacy’ is important in this study in regard to how data were collected; although esteemed scientists attributed epistemological primacy to language, what brain researchers now understand by observing and mapping neural processing is that, we should be assigning epistemological primacy differently.

fMRI imaging has shown that preconscious experience is primarily a physiological event: emotion given to sensation (or sensory experience). With this understanding, primacy is given to emotion; secondarily, the senses (for example, vision); and tertiary events are those connected to cognition (for example, language, judgments, and feelings).

For studies inquiring about responses to visual stimuli, Morrison (1986) suggested that the response mechanism should utilize a non-verbal reporting method.
It was important to decide the condition of the stimuli—whether the stimuli were presented as words, sentences, single letterforms, or alphabets. This study used stimuli in the form of visual alphabet samples to convey the typeface design features, rather than explanatory text. The purpose of this design was to avoid an interaction between visual typeface design features and the verbal or semantic meaning of a passage of text.

Stimuli in this study consisted of six different typeface designs: Helvetica Light, Helvetica Bold, Helvetica Condensed Bold, Helvetica Bold Extended, Helvetica Rounded, and Glypha Medium. The specific typestyles were chosen for their homogeneity.

In this study, participants were asked to make emotion judgments about visual stimuli. Typically, such responses would be generated through speech or written language. After reading the instructions and introduction to the questionnaire, participants were not asked to read anything additional. In a situation where study participants are directed to complete a task such as reading, the results might be different. Some researchers stressed that responses to design should be conducted in ‘natural’ settings, therefore participants were asked to read passages. Since in this study the objective was to find out whether participants responded emotionally to the design features of a letterform, asking participants to read would have defeated the purpose of this study, which was to learn about visual literacy and the derivation of emotion from typestyles.

The most well-known typeface design in the world is a typeface called Helvetica. This typeface was chosen for the study because it is relatively non-descript in design features, that is, without ornament or features to indicate what situations the typeface
might be appropriately used in. This typeface is well represented in international visual
culture, used in a variety of contexts and applications. Its style is seen as universal and as
such, the meaning or emotion of the typestyle may be difficult to decipher. However, the
simplicity of the typeface made it an optimal choice as the basis for stimuli selection,
since its attributes could be carefully controlled: the design variables could be matched to
design variables in other typestyles, resulting in pairs of typefaces with one variable of
design different between them. That is, the typefaces were paired in such a way that the
pairs varied along only one typographic design dimension: Either classification, weight,
character width, or terminal form. Depicted below are the stimuli.

Figure 12. Typeface name: Glypha Bold

Figure 13. Typeface name: Helvetica Bold
Figure 14. Typeface name: Helvetica Condensed Bold

Figure 15. Typeface name: Helvetica Heavy Extended

Figure 16. Typeface name: Helvetica Ultra Light
In order to address the research questions, 42 participants completed an online questionnaire asking them to identify how strongly they felt a certain emotion for a given typeface design. For each typestyle, respondents rated twelve emotions grouped into six positive valence and six negative valence dimensions. Subjects ranked the strength of each emotion on a scale from 0-4, 4 being strongest, 0 being weakest).

The typeface stimuli were selected and paired according to design construction criteria: Each pair had all design features in common, except that they varied on one design feature: weight, character width, terminal construction, or classification. Participants did not know that the typeface designs had been selected and paired according to shared and differing design features.

Typestyles were paired as follows: The categories included weight (paired responses from light and heavy typefaces), historical classification (responses paired from serif and sans serif classifications), terminal shape (squared and rounded terminal
shapes), and character width (paired responses from condensed [narrow] and extended [wide] typefaces).

After the initial data had been collected, paired $t$-Tests were conducted to compare scores according to typestyle categories (e.g. to compare typestyle weights, responses to the typestyle Helvetica Ultra Light were paired with the same subject’s responses to the Helvetica Bold typestyle).

The data were analyzed in a Paired $t$-Test to observe and compare mean responses for each typestyle category. The study adopted an alpha level of $\alpha = .05$ in the Paired $t$-Tests. Corresponding confidence level was set to 95%.

**Forming the Study**

Several studies investigating the semantic meaning of typefaces have been published that have offered a philosophical orientation that differs from this study. Most design studies evaluate the designed stimulus itself. This study focuses on the human emotional response to design.

Design researchers working in the area of typography are to be cautioned in designing both the research methods and the study itself, as a number of considerations affect the validity, reliability, and repeatability of typographic studies.

Design is multi-disciplinary. The researcher must be sure to clearly define terms. Designers need to select definitions, instruments, and methods that originate from their primary disciplines, such as psychology for example.

Design researchers need to understand the brain and the processes associated with seeing and perception. Knowledge of neural process guides the selection of visual
methodologies for design research because the right- and left-brain process different kinds of information. If subjects in this study had been asked to perform a left-brained cognitive task such as reading while trying to perform the right-brained task of decoding images and recognizing emotions, switching between different sides of the brain may have produced much different results.

Of further concern in graphic design research that investigates elements of design is the need to clearly articulate and define variables. Some of the relevant existing studies about type meaning have described typeface designs as personalities or polarized attributes. Meaning is created within individual people—it is not telegraphed by a design. Specifically, this study asked the participant how they felt about six typeface designs across twelve dimensions of emotion rather than asking respondents what meaning was conveyed by the typeface. It is essential to avoid personification, which in design research is the attribution of human qualities to design and designed objects.

**Instrumentation**

People are more adept at reading facial emotions than talking abstractly about emotions. In the early days of cognitive psychology, researchers couldn’t determine how to study emotion, so they focused on other things (Norman, 2011, personal correspondence). Before the development of medical imaging techniques that could look inside the brain to study subjects like emotion and vision, Paul Eckman (1972) developed the 60-Face Test to study emotion. FACS is a group of black and white photographs of six men and four women displaying six different basic emotions each. Eckman’s research
demonstrates the importance of using a visually based instrument, since the brain processes faces and design illustrations in different neural structures.

In order to obtain information about how people interpreted typestyles, it was important to select a questionnaire method that was not language-based. This study involved primarily right-brained activities, judging visual stimuli. The decision to select a visual reporting mechanism for this study was reinforced by Morrison (1986), who first suggested it. Understanding the most recent scientific findings about how the brain processes vision reinforced this decision. In order to keep participants focused on feelings and emotions, which are right-brained processes, a visual instrument was chosen to limit participant’s cognitive neural processing as much as possible.

At Delft University of Technology, industrial design professor Pieter Desmet (2002) developed a sophisticated rich media research tool to measure product emotions. PrEmo™ is an interactive emotion indicator and was the protocol chosen to measure emotion in this study.

PrEmo™ is a unique scientifically validated non-verbal self-report method to measure emotions. It is a visual interactive online instrument that had been designed specifically to measure product design emotions (Desmet, 2002).

The instrument, called PrEmo™, is an online interactive tool used to collect responses to product designs. Its form is a grid of buttons containing cartoon characters that are activated by the user’s mouse click. Once clicked, a character animates. It acts out the body language, facial expression, and makes the sound connected with the emotion portrayed by the button. There are no labels to indicate what emotion is being
demonstrated. The non-verbal nature of the instrument is important because seeing design and feeling emotion are largely right-brained activities.

![Image of animated characters](http://www.premo-online.com/en/how-does-it-work/)

*Figure 18. PrEmo™ interactive animated characters*

Cartoons portrayed facial expression, body language, and expressive sounds associated with each emotion (see Fig. 18). Users were directed to click on a cartoon character in order to see the animated emotion response and to hear the audible expression of the emotion.

Since Desmet released the first PrEmo™ tool in 2002, a new and improved version has been released together with SusaGroup. PrEmo™ is now offered in an online format that lets the researcher setup and manage experiments in the online environment. This is the instrumentation selected for this study.
Data Analysis

While it would have been possible to conduct this study and gather purely qualitative data, these questions were better answered by quantifying qualitative data. Thereby, qualitative variables such as emotion responses, which we think of as highly individual, could be quantified, measured, and compared, rather than simply described.

Physiological measurements such as heart rate and perspiration, or skin conductive response were the physiological measures most frequently employed in emotion studies, but these measures don’t give sufficient information to explain behavior. Successful emotion studies in psychology measure both valence polarity and arousal strength. This study followed that precedent. There were twelve emotions, both positive and negative, that were rated in arousal strength on a 5-point Likert scale labeled “0” (I do not feel this) to “4” (I feel this strongly) for each typestyle.

Within the discipline of design, there is general difficulty in isolating the multiple overlapping variables in a given design. Therefore the results of many studies attempting to assign cause or attribute meaning of audience/user responses to specific design features has been impossible because too many variables confound study results.

In this study, typestyles were specifically chosen because their design characteristics were very similar: five of six were typestyles from the Helvetica typeface family. The study was organized in this way in order to compare two typefaces that varied only in the feature being analyzed. Typestyles were paired so that only one attribute varied between them. For example, the single design difference between Helvetica Bold and Helvetica Ultra Light was the variable of weight. These typographic
design dimensions are as follows: Variations in weight: the typestyle being either bold or light; variations in character width: typestyle design was condensed or extended; and variation in classification: the typestyle was either serif or sans serif, and variation in terminal style: square or rounded (see Table 3 below).

<table>
<thead>
<tr>
<th>TYPEFACE</th>
<th>Serif</th>
<th>Sans serif</th>
<th>Light</th>
<th>Bold</th>
<th>Condensed</th>
<th>Extended</th>
<th>Square</th>
<th>Round</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Glypha Medium</td>
<td></td>
<td></td>
<td></td>
<td>•</td>
<td></td>
<td></td>
<td></td>
<td>•</td>
</tr>
<tr>
<td>2 Helvetica Bold</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td></td>
<td></td>
<td></td>
<td>•</td>
</tr>
<tr>
<td>3 Helvetica Bold</td>
<td>•</td>
<td></td>
<td>•</td>
<td>•</td>
<td></td>
<td></td>
<td></td>
<td>•</td>
</tr>
<tr>
<td>4 Helvetica Bold</td>
<td></td>
<td></td>
<td></td>
<td>•</td>
<td>•</td>
<td></td>
<td></td>
<td>•</td>
</tr>
<tr>
<td>5 Helvetica Ultra</td>
<td></td>
<td></td>
<td>•</td>
<td>•</td>
<td></td>
<td></td>
<td></td>
<td>•</td>
</tr>
<tr>
<td>6 Helvetica Rounded</td>
<td></td>
<td></td>
<td>•</td>
<td>•</td>
<td></td>
<td></td>
<td></td>
<td>•</td>
</tr>
</tbody>
</table>

Table 3. Typographic design attributes of typeface stimuli.

**Limitations**

Humans have survived and evolved in part as a result of emotion. This study assumes that human beings have emotions and their behavior is driven by emotions. The study acknowledges that different people have varying capabilities of emotion: Some are considered emotionally advanced; some are considered emotionally handicapped; some are considered devoid of emotion due to injury or illness; and emotional dimensions change as people get older (Doost, Moradi, Taghavi, Yule & Dalgleish, 1999, in Kim, et al. 2003). This study assumes emotional competence but does not discuss emotional intelligence.

Typestyle stimuli employed in this study are limited and therefore do not fully encompass the vast range and complexity of the available typographic designs.
The study of emotion responses can be difficult. Asking participants how they feel can produce mixed results for a variety of reasons. In order to limit some of these problems, this study used animated cartoon characters to demonstrate the emotions visually and collected data through the use of a visual response mechanism. Using this methodology, participants could register conflicting feelings, or co-occurring feelings, and even report not feeling any emotion. Responses were registered on an emotion intensity scale 0-4 that was attached to each emotion cartoon.

An important acknowledgement of the limitations of this study is that even if one chose to develop a design and emotion guideline for designers to follow, there is no guarantee that people would respond in the intended way. Myriad influences can affect individual responses.

Throughout this study the researcher has taken care in selecting and pairing the stimuli since serious difficulties exist in researching the effects of a design. Designed objects often contain many competing variables that can confound the results of a study: the variables must be isolated (Stemler, 1997).

Stylistic fashions come and go, as do preferences for typefaces. Culture, visual trends, and even ethnicity may have been factors in this study. Longitudinal studies of typography are indicated.

**Validity and Reliability**

In several studies that investigated the meaning of typestyles, participants were asked to identify the personality portrayed through the type design by choosing among polarized adjectives. In a few cases, studies attributed emotions to the overall typestyle
design. The emotion variables herein were adopted from product design instruments. It was expected that adopting a design method and emotion variables from an allied design discipline would ensure greater applicability of the results to design.

Research in many of the design specialties tends to focus not on the human at the center of the work, but on the problem, object, article, or idea being designed. Often semantic differentials, heuristic, or factorial methods are selected. As much as there is a requirement for design works to be originated from and marketed according to the perspective of the human audience, design research must give equal effort in describing the effects of design works on human beings as it does describing and improving the works themselves.

It is a necessity in design research to ask people how they feel about design and to describe how design affects them, yet as emotion researchers have shown, emotion is hard to measure. In fact, psychological researchers note that emotion is even harder to describe: many people don’t really know how they feel or may even have conflicting feelings, or may be reluctant to talk about or to divulge their true feelings. Other situations might leave people confused as to whether they feel any feelings at all.

Some people are reluctant to share their feelings at all, while others may feel pressed to report what they presume the researcher wants to hear. Studies that gather information about human emotions can be tricky because overreliance on self-reports can produce unreliable results.

Some of the studies presented in the literature review required participants to match adjectives with design, but these miss an important feature about emotion and
feelings: It is well documented in emotion studies that people may feel several emotions at once, resulting in valid but possibly unreliable results. As a result, in this study, participants were asked to select and rate a set of emotions rather than adjectives.

Another area of criticism comes from Morrison (1986), who indicated that the experiments he reviewed all used stimulus materials of a questionable nature:

“Poffenberger and Franken (1923) used the introduction to the Declaration of Independence with no control for type size. Davis and Smith (1933) used the familiar phrase, “Now is the time for all good men …” The type sizes ranged from 12-point to 24-point resulting in various amounts of the message being presented. The first line was always in all upper case letters while the second line included both upper and lower case letters. Kastl and Child (1968), Tannenbaum et al. (1964), and Benton (1979) used letters of the alphabet in their experiments (e.g., ABC… a b c…? + ! @…). The use of words in the stimulus material added a confounding factor to the experiments. The use of the alphabet in sequential order does not represent the visual pattern created by the letters in running text (e.g., how often do the letters “bcde” occur together?). Thus, any effect created by the visual pattern of the letters is lacking (p. 237). …Wendt (1968) recommended a presentation format that was an approximation to English and free from emotional content. Six artificial languages that are different levels of approximation to the English language were developed by Weaver (1949) to resemble the language, but are free from meaning” [for example “ere sasesuth wid oteren bo”] (p. 238). …A second criticism of the prior
experiments is the lack of an orderly criterion for selecting the typefaces that would allow for generalizations” (Morrison, 1986, p. 237).

**Study design**

Initial screening: Participants were asked about their eyesight accuracy, gender, and design education/experience.

Questionnaire: Participants were asked to look at an alphabet design and register their response to the design through button-click selections using the PrEmo™ interactive tool. For each alphabet, participants selected and ranked all twelve emotions. Participants chose each character (one at a time) to rate how strongly they identified the visual design with that particular emotion using an ordinal scale of zero to four that indicated the arousal, or strength of the felt emotion. Overall, six different alphabet designs were surveyed.

**Implementation of the study**

Duration: The questionnaire could be taken once at the volunteer's convenience (during a two week interval). Time to complete the questionnaire was estimated at approximately 15 minutes.

**Statistical Techniques Used**

Typefaces were analyzed during the selection process to produce pairs of stimuli that had similar appearance (typetyles from the Helvetica family of typefaces, for example, were paired). Each pairing differed on a single typographic design dimension as follows: One of the pair of typetyles were selected based upon typographic design differences in weight, light versus bold. A second pairing of typetyles was selected
based upon typographic design differences in historical classification, serif versus sans serif. The third pairing of typestyles was selected based upon typographic design differences in terminal shape, rounded versus squared. And the final pairing of typestyles was selected based upon typographic design differences in character width, narrow (condensed) versus wide (extended).

Descriptive statistics were used to analyze the responses and observe patterns in the data. The mean and range of scores were computed: males and female scores were calculated in order to observe the effects of gender on the data; the mean scores of designers and non-designers were calculated in order to observe the effects of experience on the data. For simplicity of reporting, it was determined to report the detailed findings about gender and design experience in another study.

Typefaces were paired to capture emotion responses on opposing design dimensions. Selection of the paired $t$-Test statistic allowed for direct comparisons of participants’ mean scores for each typeface. Paired $t$-Tests are designed to use one set of data and compare a second set of data to it.

Mean scores from 42 participants were paired for comparison on four typographic design dimensions: weight, historical classification, terminal shape, and character width.
CHAPTER 4: FINDINGS

Introduction

Graphic design plays an important role in helping people to decipher meanings, prioritize, and judge the personal relevance of messages in the environment. Consumer purchase decisions are affected by the congruency of association between a typeface and the brand (Doyle & Bottomley, 2004, 2006), however, Robinson (2004) points out that in this digital age, designers must go beyond aesthetics and industrial feasibility [form and function] to integrate the aspects of “emotional awareness.”

Today’s information age, with its reliance on visual information, places increasing demands on human attention, processing speed, and decision-making—“A wealth of information creates a poverty of attention” (Simon, 1971). The pace and complexity of modern life, according to Cialdini (2001), increases the likelihood that humans will use shortcuts of thinking, causing errors in judgment. And, as people rely more and more on these shortcuts of thinking, they become vulnerable to people who know how to manipulate these fixed action patterns to their advantage.

While much is known about how the brain processes components of vision (motion and spatial relationships, Merigan & Maunsell, 1993; color, Zeki, 1973, 1974b, 1977; Merigan & Maunsell, 1993; edges, Zeki, Perry, et al., 2003; form (shapes), Gulyas & Roland, 1994; Gulyas, Heywood, et al., 1994; Grill-Spector, Kushnir, et al., 1998; Merigan & Maunsell, 1993; Marcar, Loenneker, et al., 2004; and patterns, Pinker, 1984), virtually nothing is known about how categories of design elements are interpreted through emotion and perception. Or for that matter, whether design elements are
processed individually, as basic visual criteria, at all. This study provided the first evidence from typographic design about the role of emotion in visual perception of graphic and typographic designs.

**Alpha Level**

Ordinal scales can be analyzed using Paired t-Tests. These statistical measures help to minimize Type I errors, that is, claiming a difference is significant when it really is not (Sauro & Lewis, 2007). “Setting $\alpha$ [alpha] = .05 provides significant control over the likelihood of a Type I error (rejecting the null hypothesis when there is actually no difference)” (Sauro & Lewis, 2007, pg. 20). Lewis & Haviland (1993) indicates that though knowledgeable authors indicated that the median is the preferred measure of central tendency for studies using ordinal scales, there have been conflicting views. Lewis (1993) found that when multipoint scales (such as 5- or 7-point scales) were used in usability studies, “the mean difference correlated more than the median difference with the observed significance levels (both parametric and nonparametric) for discrete multipoint scale data. Therefore, for these scales in this measurement context, the mean can be a better measure of central tendency than the median” (Lewis, 1993).

**Summary of findings**

Q1: Does viewing specific typefaces produce emotional responses?

H1: People respond emotionally to the design of typestyles.

Null H1: Viewing typeface designs produces no emotional response in participants.

Q2: When viewing typestyle designs, do all people feel the same emotions?
H2: Subjects feel the same emotions when viewing different typestyle designs.

Null H2: Subjects do not feel the same emotions when viewing different typestyle designs.

Q3: Are certain emotions predominantly associated with the formative design features of typefaces—differences in classification (serif or sans serif), terminal construction (angular or rounded), character width (condensed or extended), and weight (light or bold)?

H3: Specific emotions (desire, satisfaction, pride, hope, joy, fascination, disgust, dissatisfaction, shame, fear, sadness, and boredom) are correlated with specific design features of type (light, bold, sans serif, serif, condensed, extended, angular, and rounded).

Null H3: There is no correlation between emotions and design features of type.

**Weight:** Light (Helvetica Ultra Light) vs Heavy (Helvetica Bold)

For the category of ‘weight’, participants responded to Helvetica Ultra Light with significantly higher desire, satisfaction, and fascination than Helvetica Bold:

Participants responded to the design feature ‘light’ weight with significantly higher desire, satisfaction, and fascination than the design feature ‘heavy’.

**Desire**

\[ \text{paired-}t (df=41) = 3.3, \ p = 0.001 \ (95\% \ confidence) \]

**Satisfaction**

\[ \text{paired-}t (df=41) = 2.6, \ p = 0.01 \ (95\% \ confidence) \]

**Fascination**

\[ \text{paired-}t (df=41) = 4.0, \ p = 0.0001 \ (95\% \ confidence) \]

(See Fig. 19. Paired comparison chart for positive emotions responses for weight.)
**Weight:** Heavy (Helvetica Bold) vs Light (Helvetica Ultra Light)

For the category of ‘weight’, participants responded to Helvetica Bold with significantly higher dissatisfaction and fear than Helvetica Ultra Light:

Participants responded to the design feature ‘heavy’ weight with significantly higher dissatisfaction and fear than the design feature ‘light’.

**Dissatisfaction** paired-\(t\) (\(df = 41\)) = 2.3, \(p = 0.026\) (95% confidence)

**Fear** paired-\(t\) (\(df = 41\)) = 2.5, \(p = 0.01\) (95% confidence)

(See Fig. 20. Paired comparison chart for negative emotions responses for weight.)

**Classification:** Serif (Glypha Medium) vs Sans Serif (Helvetica Bold)

Participants responded to Glypha Medium with significantly higher satisfaction than Helvetica Bold: Participants responded to the design feature ‘serif’ with significantly higher satisfaction than the design feature ‘sans serif’.

**Satisfaction** paired-\(t\) (\(df = 41\)) = 2.1, \(p = 0.03\) (95% confidence).

(See Fig. 21. Paired comparison chart for positive emotions responses for classification.)

**Classification:** Sans Serif (Helvetica Bold) vs Serif (Glypha Medium)

Participants responses were not significantly different between Helvetica Bold and Glypha Medium: Participants reported no significant difference in response to the design features ‘sans serif’ and ‘serif’.
No significant difference

(See Fig. 22. Paired comparison chart for negative emotions responses for classification.)

Terminal Shape: Round terminals (Helvetica Rounded) vs Square terminals (Helvetica Bold)

Participants respond to Helvetica Rounded with no significant differences than Helvetica Bold. Participants responded to the design feature ‘round terminals’ with no significant differences than the design feature ‘square terminals’.

No significant difference

(See Fig. 23. Paired comparison chart for positive emotions responses for terminal shape.)

Terminal Shape: Square terminals (Helvetica Bold) vs Round terminals (Helvetica Rounded)

Participants respond to Helvetica Bold with no significant differences than Helvetica Rounded. Participants responded to the design feature ‘square terminals’ with no significant differences than the design feature ‘round terminals’.

No significant difference

(See Fig. 24. Paired comparison chart for negative emotions responses for terminal shape.)
**Character Width:** Condensed (Helvetica Condensed Bold) vs Extended (Helvetica Bold Extended)

Participants respond to Helvetica Condensed Bold with significantly higher desire, satisfaction, joy, and fascination than Helvetica Bold Extended.

Participants responded to the design feature ‘condensed’ character width with significantly higher desire, satisfaction, and fascination than the design feature ‘extended’.

- **Desire**
  - paired-\( t (df 41) = 3.3, p = 0.001 \) (95% confidence),

- **Satisfaction**
  - paired-\( t (df 41) = 2.6, p = 0.01 \) (95% confidence),

- **Joy**
  - paired-\( t (df 41) = 2.8, p = 0.007 \) (95% confidence),

- **Fascination**
  - paired-\( t (df 41) = 4.0, p = 0.03 \) (95% confidence).

(See Fig. 25. Paired comparison chart for positive emotions responses for character width.)

**Character Width:** Extended (Helvetica Bold Extended) vs Condensed (Helvetica Condensed Bold)

Participants respond to Helvetica Bold Extended with significantly higher disgust, dissatisfaction, fear, sadness, and boredom than Helvetica Condensed Bold.

Participants responded to the design feature ‘extended’ character width with significantly higher dissatisfaction, fear, sadness, and boredom than the design feature ‘condensed’.
Results of the paired t-Tests. The primary findings from this study indicate that
(1) People responded to type designs with emotion rather than indifference, (2) People agreed about the emotions associated with specific typefaces, and (3) Certain emotions were associated with the formative design features of typefaces. (4) Of the positively valenced emotions, no significance was found for the emotions pride or hope. (5) Of the negatively valenced emotions, no significance was found for the emotion shame.

Last, several of the findings in this study agree with Scherer’s (2005) utilitarian emotions. Since utilitarian emotions (anger, fear, joy, disgust, sadness, shame, and guilt) have a very high impact on behavior (Scherer, 2005), the following typefaces and design features may have a greater impact on behavior than others. Participants significantly associated the following typefaces (and their design features) with certain emotions that also correspond with Scherer’s utilitarian emotions: Helvetica Ultra Light (light weight) was associated with desire; Helvetica Bold (heavy weight) with fear; Helvetica Condensed Bold (narrow/condensed character width) with joy; and Helvetica Bold Extended (wide/extended character width) with fear and sadness.
One finding in this study agreed with Scherer’s aesthetic emotions (awe, wonder, admiration, bliss, fascination, harmony, rapture, ecstasy, and solemnity). Participants associated the typeface Helvetica Bold Condensed (narrow/condensed character width) with fascination.

**Answers to the null hypothesis** Desire, satisfaction, and fascination were significantly different for a typeface with ‘light’ weight than a ‘heavy’ weight. A typeface with ‘heavy’ weight showed significant difference for dissatisfaction and fear than the ‘light’ typeface. There were no significant differences reported in the terminal shape comparison, neither for typefaces with ‘round’ nor ‘square’ terminals. Desire, satisfaction, joy, and fascination were reported as significantly different for a typeface that had a ‘condensed’ character width. Dissatisfaction, fear, sadness, and boredom were significantly different for the character width category of ‘extended’ vs ‘condensed’.

Satisfaction was reported as significantly different for a typeface with a ‘serif’ classification vs. ‘sans serif’.

The findings from this study clearly indicate that subjects responded to typefaces with statistically significant levels of emotion, therefore I rejected the Null H1 hypothesis, “Viewing typeface designs produces no emotional response in participants.”

The preponderance of subjects reported the same emotions when viewing the typestyle designs. This was seen in the charts, where responses cluster together, rather than distribute randomly. Therefore based upon observation of the charts, I rejected the Null H2 hypothesis: Subjects do not feel the same emotions when viewing different typestyle designs. (Refer to Figs. 27, 28, 29, 30, 31, and 32.)
Fig. 19. Paired comparison chart for positive emotions responses for weight.
Fig. 20. Paired comparison chart for negative emotions responses for weight.
Fig. 21. Paired comparison chart for positive emotions responses for classification.
Fig. 22. Paired comparison for negative emotions responses for classification.
Fig. 23. Paired comparison for positive emotions responses for terminal shape.
Fig. 24. Paired comparison for negative emotions responses for terminal shape.
Fig. 25. Paired comparison for positive emotions responses for character width.
Fig. 26. Paired comparison for negative emotions responses for character width.
Fig. 27. Glypha Medium—Count of responses by arousal selection.
Fig. 28. Helvetica Bold—Count of responses by arousal selection.
Fig. 29. Helvetica Ultra Light—Count of responses by arousal selection.
Fig. 30. Helvetica Bold Condensed—Count of responses by arousal selection.
Fig. 31. Helvetica Extended Bold—Count of responses by arousal selection.
Fig. 32. Helvetica Rounded—Count of responses by arousal selection.
In light of these findings I concluded that some emotions appear to be associated with certain typeface design features, and therefore the Null H3 hypothesis, “There is no correlation between emotions and design features of type”, was rejected.

**Answers to the research questions** The study found that people report specific emotions when viewing different typefaces. The pairwise comparisons of typefaces found that some of the emotions were significantly associated with specific typographic design features. Not all of the pairwise comparisons resulted in significant differences: participants reported there were no emotions significantly associated with the typographic feature ‘terminal shape’, neither squared nor rounded, and there were no emotions significantly associated with the ‘historical classification’ of serif.

<table>
<thead>
<tr>
<th>Research Questions</th>
<th>Objectives</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1: Does viewing specific typefaces produce emotional responses? Research aim is to understand whether emotion is involved in interpreting visual information/typestyles.</td>
<td>Since many people (including some designers) find it difficult to select appropriate typestyles, find out whether participants can sense emotion when viewing typefaces.</td>
<td>Participants reported emotions when viewing each of six typefaces.</td>
</tr>
<tr>
<td>Q2: When viewing typestyle designs, do all people feel the same emotions? Research aim is to understand whether people have the same or similar interpretation of visual information/typestyle designs.</td>
<td>Ask participants to rank their emotion response to the typefaces on an arousal scale from no emotion to high emotion response (0–4).</td>
<td>Data observed in the descriptive charts signify clusters of agreement rather than randomly dispersed patterns of responses.</td>
</tr>
<tr>
<td>Q3: Are certain emotions predominantly associated with the formative design features of typefaces—differences in classification (serif or sans serif), terminal construction (angular or rounded), character width (condensed or extended), and weight (light or bold)? When people look at different typestyles, does the way they respond have anything to do with the way the design was constructed? Research aim is to understand whether design features are linked to emotion for purposes of interpreting visual information.</td>
<td>After participants have responded to the six typestyles stimuli, find out if there is a relationship between type design features and people’s responses.</td>
<td>Participant scores significantly agreed about which emotion(s) were felt for each typestyle and paired comparisons found significant relationships between some of the emotions and some of the design features. Only three emotions failed to have significance on any of the pairings: pride, hope, and shame.</td>
</tr>
</tbody>
</table>

*Table 4. Research questions, objectives, and results*
### SUMMARY OF SIGNIFICANT FINDINGS

*α* = 0.05 (95% confidence)

<table>
<thead>
<tr>
<th>CATEGORY: WEIGHT ANALYSIS</th>
<th>LIGHT</th>
<th>HEAVY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desire</td>
<td>[Paired <em>t</em>(df/41) = 3.3]</td>
<td>Dissatisfaction [Paired <em>t</em>(df/41) = 2.3]</td>
</tr>
<tr>
<td>Satisfaction</td>
<td>[Paired-<em>t</em>(df/41) = 2.6]</td>
<td>Fear [Paired <em>t</em>(df/41) = 2.5]</td>
</tr>
<tr>
<td>Fascination</td>
<td>[Paired <em>t</em>(df/41) = 4.0]</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CATEGORY: CLASSIFICATION</th>
<th>SERIF</th>
<th>SANS SERIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satisfaction</td>
<td>[Paired-<em>t</em>(df/41) = 2.1]</td>
<td>No Significance</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CATEGORY: TERMINAL SHAPE</th>
<th>ROUNDED</th>
<th>SQUARED</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Significance</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CATEGORY: CHARACTER WIDTH</th>
<th>CONDENSED (NARROW)</th>
<th>EXTENDED (WIDE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desire</td>
<td>[Paired-<em>t</em>(df/41) = 3.3]</td>
<td>Dissatisfaction [Paired <em>t</em>(df/41) = 2.05]</td>
</tr>
<tr>
<td>Satisfaction</td>
<td>[Paired-<em>t</em>(df/41) = 2.6]</td>
<td>Fear [Paired <em>t</em>(df/41) = 2.38]</td>
</tr>
<tr>
<td>Joy</td>
<td>[Paired-<em>t</em>(df/41) = 2.8]</td>
<td>Sadness [Paired <em>t</em>(df/41) = 3.3]</td>
</tr>
<tr>
<td>Fascination</td>
<td>[Paired-<em>t</em>(df/41) = 4.0]</td>
<td>Boredom [Paired <em>t</em>(df/41) = 2.05]</td>
</tr>
</tbody>
</table>

*Table 5. Summary of significant findings.*
CHAPTER 5: DISCUSSION

Word and visual form are separate processing modes. According to Lewis & Walker (1989) words and type form are processed with similar speed, however the most recent vision research confirms that the brain processes visual features at least one-half second before cognition begins. “Access to affective meaning in the printed word is automatic and fast,” (Doyle & Bottomley, 2009). Reading requires conscious cognition. According to research on the brain, visual form is processed unconsciously and consciously, from which one can conclude that visual language has primacy over verbal language.

Out of 73 studies investigating typographic meaning, 13 studies investigated emotion, however the studies varied sufficiently as to prevent comparison or generalization of their findings. While the studies were said to investigate emotion, none of them used psychologist-accepted terms for emotions, nor did they employ commonly accepted emotion research methodologies. Predominantly, researchers with little or no professional experience in typography conducted the studies.

Existing studies of typographic meaning do not adequately define nor differentiate between important key terms. Connotation, or the derivation of meaning of the visual design by comparison and metaphor, is the primary method that existing studies use to investigate user experience with type. These studies provide descriptions, objects, adjectives, or personalities by which participants are asked judge the ‘emotional content’ of the typeface stimuli. The studies included in the literature review used descriptions and adjectives, whereas future design and emotion studies must carefully differentiate among
variables and incorporate the most recent definitions from psychological science in order to achieve homogeneity and comparability.

Designers form a bridge between what their client needs and what the client’s customer wants. Design practitioners derive much of their research from marketing analysis. In general, graphic design studies place the designed object at the center of the inquiry, rather than the human. Practitioners’ studies typically describe qualities of the design rather than measuring the human visceral experience. The design research reported in this study is a significant departure from typical research and is focused on the human emotion experience toward typographic designs.

*Design studies: Theory and research in graphic design* (2006) and Brenda Laurel’s seminal title, *Design Research* (2004) gave designers theoretical and philosophical frameworks to apply in a broad range of research methods. Laurel (2004) identifies the four main areas of graphic design research: People, Form, Process, and Action. These important areas of design research are often neglected in favor of marketing or consumer research. This study highlights the need to conduct more research originating from the graphic designer’s perspective and addressing human-centered issues in graphic design.

Findings indicated that not only do people respond to type designs with emotion, but participants also agreed about which emotions were associated with the typestyles. Since emotion is processed at a pre-conscious level, these findings indicate the need to revisit design theories and incorporate a neurological processing perspective into each theory. Barry’s *Theory of Perceptual Aesthetics* (2004) is the first visual communications
theory to stress that designers should study the brain in order to understand design’s
effects on behavior. Graphic designers too need to adopt a human-centered perspective, if
this young field is to keep pace and advance along with scientific discovery.

The present study contributes to visual communications theory, that is, the study
of visual imagery and text, by positioning graphic design with imagery, and typography
with text as other areas for visual communication inquiry. Further, it adds what may be
the first empirical support for the Theory of Perceptual Aesthetics (Barry, 2006) and
extends the boundaries of enquiry in social semiotics by suggesting a new human-
centered approach.

This study has potential to add a new dimension to the Gestalt psychology theory
of visual perception: the role of emotion in visual processing. Graphic designers should
also consider developing a new theory of graphic design and emotion to begin mapping
human-centered theories in graphic design.

In addition, the typographic terminology of these studies is limited by historical
context of the study. For example, Morrison (1986) employs the historical classification
scheme of Craig (1978), who cites five general classifications of type: Old Style,
Transitional, Modern, Egyptian, and Contemporary. Today scholars have classified many
more design categories—examples include Humanist Sans Serif, Geometric Sans Serif,
and Modern Sans Serif (all of which fall into Craig’s ‘Contemporary’ classification).
Some scholars identify many more historical classifications of type. Because there are
many classifications recognized by typographic and graphic designers, it is important for
future research studies to bear in mind the limitations of historical context and to adopt the most recent findings to help unify future studies.

The studies cited here are also affected by historical context within the practice of science: In recent years, our understanding of the brain and cellular-level functioning has exploded as a result of advances in medical imaging technology. Thus today more is understood about vision and emotion and their connections, and about conscious and unconscious processes and their impact on human behavior.

Going forward, understanding changing technology and how it affects research will be an important distinction. This is especially so in the sciences and arts. With the aid of medical imaging technology advances, emotion psychologists have established a group of fundamental emotions: joy, desire, happiness, surprise, sadness, anger, fear, and disgust (Ekman, Friesen, & Ellsworth, 1982; Frijda, 1987; Izard, 1972; Ortony, et al, 1988/1994; Plutchik, 1980), though the field is on a continuous trajectory of change.

It may not be sufficient for design researchers to rely upon type designer’s naming conventions (e.g. Helvetica Bold) to differentiate features. Design features and naming conventions are approximates rather than absolutes: qualitative rather than quantitative. Typeface design features themselves need further definition. For example, by looking at the Multiple Master matrix pictured earlier in this study, we can see that determining where to apply the label ‘bold’ would be problematic.

It is critical to develop a system to quantify typographic features so that researchers can compare results across studies. Qualitative features need to be clearly defined, perhaps by applying a measurement matrix. For example, instead of using
typography’s vague terminology (bold, condensed, etc.), we could define ‘bold,’ for instance, as an expression of the numeric relationship between the stroke weight of a typestyle and the counter in its ‘O’ letterform (Roby, 2011, personal communication).

In other words, design researchers should establish some method to define typographic terminology using repeatable measures. Likewise, establishing measurable parameters to evaluate typeface design features, avoiding qualitative descriptions, would help to unify typographic research literature and establish a common trajectory for future research.

Future studies in typography need to consider the physical size of the stimuli, since the same size type may appear larger or smaller as a result of the height and width of the letterforms.

Results of this study may have the potential for error resulting from learning effects, sequence effects, or order effects, since the stimuli were not presented in random order as a result of using the online tool.

Future design research that makes use of online delivery mechanisms need to be aware of differences that may occur as a result of how the stimuli might appear on a variety of computer platforms and monitors. In this study, sizes of the alphabet stimuli could have been insufficient for participants to distinguish typographic design details, since online delivery of the questionnaire made it impossible to control for different sizes of participants’ computer monitors.

In order to establish a more general effect between typefaces, it would be prudent to represent a greater range of typefaces in order to be more definitive. This is especially
so since the study found that participants associated certain emotions with the formative design features of typefaces.

Conscious emotion experience is traditionally measured by gathering individuals’ subjective reports of arousal and valence measured on a Likert scale. Evidence shows that emotion can occur pre-consciously, before a subject has recognized, analyzed or evaluated the incoming stimulus (Lindgaard et al., 2006).

When we compare typefaces that share all but one typographic feature in common, the question remains whether we can we really say for instance that the design feature ‘bold’ actually equals the emotion ‘sadness’. Numerous other lurking variables might account for and confound the results.

Also, the fact remains that emotions are soft-edged, blending into one another where several emotions can coexist at the same time; emotions are hard to identify. A mixed-methods research design utilizing medical imaging technology and physiological measures alongside asking people how they feel could produce a richer range of results. But until science identifies whether there are discrete neural signatures that distinguish each emotion in the brain, researchers will have to rely upon self-report measures and obtain large sample sizes to improve reliability of emotion studies.

And there is still the question of whether emotion criteria selected to evaluate product designs are the most valid emotions to ask about when evaluating graphic or typographic design, since findings of this study produced no significant results for the emotion terms “hope,” “pride,” or “shame.”
The design elements selected for studies need to be obtained from literature that has established which of the design elements are foundational in visual perception. In this way, design researchers must be cognizant of multiple disciplines (such as brain research) in order to conduct relevant and repeatable studies.

Another difficulty in research about graphic design and visual communications is isolating design variables within stimuli. Often, several design features are present within each stimulus, for example, bold extended serif as opposed to bold condensed sans serif. The example demonstrates that results of comparing these two typefaces would result in an interaction between classification and character width criteria. This has been a common problem in design studies.

Design researchers need to carefully select stimuli with the intention of limiting the design differences among stimuli. Of the six typefaces studied in this experiment, five belong to the Helvetica typeface family. Such purposeful selection of stimuli will lead to better validity of results.

In addition, graphic design researchers need to use instruments that are visually-based to collect human perceptions or judgments about visual design and visually-based communications. Emotion and design are most reliably measured using visually-based instruments, such as the PrEmo™ tool used to collect data in this study.

Much of design is concerned with creating a relationship between a buyer and a seller, or a between product or experience and a consumer. Bringing the sciences into design domains is critically important because it is important for designers to know unequivocally how to influence decision-making and how to earn people’s trust.
Consumers often make purchase decisions at an unconscious level, responding to the aesthetics of one package over another. Finding and quantifying the design factors that influence these choices will allow designers to insure that their designs will provide the results desired by their clients, influencing consumer purchases and reinforcing brand trust. This is not to say that designers who apply these techniques will be able to predict the beliefs and behaviors of customers, but their designs will have a greater likelihood of producing the intended response. Designers would be able to convey images and concepts more purposefully and confidently than ever before.

As this line of research advances, it will be essential to identify areas for the application of design ethics and to advocate for the importance of designers’ ethical behavior, so that—although one cannot control all the applications of research—clients, designers, and communications can remain in respectful balance. This design research should interest consumer protection agencies, whose interventions on behalf of consumers may become more important in the future.

Perhaps because of the diversity of the design disciplines, there are few academic journals in design. As Demir, Desmet & Hekkert (2009) pointed out, among the disciplines engaged in design and emotion there are already a number of concepts, arguments, methods, and tools that have been developed for research. As a result, there is a significant need to develop agreed upon foundational knowledge and accepted structure and methods for emotion research in the field of design.

While Weaver (1949) and Morrison (1986) elected to present stimuli in the form of third order approximations of English (gibberish, which designers call ‘greek’)}
order to reduce the ambiguity created by the stimulus material in previous studies, this study depended upon the separation of visual and verbal semantics. This study examined only the visual design aspects of typefaces. Since people might respond to third order approximations of English (‘greek’) by finding meaning where none is intended. It was important to eliminate the possibility of any conscious or subconscious written language associations by the participants, especially any variables that might suggest semantic meaning. Such factors would include English language factors: sentence construction (e.g. meaning suggested by sequence of subject, adjective, verb, noun, adverb, etc.), word length (e.g. articles: a, the, pronouns: he, she, etc.), or cadence (short vs long words and arrangement thereof), or other possible means for confounding visual meaning (design) with verbal meaning (semantic or linguistic). Therefore the stimuli were presented as typeface samples, as is common practice in marketing typefaces. A type sample consists of upper- and lower-case letters arranged as an alphabet, plus numbers, symbols, and punctuation. The use of typeface samples as stimuli helped to prevent confounding errors, eliminating language variables and focusing instead on the visual presentation, the meaning communicated by the stylistic design of the characters (letterforms).

While it is difficult to make comparisons between studies that have used differing semantic descriptions of typestyle, the researcher found a possible contradiction worth noting: The findings from this study indicate that people respond with a variety of emotions to different typestyles. This study seems to conflict with studies by Bartram, (1982), Rowe, (1982), and Tantillo, (1995), which concluded that consumers have limited associations with type (elegance, potency, novelty).
Asking participants to compare two items simultaneously could affect rankings or paired associations, more than evaluating one typeface at a time.

One primary limitation of all the foregoing research studies is that design researchers have not employed language, definitions, and emotions that have been established by the scientific community of emotion psychology researchers. When adjectives are used in studies, rather than emotions, comparing research studies is impossible (Doyle & Bottomley, 2009). Design researchers need to substantiate whether emotion criteria established by psychology or emotion researchers is useful and applicable in design research of visual phenomenon so as to be able to compare studies across different disciplines. Product researchers have validated emotions pertinent to product evaluations. Design researchers need to investigate whether there is a different set of emotions that pertain generally to visual phenomenon or graphic design.

Summary

In order to develop a convergence of design research, the findings from this study suggest the need for design researchers to resolve the following key issues:

1) Designers must clearly define design features (especially in typography) in order to discern between qualitative terminology (e.g. different between ‘bold’ and ‘extra bold’) and quantifiable measures to define variables uniformly across studies.

2) Designers should develop new visual methodologies for research.

3) Design researchers must adopt a definition for emotion from established psychological theory. Design researchers must specify how the term emotion should be applied: for
example, shall researchers say that objects or experiences can contain emotions or rather that peoples’ responses toward designs and experiences are emotional?

4) Design researchers must work in an interdisciplinary manner in order to fully understand the human being for which they design:
   a) Understand precisely how humans are motivated visually.
   b) Understand how humans process sensory information both conscious and pre-conscious.
   c) Understand the anatomy and physiology of the brain.
   d) Understand how the brain processes vision
   e) Understand the most recent research about human memory formation.
   f) In order to balance humanistic and experimental findings, design researchers should adopt physiological research tools and medical imaging techniques.

5) Design researchers need to develop human-centered theory about emotion and design.

6) Design researchers should extend the Gestalt Theory to include emotion as a primary component of vision

7) Design researchers should develop and validate new visual tools and methodologies to bypass language entirely, and collect data of a purely aesthetic, visual, or design nature.

8) Design research ought to report its findings through design’s unique way of interpreting data: For greater depth of understanding, results should be presented visually, as information designs, as well as reported statistically (See examples in
appendix from University of Minnesota Duluth undergraduate student Scott Roby, 2010, and graduate student Monique Rogers, 2011).
CHAPTER 6: IMPLICATIONS

In order for design to be effective, designers need to understand the human beings that they design for: psychologically, physically, emotionally, and socially. The greatest opportunities for application of this research resided in helping designers understand how design influences behavior. Results from this study could be applied and utilized in a wide range of design disciplines including advertising, graphic design, interaction, web design, product design, engineering, industrial design, and architecture.

Understanding how humans respond to visual media, and through what neural channels they process visual information has significant implications. Theoretically, this study suggests that designers should be able to use design features to shape human response behaviors and perhaps even improve the speed of visual understanding. If designers knew which design features elicited the quickest emotion response, they could use design features to solve social problems. Typography could be used to improve highway and consumer safety, to improve typographic legibility for learning and general communications. However, one of the greatest difficulties of designing for emotion is the very nature of emotion itself. “Things loved for one reason in a particular situation,” according to Hassenzahl (2004, p. 47), “can be hated for the same reason in another.”

Regardless of the challenge, designing for emotion is increasingly needed as humans adjust to mounting levels of information in the environment. Findings from this study show the important influence that design effects can have on humans (emotions, attention, perception, and behavior) and the need for designers to understand how biophysical structures interact with visual literacy.
Non-expert typographers are becoming increasingly important shapers of our graphic language (Walker, 2001, in Spitzmuller, 2007). Since technology has delivered design tools into the hands of amateurs, it would benefit everyone to understand how to interpret visual language and apply it through graphic design and typography. These findings can be applied to teach non-experts and inform the general public about how design aids comprehension and understanding.

**Future Research**

The route of visual processing has important implications for graphic design research. By applying knowledge from vision research to design studies, graphic design researchers can now articulate whether and how valence is connected to design features; future graphic design research can help vision researchers identify the kinds of design stimuli to which the brain attends; and concepts such as visual plasticity might help graphic design researchers explain fluctuating trends in design and visual culture, thereby allowing researchers to advance theories in graphic design.

These conclusions point out the need for examining cultural differences in future research. Replication of this study should produce results that fluctuate over time and change according to stylistic trends in design aesthetics, suggesting the need for longitudinal studies in the future.

There are a number of issues in typographic research that require the attention of researchers. First, researchers of future typeface meaning studies should adopt consistent terminology and variables. Of the 73 studies reviewed in this study, few researchers built upon previous studies but rather each study built a formidable array of adjectives to
describe the results of applying a typeface to achieve a certain meaning, for example
‘dress,’ ‘typeface congeniality,’ ‘personalities,’ ‘atmospheric qualities,’ or ‘moods.’

Future research to expand the number of typefaces and design features could be
combined with these findings to build a robust taxonomy of design effects on emotions.
Since graphic designers had no rules to explain how to choose typestyles to convey
meaning, beginning to develop a rubric to explain the relationship between type features
and emotion will help designers to select typestyles and apply design that will achieve
consistent communication results.

**Recommendations**

This study established the relation between elements of typographic design and
positive- and negative-valence emotions. Emotion touches and colors nearly all of human
experience. In particular, it is well established that aesthetic visual art produces an
emotional response, but the connection of emotion and graphic design had not been
empirically established. This study contributed evidence of this connection.

Though this study has stressed the use of appropriate emotion terminology, the
results of this study generally support the conclusions of Kastl & Child (1968) and
Tannenbaum et al. (1964), that “there is a substantial basis for the use of typography
as a code for the communication of connotative variations (p.72).”

One of the biggest problems is that researchers have not known how designers
convey meaning visually; perhaps this is because, as the literature review of emotion and
vision shows, visual literacy is not purely a cognitive act. If one accepts this concept, then
the methods selected for research must change. Researchers should adopt interactive
visual data collection methods as this study does, to avoid interactions between design and content.

The findings in this study are but a beginning to a fruitful new area for human-centered and social graphic design research: visual literacy. With evidence about human emotion responses to typographic design features, this study shows how visual design affects people.

Further research should use a wider range of typefaces and identify and involve other typographic design features.

Cross-cultural studies and longitudinal studies would provide key perspectives about the social nature of visual design and the effect of stylistic trends over time.

Visual design has both the responsibility to motivate as well as the potential to manipulate—an idea that is not new, but that has not been addressed much in design education and ethics. Designers need to develop best practices for design ethics and investigate how to enact consumer protection measures in design.

Most importantly, design studies like this one will provide evidence of design’s unique knowledge domain, as this study significantly demonstrates.

Finally, in conclusion, because people reported similar emotion responses to typographic design features, this study strongly suggests that design’s underlying features represent a common visual language.
REFERENCES


Coyle & Thornson. (2001). The effects of progressive levels of interactivity and vividness in web marketing sites.


Roby, S. (2010). Information graphic summarizing the findings from this study.

Rogers, M. (2011). Information graphic summarizing the findings from this study.


APPENDIX A

Descriptive statistics

<table>
<thead>
<tr>
<th>TYPEFACE</th>
<th>Classification</th>
<th>Weight</th>
<th>Character Width</th>
<th>Terminals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glypha Medium</td>
<td>Serif</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Helvetica Bold</td>
<td>Sans serif</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Helvetica Condensed Bold</td>
<td>Light</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Helvetica Bold Extended</td>
<td>Bold</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Helvetica Ultra Light</td>
<td>Condensed</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Helvetica Rounded Medium</td>
<td>Extended</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VALENCE OF EMOTIONS</th>
<th>ID</th>
<th>Positive Valence</th>
<th>ID</th>
<th>Negative Valence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive Valence</td>
<td></td>
<td></td>
<td>Negative Valence</td>
<td></td>
</tr>
<tr>
<td>D1</td>
<td>Desire</td>
<td></td>
<td>D2</td>
<td>Disgust</td>
</tr>
<tr>
<td>S1</td>
<td>Satisfaction</td>
<td></td>
<td>D3</td>
<td>Dissatisfaction</td>
</tr>
<tr>
<td>P</td>
<td>Pride</td>
<td></td>
<td>S2</td>
<td>Shame</td>
</tr>
<tr>
<td>H</td>
<td>Hope</td>
<td></td>
<td>F2</td>
<td>Fear</td>
</tr>
<tr>
<td>J</td>
<td>Joy</td>
<td></td>
<td>S3</td>
<td>Sadness</td>
</tr>
<tr>
<td>F1</td>
<td>Fascination</td>
<td></td>
<td>B</td>
<td>Boredom</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PARTICIPANTS</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>DESIGNERS (Total All)</td>
<td>n = 32</td>
<td>76 %</td>
</tr>
<tr>
<td>Designers, Male</td>
<td>n = 15</td>
<td>47 %</td>
</tr>
<tr>
<td>Designers, Female</td>
<td>n = 17</td>
<td>53 %</td>
</tr>
<tr>
<td>Designers, Gay</td>
<td>n = 0</td>
<td>0 %</td>
</tr>
<tr>
<td>NON-DESIGNERS (Total All)</td>
<td>n = 10</td>
<td>24 %</td>
</tr>
<tr>
<td>Non-Designers, Male</td>
<td>n = 3</td>
<td>30 %</td>
</tr>
<tr>
<td>Non-Designers, Female</td>
<td>n = 6</td>
<td>60 %</td>
</tr>
<tr>
<td>Non-Designers, Gay</td>
<td>n = 1</td>
<td>10 %</td>
</tr>
<tr>
<td>TOTAL PARTICIPANTS</td>
<td>n = 42</td>
<td>100 %</td>
</tr>
<tr>
<td>TOTAL MALES</td>
<td>n = 18</td>
<td>43 %</td>
</tr>
<tr>
<td>TOTAL FEMALES</td>
<td>n = 23</td>
<td>55 %</td>
</tr>
<tr>
<td>TOTAL GAY PARTICIPANTS</td>
<td>n = 1</td>
<td>2 %</td>
</tr>
<tr>
<td>TYPEFACE STIMULI</td>
<td>Positive Valenced Emotions</td>
<td>Negative Valenced Emotions</td>
</tr>
<tr>
<td>------------------</td>
<td>-----------------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td><strong>1. Glypha Medium:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Sum ( n=42 )</td>
<td>D1</td>
<td>S1</td>
</tr>
<tr>
<td></td>
<td>34</td>
<td>81</td>
</tr>
<tr>
<td>(b) Average</td>
<td>0.81</td>
<td>1.92</td>
</tr>
<tr>
<td><strong>2. Helvetica Bold:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Sum ( n=42 )</td>
<td>36</td>
<td>57</td>
</tr>
<tr>
<td>(b) Average</td>
<td>0.85</td>
<td>1.35</td>
</tr>
<tr>
<td><strong>3. Helvetica Bold Condensed:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Sum ( n=42 )</td>
<td>43</td>
<td>62</td>
</tr>
<tr>
<td>(b) Average</td>
<td>1.02</td>
<td>1.47</td>
</tr>
<tr>
<td><strong>4. Helvetica Extended Bold:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Sum ( n=42 )</td>
<td>19</td>
<td>35</td>
</tr>
<tr>
<td>(b) Average</td>
<td>0.45</td>
<td>0.83</td>
</tr>
<tr>
<td><strong>5. Helvetica Ultra Light:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Sum ( n=42 )</td>
<td>68</td>
<td>82</td>
</tr>
<tr>
<td>(b) Average</td>
<td>1.61</td>
<td>1.95</td>
</tr>
<tr>
<td><strong>6. Helvetica Round Medium:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Sum ( n=42 )</td>
<td>41</td>
<td>68</td>
</tr>
<tr>
<td>(b) Average</td>
<td>0.97</td>
<td>1.61</td>
</tr>
</tbody>
</table>
## Number of Responses per Arousal Score

### Typeface: Glypha Medium

<table>
<thead>
<tr>
<th>Emotion</th>
<th>All Participants</th>
<th>(n=42)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>D1</td>
<td>22</td>
<td>11</td>
</tr>
<tr>
<td>S1</td>
<td>7</td>
<td>11</td>
</tr>
<tr>
<td>P</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>H</td>
<td>22</td>
<td>11</td>
</tr>
<tr>
<td>J</td>
<td>15</td>
<td>9</td>
</tr>
<tr>
<td>F1</td>
<td>21</td>
<td>6</td>
</tr>
<tr>
<td>D2</td>
<td>31</td>
<td>5</td>
</tr>
<tr>
<td>D3</td>
<td>26</td>
<td>7</td>
</tr>
<tr>
<td>S2</td>
<td>36</td>
<td>2</td>
</tr>
<tr>
<td>F2</td>
<td>35</td>
<td>4</td>
</tr>
<tr>
<td>S3</td>
<td>38</td>
<td>1</td>
</tr>
<tr>
<td>B</td>
<td>18</td>
<td>11</td>
</tr>
</tbody>
</table>

## Number of Responses per Arousal Score

### Typeface: Helvetica Bold

<table>
<thead>
<tr>
<th>Emotion</th>
<th>All Participants</th>
<th>(n=42)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>D1</td>
<td>22</td>
<td>9</td>
</tr>
<tr>
<td>S1</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>P</td>
<td>18</td>
<td>6</td>
</tr>
<tr>
<td>H</td>
<td>25</td>
<td>8</td>
</tr>
<tr>
<td>J</td>
<td>21</td>
<td>4</td>
</tr>
<tr>
<td>F1</td>
<td>22</td>
<td>10</td>
</tr>
<tr>
<td>D2</td>
<td>28</td>
<td>6</td>
</tr>
<tr>
<td>D3</td>
<td>23</td>
<td>9</td>
</tr>
<tr>
<td>S2</td>
<td>36</td>
<td>2</td>
</tr>
<tr>
<td>F2</td>
<td>30</td>
<td>7</td>
</tr>
<tr>
<td>S3</td>
<td>39</td>
<td>1</td>
</tr>
<tr>
<td>B</td>
<td>19</td>
<td>4</td>
</tr>
</tbody>
</table>
### NUMBER OF RESPONSES PER AROUSAL SCORE — TYPEFACE: HELVETICA CONDENSED BOLD

<table>
<thead>
<tr>
<th>Emotion</th>
<th>All Participants</th>
<th>n=42</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1 2 3 4</td>
<td>42</td>
</tr>
<tr>
<td>D1</td>
<td>22 7 6 4 3</td>
<td>42</td>
</tr>
<tr>
<td>S1</td>
<td>11 14 7 6 4</td>
<td>42</td>
</tr>
<tr>
<td>P</td>
<td>25 4 7 5 1</td>
<td>42</td>
</tr>
<tr>
<td>H</td>
<td>26 5 6 4 1</td>
<td>42</td>
</tr>
<tr>
<td>J</td>
<td>21 7 4 9 1</td>
<td>42</td>
</tr>
<tr>
<td>F1</td>
<td>24 8 2 6 2</td>
<td>42</td>
</tr>
<tr>
<td>D2</td>
<td>31 7 3 1 0</td>
<td>42</td>
</tr>
<tr>
<td>D3</td>
<td>22 9 7 3 1</td>
<td>42</td>
</tr>
<tr>
<td>S2</td>
<td>34 6 1 1 0</td>
<td>42</td>
</tr>
<tr>
<td>F2</td>
<td>33 5 3 1 0</td>
<td>42</td>
</tr>
<tr>
<td>S3</td>
<td>38 1 2 1 0</td>
<td>42</td>
</tr>
<tr>
<td>B</td>
<td>17 8 8 7 2</td>
<td>42</td>
</tr>
</tbody>
</table>

### NUMBER OF RESPONSES PER AROUSAL SCORE — TYPEFACE: HELVETICA BOLD EXTENDED

<table>
<thead>
<tr>
<th>Emotion</th>
<th>All Participants</th>
<th>n=42</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1 2 3 4</td>
<td>42</td>
</tr>
<tr>
<td>D1</td>
<td>28 11 1 2 0</td>
<td>42</td>
</tr>
<tr>
<td>S1</td>
<td>21 13 3 4 1</td>
<td>42</td>
</tr>
<tr>
<td>P</td>
<td>28 8 3 0 3</td>
<td>42</td>
</tr>
<tr>
<td>H</td>
<td>29 8 3 2 0</td>
<td>42</td>
</tr>
<tr>
<td>J</td>
<td>28 7 5 2 0</td>
<td>42</td>
</tr>
<tr>
<td>F1</td>
<td>29 8 3 2 0</td>
<td>42</td>
</tr>
<tr>
<td>D2</td>
<td>16 5 7 7 7</td>
<td>42</td>
</tr>
<tr>
<td>D3</td>
<td>20 3 7 6 6</td>
<td>42</td>
</tr>
<tr>
<td>S2</td>
<td>31 4 5 1 1</td>
<td>42</td>
</tr>
<tr>
<td>F2</td>
<td>22 6 9 3 2</td>
<td>42</td>
</tr>
<tr>
<td>S3</td>
<td>27 4 4 4 3</td>
<td>42</td>
</tr>
<tr>
<td>B</td>
<td>9 11 9 8 5</td>
<td>42</td>
</tr>
</tbody>
</table>
### NUMBER OF RESPONSES PER AROUSAL SCORE — TYPEFACE: HELVETICA ULTRA LIGHT

<table>
<thead>
<tr>
<th>Emotion</th>
<th>All Participants</th>
<th>n=42</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>D1</td>
<td>16</td>
<td>3</td>
</tr>
<tr>
<td>S1</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>P</td>
<td>17</td>
<td>7</td>
</tr>
<tr>
<td>H</td>
<td>24</td>
<td>5</td>
</tr>
<tr>
<td>J</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td>F1</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>D2</td>
<td>33</td>
<td>6</td>
</tr>
<tr>
<td>D3</td>
<td>32</td>
<td>6</td>
</tr>
<tr>
<td>S2</td>
<td>31</td>
<td>9</td>
</tr>
<tr>
<td>F2</td>
<td>37</td>
<td>4</td>
</tr>
<tr>
<td>S3</td>
<td>32</td>
<td>7</td>
</tr>
<tr>
<td>B</td>
<td>21</td>
<td>8</td>
</tr>
</tbody>
</table>

### NUMBER OF RESPONSES PER AROUSAL SCORE — TYPEFACE: HELVETICA ROUNDED MEDIUM

<table>
<thead>
<tr>
<th>Emotion</th>
<th>All Participants</th>
<th>n=42</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>D1</td>
<td>21</td>
<td>9</td>
</tr>
<tr>
<td>S1</td>
<td>10</td>
<td>13</td>
</tr>
<tr>
<td>P</td>
<td>20</td>
<td>7</td>
</tr>
<tr>
<td>H</td>
<td>24</td>
<td>7</td>
</tr>
<tr>
<td>J</td>
<td>19</td>
<td>7</td>
</tr>
<tr>
<td>F1</td>
<td>22</td>
<td>7</td>
</tr>
<tr>
<td>D2</td>
<td>25</td>
<td>6</td>
</tr>
<tr>
<td>D3</td>
<td>24</td>
<td>9</td>
</tr>
<tr>
<td>S2</td>
<td>33</td>
<td>5</td>
</tr>
<tr>
<td>F2</td>
<td>30</td>
<td>8</td>
</tr>
<tr>
<td>S3</td>
<td>31</td>
<td>7</td>
</tr>
<tr>
<td>B</td>
<td>16</td>
<td>12</td>
</tr>
<tr>
<td>ID</td>
<td>Designer or Non-Designer</td>
<td>Male, Female, Gay</td>
</tr>
<tr>
<td>------</td>
<td>-------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12171</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12172</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12173</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12174</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12175</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12179</td>
<td>N</td>
<td>F</td>
</tr>
<tr>
<td>12184</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12186</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12187</td>
<td>N</td>
<td>M</td>
</tr>
<tr>
<td>12188</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12189</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12191</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12194</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12195</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12197</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12202</td>
<td>N</td>
<td>F</td>
</tr>
<tr>
<td>12204</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12207</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12208</td>
<td>N</td>
<td>F</td>
</tr>
<tr>
<td>12209</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12211</td>
<td>N</td>
<td>F</td>
</tr>
<tr>
<td>12219</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12233</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12236</td>
<td>N</td>
<td>M</td>
</tr>
<tr>
<td>12250</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12251</td>
<td>N</td>
<td>F</td>
</tr>
<tr>
<td>12254</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12262</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12263</td>
<td>N</td>
<td>F</td>
</tr>
<tr>
<td>12265</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12266</td>
<td>N</td>
<td>G</td>
</tr>
<tr>
<td>12267</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12269</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12438</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12600</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12647</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12652</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12654</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12682</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12701</td>
<td>N</td>
<td>M</td>
</tr>
<tr>
<td>12799</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12737</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>ID</td>
<td>Designer or Non-Designer</td>
<td>Male, Female, Gay</td>
</tr>
<tr>
<td>------</td>
<td>--------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12171</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12172</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12173</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12174</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12175</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12179</td>
<td>N</td>
<td>F</td>
</tr>
<tr>
<td>12184</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12186</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12187</td>
<td>N</td>
<td>M</td>
</tr>
<tr>
<td>12188</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12189</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12191</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12194</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12195</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12197</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12202</td>
<td>N</td>
<td>F</td>
</tr>
<tr>
<td>12204</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12207</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12208</td>
<td>N</td>
<td>F</td>
</tr>
<tr>
<td>12209</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12217</td>
<td>N</td>
<td>F</td>
</tr>
<tr>
<td>12219</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12233</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12236</td>
<td>N</td>
<td>M</td>
</tr>
<tr>
<td>12250</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12251</td>
<td>N</td>
<td>F</td>
</tr>
<tr>
<td>12254</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12262</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12263</td>
<td>N</td>
<td>F</td>
</tr>
<tr>
<td>12265</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12266</td>
<td>N</td>
<td>G</td>
</tr>
<tr>
<td>12267</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12269</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12438</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12600</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12647</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12652</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12654</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12682</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12701</td>
<td>N</td>
<td>M</td>
</tr>
<tr>
<td>12709</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12737</td>
<td>D</td>
<td>F</td>
</tr>
</tbody>
</table>
### RAW SCORES FOR HELVETICA CONDENSED BOLD

<table>
<thead>
<tr>
<th>Participants</th>
<th>Male, Female, Gay</th>
<th>Positive Valenced Emotions</th>
<th>Negative Valenced Emotions</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
<td>Design or Non-</td>
<td>D1</td>
<td>S</td>
</tr>
<tr>
<td></td>
<td>Designer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12171</td>
<td>D</td>
<td>M</td>
<td>0</td>
</tr>
<tr>
<td>12172</td>
<td>D</td>
<td>F</td>
<td>0</td>
</tr>
<tr>
<td>12173</td>
<td>D</td>
<td>F</td>
<td>2</td>
</tr>
<tr>
<td>12174</td>
<td>D</td>
<td>F</td>
<td>0</td>
</tr>
<tr>
<td>12175</td>
<td>D</td>
<td>M</td>
<td>0</td>
</tr>
<tr>
<td>12179</td>
<td>N</td>
<td>F</td>
<td>1</td>
</tr>
<tr>
<td>12184</td>
<td>D</td>
<td>M</td>
<td>1</td>
</tr>
<tr>
<td>12186</td>
<td>D</td>
<td>F</td>
<td>0</td>
</tr>
<tr>
<td>12187</td>
<td>N</td>
<td>M</td>
<td>4</td>
</tr>
<tr>
<td>12188</td>
<td>D</td>
<td>F</td>
<td>0</td>
</tr>
<tr>
<td>12189</td>
<td>D</td>
<td>F</td>
<td>0</td>
</tr>
<tr>
<td>12191</td>
<td>D</td>
<td>F</td>
<td>0</td>
</tr>
<tr>
<td>12194</td>
<td>D</td>
<td>M</td>
<td>1</td>
</tr>
<tr>
<td>12195</td>
<td>D</td>
<td>M</td>
<td>2</td>
</tr>
<tr>
<td>12197</td>
<td>D</td>
<td>M</td>
<td>0</td>
</tr>
<tr>
<td>12202</td>
<td>N</td>
<td>F</td>
<td>1</td>
</tr>
<tr>
<td>12204</td>
<td>D</td>
<td>F</td>
<td>0</td>
</tr>
<tr>
<td>12207</td>
<td>D</td>
<td>F</td>
<td>3</td>
</tr>
<tr>
<td>12208</td>
<td>N</td>
<td>F</td>
<td>0</td>
</tr>
<tr>
<td>12209</td>
<td>D</td>
<td>F</td>
<td>4</td>
</tr>
<tr>
<td>12217</td>
<td>N</td>
<td>F</td>
<td>2</td>
</tr>
<tr>
<td>12219</td>
<td>D</td>
<td>M</td>
<td>1</td>
</tr>
<tr>
<td>12233</td>
<td>D</td>
<td>M</td>
<td>0</td>
</tr>
<tr>
<td>12236</td>
<td>N</td>
<td>M</td>
<td>0</td>
</tr>
<tr>
<td>12250</td>
<td>D</td>
<td>F</td>
<td>2</td>
</tr>
<tr>
<td>12251</td>
<td>N</td>
<td>F</td>
<td>0</td>
</tr>
<tr>
<td>12254</td>
<td>D</td>
<td>M</td>
<td>0</td>
</tr>
<tr>
<td>12262</td>
<td>D</td>
<td>F</td>
<td>3</td>
</tr>
<tr>
<td>12263</td>
<td>N</td>
<td>F</td>
<td>0</td>
</tr>
<tr>
<td>12265</td>
<td>D</td>
<td>M</td>
<td>0</td>
</tr>
<tr>
<td>12266</td>
<td>N</td>
<td>G</td>
<td>3</td>
</tr>
<tr>
<td>12267</td>
<td>D</td>
<td>F</td>
<td>0</td>
</tr>
<tr>
<td>12269</td>
<td>D</td>
<td>M</td>
<td>2</td>
</tr>
<tr>
<td>12348</td>
<td>D</td>
<td>M</td>
<td>4</td>
</tr>
<tr>
<td>12600</td>
<td>D</td>
<td>F</td>
<td>1</td>
</tr>
<tr>
<td>12647</td>
<td>D</td>
<td>F</td>
<td>0</td>
</tr>
<tr>
<td>12652</td>
<td>D</td>
<td>F</td>
<td>0</td>
</tr>
<tr>
<td>12654</td>
<td>D</td>
<td>M</td>
<td>2</td>
</tr>
<tr>
<td>12682</td>
<td>D</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td>12701</td>
<td>N</td>
<td>M</td>
<td>0</td>
</tr>
<tr>
<td>12709</td>
<td>D</td>
<td>M</td>
<td>0</td>
</tr>
<tr>
<td>12737</td>
<td>D</td>
<td>F</td>
<td>1</td>
</tr>
</tbody>
</table>
## RAW SCORES FOR HELVETICA BOLD EXTENDED

<table>
<thead>
<tr>
<th>Participants</th>
<th>Positive Valenced Emotions</th>
<th>Negative Valenced Emotions</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
<td>Designer or Non-Designer</td>
<td>Male, Female, Gay</td>
</tr>
<tr>
<td>12171</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12172</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12173</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12174</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12175</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12179</td>
<td>N</td>
<td>F</td>
</tr>
<tr>
<td>12184</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12186</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12187</td>
<td>N</td>
<td>M</td>
</tr>
<tr>
<td>12188</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12189</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12191</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12194</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12195</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12197</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12202</td>
<td>N</td>
<td>F</td>
</tr>
<tr>
<td>12204</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12207</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12208</td>
<td>N</td>
<td>F</td>
</tr>
<tr>
<td>12209</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12217</td>
<td>N</td>
<td>F</td>
</tr>
<tr>
<td>12219</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12233</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12236</td>
<td>N</td>
<td>M</td>
</tr>
<tr>
<td>12250</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12251</td>
<td>N</td>
<td>F</td>
</tr>
<tr>
<td>12254</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12262</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12263</td>
<td>N</td>
<td>F</td>
</tr>
<tr>
<td>12265</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12266</td>
<td>N</td>
<td>G</td>
</tr>
<tr>
<td>12267</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12269</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12438</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12600</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12647</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12652</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12654</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12682</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12701</td>
<td>N</td>
<td>M</td>
</tr>
<tr>
<td>12709</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12737</td>
<td>D</td>
<td>F</td>
</tr>
</tbody>
</table>
### RAW SCORES FOR HELVETICA ULTRA LIGHT

<table>
<thead>
<tr>
<th>ID</th>
<th>Designer or Non-Designer</th>
<th>Male, Female, Gay</th>
<th>Positive Valenced Emotions</th>
<th>Negative Valenced Emotions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>D1</td>
<td>S</td>
</tr>
<tr>
<td>12171</td>
<td>D</td>
<td>M</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>12172</td>
<td>D</td>
<td>F</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>12173</td>
<td>D</td>
<td>F</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>12174</td>
<td>D</td>
<td>F</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>12175</td>
<td>D</td>
<td>M</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>12179</td>
<td>N</td>
<td>F</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>12184</td>
<td>D</td>
<td>M</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>12186</td>
<td>D</td>
<td>F</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>12187</td>
<td>N</td>
<td>M</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>12188</td>
<td>D</td>
<td>F</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>12189</td>
<td>D</td>
<td>F</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>12191</td>
<td>D</td>
<td>F</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>12194</td>
<td>D</td>
<td>M</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>12195</td>
<td>D</td>
<td>M</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>12197</td>
<td>D</td>
<td>M</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>12202</td>
<td>N</td>
<td>F</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>12204</td>
<td>D</td>
<td>F</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>12207</td>
<td>D</td>
<td>F</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>12208</td>
<td>N</td>
<td>F</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>12209</td>
<td>D</td>
<td>F</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>12217</td>
<td>N</td>
<td>F</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>12219</td>
<td>D</td>
<td>M</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>12233</td>
<td>D</td>
<td>M</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>12250</td>
<td>D</td>
<td>F</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>12251</td>
<td>N</td>
<td>F</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>12254</td>
<td>D</td>
<td>M</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>12256</td>
<td>D</td>
<td>F</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>12263</td>
<td>N</td>
<td>F</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>12265</td>
<td>D</td>
<td>M</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>12266</td>
<td>N</td>
<td>G</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>12267</td>
<td>D</td>
<td>F</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>12269</td>
<td>D</td>
<td>M</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>12438</td>
<td>D</td>
<td>M</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>12600</td>
<td>D</td>
<td>F</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>12647</td>
<td>D</td>
<td>F</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>12652</td>
<td>D</td>
<td>F</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>12654</td>
<td>D</td>
<td>M</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>12682</td>
<td>D</td>
<td>M</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>12701</td>
<td>N</td>
<td>M</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>12709</td>
<td>D</td>
<td>M</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>12737</td>
<td>D</td>
<td>F</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>
### RAW SCORES FOR HELVETICA ROUNDED

<table>
<thead>
<tr>
<th>Participants</th>
<th>Positive Valenced Emotions</th>
<th>Negative Valenced Emotions</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
<td>Designer or Non-Designer</td>
<td>Male, Female, Gay</td>
</tr>
<tr>
<td>12171</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12172</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12173</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12174</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>12175</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12179</td>
<td>N</td>
<td>F</td>
</tr>
<tr>
<td>12184</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12186</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12187</td>
<td>N</td>
<td>M</td>
</tr>
<tr>
<td>12188</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12189</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12191</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12194</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12195</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12197</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12202</td>
<td>N</td>
<td>F</td>
</tr>
<tr>
<td>12204</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12207</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12208</td>
<td>N</td>
<td>F</td>
</tr>
<tr>
<td>12209</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12217</td>
<td>N</td>
<td>F</td>
</tr>
<tr>
<td>12219</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12233</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12236</td>
<td>N</td>
<td>M</td>
</tr>
<tr>
<td>12250</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12251</td>
<td>N</td>
<td>F</td>
</tr>
<tr>
<td>12254</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12262</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12263</td>
<td>N</td>
<td>F</td>
</tr>
<tr>
<td>12265</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12266</td>
<td>N</td>
<td>G</td>
</tr>
<tr>
<td>12267</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12269</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12238</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12600</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12647</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12652</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>12654</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12682</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12701</td>
<td>N</td>
<td>M</td>
</tr>
<tr>
<td>12709</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>12737</td>
<td>D</td>
<td>F</td>
</tr>
</tbody>
</table>
APPENDIX B

IRB Clearance

Research Exempt from IRB Committee Review

Category 2:
SURVEYS/INTERVIEWS, STANDARD EDUCATION TESTS & OBSERVATIONS
OF PUBLIC BEHAVIOR

Submission Instructions:
E-mail a copy of this application and any other materials required to the Research Subjects' Protections Programs Office: RSPPeRev@umn.edu

Electronically submitted protocols must be sent from a University of MN e-mail account. Original signatures are not required. U of M x.500 IDs have been deemed by the University of Minnesota to constitute a legal signature.

Academic Advisors and Co-Investigators should be carbon copied (Cc) on the submission e-mail.

For help with this form and to download additional appendices: see http://www.research.umn.edu/irb/download/ or call 612-626-5654

1.1 Project Title (Project title must match grant title. If different, also provide grant title):
Investigating human emotion response to typeface designs.

1.2 Principal Investigator (PI)

Name (Last name, First name MI):
Koch, Beth E.

Highest Earned Degree:
PhD (all but dissertation)

Mailing Address:
1201 Ordean Ave HUM317
Duluth, MN 55812

Phone Number:
218 726-6961

Pager or Cell Phone Number:
651 278-8181

Fax:

U of M Employee/Student ID:
3146793

U of M x.500 ID (ex. smith001):
bekoch

Email:
bekoch@d.umn.edu

U of M Employee/Student ID:
3146793

U of M x.500 ID (ex. smith001):
bekoch

University Department (if applicable):
Design, Housing & Apparel

Occupational Position:
Faculty □ Staff □ Student □ Fairview Researcher □ Gillette Researcher □ Other:

Human Subjects Training (one of these must be checked—refer to training links at the end of this section):
□ CITI □ Investigator 101 □ NIH training (EXCEPT for 5/8/06 to 2/29/08) □ UM/RCR (between 1994-2003) □ Other:

HIPAA Training (Required if Data Contains PHI):
□ HIPAA

As Principal Investigator of this study, I assure the IRB that the following statements are true:
The information provided in this form is correct. I will seek and obtain prior written approval from the IRB for any substantive modifications in the proposal, including changes in procedures, co-investigators, funding agencies, etc. I will promptly report any unexpected or otherwise significant adverse events or unanticipated problems or incidents that may occur in the course of this study. I will report in writing any significant new findings which develop during the course of this study which may affect the risks and benefits to participation. I will not begin my research until I have received written notification of final IRB approval. I will comply with all IRB requests to report on the status of the study. I will maintain records of this research according to IRB guidelines. The grant that I have submitted to my funding agency which is submitted with this IRB submission accurately and completely reflects what is contained in this application. If these conditions are not met, I understand that approval of this research could be suspended or terminated.

bekoch 7-22-2010

x.500 of PI Date

Training Links:
FIRST (Fostering Integrity in Research, Scholarship and Training): http://cflegacy.research.umn.edu/first/humansubjects.htm

HIPAA: http://www.research.umn.edu/first/AdditionalCourses.htm

- The online NIH tutorial offered during the period May 8, 2006-February 29, 2008 is NOT acceptable to meet this requirement.
- If you completed a version of this training not included on the list provided, provide details as indicated
- The University of Minnesota uses two methods to verify records about completion of human subjects protection training: 1) training registration online, or 2) researcher must provide copy of completion certificate. To check your online training record, go to http://www.research.umn.edu/first/Reports.htm
1.3 Department, Division Head, or Dean Information

Please note as the researcher, you are responsible for confirming and following your departmental standards and requirements for research.

Becky Yust, PhD
Name of Department Head, Division Head, or Dean

1.4 Are there additional Co-Investigators and Staff?

☐ Yes. Download an extra personnel sheet and include it with your application.
☐ No. Continue to 1.5.

1.5 Is the PI of this research a student?

☐ Yes. Include Appendix J. Electronically submitted protocols must be carbon copied (Cc) to their advisor.
☐ No. Continue to 2.

Academic Advisor to the Student Investigator

Advisor’s Name (Last name, First name MI):
Hokanson, Brad
University Department:
Design, Housing & Apparel
Mailing Address:
University of Minnesota
Design Housing and Apparel
Room 240 McNH 6136
1985 Buford Ave
St Paul, MN 55108
Phone Number:
612 624-4918
Email:
brad@umn.edu
U of M x.500 ID (ex. smith001):
brad

2. Funding

2.1 Is this research funded by an internal or external agency?

☐ Yes. Include Appendix A
☐ No.
If no, explain how costs of research will be covered:
Questionnaire and data tools obtained free. Volunteer subjects. No other expenses.

3. Institutional Oversight

3.1 Is this research proposal being reviewed by any other institution or peer review committee?

☐ Yes. It is the responsibility of the PI to secure the appropriate approval from these committees and document that approval to the IRB. Attach a copy of documentation of approval, if received, and indicate committees below.
If yes, please list which committees will review this proposal:

☐ No.

4. Conflict of Interest

Federal Guidelines emphasize the importance of assuring there are no conflicts of interest in research projects that could affect the welfare of human subjects. Disclosure of financial interests is required from all individuals involved in the design, conduct or reporting of the research. If this study involves or presents a potential conflict of interest, additional information will need to be provided to the IRB. Examples of potential conflicts of interest may include, but are not limited to:

- A researcher or family member participating in research on a technology, process or product owned by a business in which the faculty member holds a financial interest
- A researcher participating in research on a technology, process or product developed by that researcher
4.1 Do any of the Investigators or personnel listed on this research have a business interest or a financial interest of $10,000 or more associated with this study when aggregated for their immediate family?

☐ No.
☐ Yes.

If yes, identify the individual(s) and complete section 4.3:

4.2 Do any of the investigators or personnel (when aggregated for their immediate family) listed on this research have:

Ownership interests less than $10,000 when the value of interest could be affected by the outcome of the research.

☐ No. ☐ Yes.

Do ownership interests exceed 5% interest in any one single entity when aggregated for the immediate family?

☐ No. ☐ Yes.

Compensation less than $10,000 when the value of the compensation could be affected by the outcome of the research.

☐ No. ☐ Yes.

If yes, identify the individual(s) and complete section 4.3:

4.3 Has this potential conflict of interest been disclosed and managed?

☐ No.

If you are a University of Minnesota researcher, please disclose your potential conflict of interest online for review by your Department Head and Dean via the Report of External Professional Activities (REPA) at: https://egms.umn.edu/REPA/

If you are a Fairview Health System researcher, please complete the Fairview Health Services Conflict of Interest Disclosure forms (http://www.fairview.org/prof/research/proceed_forms.asp) and submit the completed forms to the Fairview Office of Research.

If you are a Gillette Children's Specialty Healthcare researcher, please contact the Director of Research Administration, at 651-229-1745.

☐ Yes. Date of Management Plan:
The IRB will verify that a management plan is in place with the Conflict Review and Management Committee (CRC). If the CMC does not have an approved management plan for this research, the CMC will contact the individual(s) listed in question 4.1 for additional information.

Final IRB approval cannot be granted until all potential conflict matters are settled. The IRB requires a recommendation from the CRC regarding disclosure to subjects and management of the conflict. The full IRB committee determines what disclosure language should be in the consent form.

5. Summary of Activities

Use lay language, do not cut and paste from or refer to a grant or an abstract.

5.1 Briefly state your research question.

In order to connect with an audience, designers are trained to apply specific features to design that theoretically communicate meaning visually (for example, a designer may select thin lines rather than thick to visually demonstrate the concept "light weight"). According to design rules, all viewers should respond similarly to these visual features, but this has never been scientifically investigated. This study will answer the question, "How do people respond emotionally to visual design features of typefaces?".

5.2 Describe the tasks subjects will be asked to perform.

Describe the frequency and duration of procedures, psychological tests, educational tests, and experiments; including screening, intervention, follow-up etc. Reminder: No personal or sensitive information can be sought under exempt guidelines. (If you intend to pilot a process before recruiting for the main study please explain.)

Initial screening: Participants will be asked about their eyesight accuracy, gender, and design education/experience.

Questionnaire: Participants will be asked to look at an alphabet design and record their response to the design using the PrEmo™ interactive tool. For each alphabet, participants will rate all twelve emotions. Each emotion is portrayed by a cartoon character that animates the body, facial, and vocal emotion expression. Participants will choose each character (one at a time) and rate how strongly they identify the visual design with that particular emotion using a scale of zero to four. Overall, six different alphabet designs will be surveyed.

Instrumentation: PrEmo™ was developed by Dr. Pieter Desmet at Delft University of Technology in 2002. A new and improved version has been released together with SusaGroup, which is offered in an online environment that lets you setup and manage your own experiments. PrEmo is a unique scientifically validated non-verbal self report instrument to measure emotions. http://www.premo-online.com/en/how-does-it-work/

Duration: The questionnaire can be taken once at the volunteer’s convenience (during a two week interval) and it will take approximately 15 minutes to complete.

Attach all surveys, instruments, interview questions, focus group questions etc.

5.3 Describe what non-participants will do during this period (activities and supervision if applicable):

If your subjects will be students, it is important that the study design not penalize students who will not be participating if not all students will be participating.

Some subjects may be university students, but they will not be recruited from a classroom or identified.

5.4 How long do you anticipate this research study will last from the time you are determined to meet the criteria for exempt research?

Exempt research is generally considered short-term in nature. This office routinely inactivates exempt applications after five years from the time it was determined to meet the exempt criteria. If you think your project will extend beyond five years, contact the IRB office (612-626-5654 or irb@umn.edu).

The proposed study should last less than one year (but could be continued for up to five years).
6. Participant Population

6.1 Expected Number of Participants: 100+

| # of Male: 50+ | # Female: 50+ |

6.2 Expected Age Range
Please confirm subjects are at least 18 years old, checking all that apply (you may not conduct research with subjects younger than 18 under exempt category two, if you would like to include subjects younger than 18, you must complete the full IRB application requesting expedited review if appropriate):

☐ 18-64
☐ 65 and older

6.3 Describe the criteria for inclusion and exclusion of subjects in this research study.
Inclusion Criteria:
Volunteers with access to the internet.

Exclusion Criteria:
Persons with vision that cannot be corrected to at least 20/40 will be excluded.

6.4 Location of Subjects during Research Data Collection
Check all that apply:
☐ Elementary/Secondary Schools (include Appendix M)
☐ Community Center, specify:
☐ University Campus (non-clinical), specify: online
☐ Subject’s Home, specify: online
☐ International Location (include Appendix K): online
☐ Other special institutions, specify: online

7. Compensation

7.1 Will you give subjects gifts, payments, compensation, reimbursement, services without charge or extra credit?
☐ Yes.
☒ No.
If yes, please explain:

8. Recruitment

8.1 Are subjects chosen from records?
☐ Yes. Complete 8.1a-c
☒ No. Continue to 8.2

8.1a What type of records:
☐ Medical
☐ Educational
☐ Employment
8.1b Are the records publicly available?
- Yes. Proceed to question 8.2
- No. Proceed to question 8.1c

8.1c Do you already have permissible access to the private records? (i.e. through your job, volunteer work, internship, etc.)
- Yes. Describe how you have permissible access.
- No. You must ask the custodian of the record to make initial contact for you (describe how they will do this in question 8.2) and let the potential subject contact you if they are interested. Attach a letter of cooperation from the custodian of the record indicating that they will make initial contact on your behalf. Please note that even if the custodian is willing to give you the private list, if you do not have permissible access to the records, the fact that the custodian will give you the list does not create permissible access. The custodian will still have to make initial contact.

8.2 Describe the recruitment process to be used:
Attach a copy of any and all recruitment materials to be used e.g. advertisements, bulletin board notices, e-mails, letters, phone scripts, or URLs.

- Researcher will post an online announcement (with a link to the questionnaire) on two social networking sites, Facebook and Linked-In, and will email announcements to design associations (AIGA, AdFed, Type Officianados), and student associations at University of Minnesota and University of Minnesota Duluth.

8.3 Explain who will approach potential subjects to take part in the research study and what will be done to protect individuals' privacy in this process:
Initial contact of subjects identified through records search must be made by the official holder of the record, i.e. primary physician, therapist, public school official.

- Public announcements will be sent out by the researcher. I will request that organization officials disperse the request for volunteers to their membership. Researcher will not have access to any participant records or addresses.

9. Confidentiality

See Protecting Private Data Guideline from the Office of Information Technology (OIT) for information about protecting the privacy of research data.

9.1 Describe provisions that will be taken to maintain confidentiality of data (e.g. surveys, video, audio tape, photos):
- Survey will not collect any identifiable personal data.

9.2 Describe the security plan for data including where stored and for how long, noting that you may not keep identifiable data indefinitely:
- The survey data will be stored on the server at SusaGroup in the U.K. Researcher will access the data and download data to a university laptop in order to statistically analyze the data. After downloading the data, researcher will notify SusaGroup to erase the experiment and data from the server. Data on the investigator's university-supplied laptop is secured by the university network. When the study is published (up to five years from application approval) all files will be destroyed by wiping the data from the harddrive.

9.3 Will the PI have a link to identify subjects?
- Yes.
- No.
9.4 Will identifiable data be made available to anyone other than the PI?

☐ Yes.
☒ No.

If yes, explain who and why they will have access to the identifiable data:

10. Informed Consent Process

Reminder: If you are mailing a survey to subjects and asking them to return it to you, or doing a phone interview, you must send or read a consent statement which includes the same information as the consent form but is not signed.

10.1 Describe who will conduct the consent process with subjects and how consent will be obtained:

The investigator will design the initial welcome screen of the questionnaire to contain a consent statement. Participants will be asked to press a button to register their consent, or to close the window if they do not.

10.2 Recognizing that consent itself is a process of communication, describe what will be said to subjects to introduce the research:

- Do not say “see consent form”. Write the explanation in lay language.
- If you are using telephone surveys, attach telephone scripts.

**Introduction Screen:**

“*This study is among a very few experiments to investigate type design. We would appreciate your help in inviting friends and colleagues to participate, both designers and non-designers alike. Confidentiality: Your response to this survey is confidential. The data collected from this survey cannot be connected back to you—no identifying information is being collected. The data will be used for design research that will be reported in written articles including a dissertation and academic journals. The data will be destroyed and the URL will be removed at the end of the research. At the end of this questionnaire you will find information about how to contact the author and university if you have further questions.*

This questionnaire will take roughly 15 minutes to complete, and consists of three general questions and six experimental questions.

Press the Next button if you agree to participate in the study (to acknowledge your informed consent) and to receive further directions. Otherwise, if you do not consent, please close this window."

10.3 Prepare and attach consent forms for review. For exempt category two research, it is not necessary to obtain signed documentation of consent (i.e. a signature). Please submit a ‘consent information sheet’ which does not include a signature line. The IRB office reserves the right to require that you obtain signatures, but in most cases it is not necessary.

Even though the IRB may determine that some research is exempt from the federal regulations, adequate provisions still need to be in place to protect research participants.

In making its consideration of exempt status, the HRPP/IRB office still has to determine that:

- The research involves no more than minimal risk to participants
- Selection of participants is equitable
c) If there is recording of identifiable information, there are adequate provisions to maintain the confidentiality of the data

d) If there are interactions with participants, there will be a consent process that will disclose such information as:
   • that the activity involves research
   • a description of the procedures
   • that participation is voluntary
   • name and contact information for the investigator

e) There are adequate provisions to maintain the privacy of participants.

Information Sheet for Research

This regulation does not apply to FDA regulated research.

You have reached the end of this form. Please make sure that you have responded to every question on this application (even if your response is “not applicable”).
IRB changes applied to the final page of the study

The researcher conducting this study is Beth E. Koch. You may email the author with questions before continuing or, if you have questions later, you are encouraged to contact them at University of Minnesota Duluth, (218) 726-6961, bekoch@d.umn.edu; or you may contact the researcher’s advisor, Brad Hokanson, PhD, at (612) 624-4918, brad@umn.edu.

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher, you are encouraged to contact the Research Subjects’ Advocate Line, D528 Mayo, 420 Delaware St. SE, Minneapolis, MN 55355; (612) 625-1650.
## Appendix J
### Student as Principal Investigator Worksheet

*Use this worksheet in collaboration with your Academic or Project Advisor to demonstrate research preparedness of the Student investigator.*

### To be completed by the Academic Advisor

1. **Student academic level:** (check all that apply)
   - Undergraduate
   - Graduate:  
     - Masters candidate
     - PhD. candidate

2. **Explain how the scope of the proposed project, including anticipated risks and benefits, is appropriate to student research?**
   
   The scope of the proposed dissertation project involves anonymous online questionnaires that gauge respondents' emotional response to a series of letterform designs (typography). The project methodology uses a web-based interactive response tool that has already been validated in design research. The project extends previous research into new areas of design and builds upon current theory in visual communication. The study seeks to determine the degree of agreement about emotional arousal and valence among designers and non-designers. The benefits of asking people how they feel about typefaces will contribute to design education and will help designers understand the emotional impact of designs. It is hoped that this study will lay a foundation for further research to decipher how humans interpret visual language.

3. **Explain what experience, training or special preparation, the student researcher brings to the project from relevant coursework or professional exposure:**

   The researcher has been a practicing graphic designer for over twenty-five years and has been teaching graphic design and typography for seven years. Previous research has included learning psychology, training in course development and instructional design, and research in multimedia learning design provides background to the study. The researcher has studied the physiology of vision, emotion, and perception. She has taken coursework that provided training in writing questionnaires and using online delivery tools.

---

As Academic or project advisor for the named student investigator, I assume the roles and responsibilities required to oversee the conduct of this research, prevent harms to subjects and foster benefits to the subjects. I will report any changes in the project, adverse events, or incidents to the IRB which may affect the conduct of this project.

Brad Hokanson, PhD

Name of Academic Advisor (Printed)  
Brad  
07/22/2010

Academic Advisor x500  
Date

Advisors shoulder the responsibility for students engaged in independent research and should be copied on all correspondence.

---

Updated April 2010

Student as Principal Investigator Worksheet – Appendix J
By my signature as a Faculty Advisor on this research application, I certify that the student researcher is knowledgeable about the regulations and policies governing research with human subjects and has sufficient training and experience to conduct this particular study in accordance with the research protocol.

Additionally:
I hereby confirm that I have thoroughly reviewed this IRB application and verify that it is complete and the research is appropriate for student research in topic and design.

I agree to meet with the student researcher on a regular basis to monitor study progress. I will arrange for communication during the course of the study if the procedures are carried out in a location away from the University or when regular channels of communication are not feasible.

I assure that the student researcher will promptly report unanticipated problems to the IRB and will adhere to all requirements for continuing review.

If I will be unavailable (e.g. sabbatical leave, vacation or resignation), I will arrange for an alternate faculty advisor to assume responsibility during my absence, and I will advise the IRB, in writing, of such changes.

If the student leaves the university, I will provide all the necessary documents for terminating the study or continuing review.

Signature of Faculty Advisor

Date
APPENDIX C

Email invitations to participants

SUBJECT:

Typographic Design Research Study

BODY:

Please post or announce to your members:

Join my Typographic Design Research Study! I need opinions about six typeface designs. The short survey takes roughly 15 minutes and is completely confidential. 

Typographic Design Research Study @ https://www.measuring-emotions.com/typedesign

In order to connect with an audience, designers are trained to apply specific features to design that theoretically communicate meaning visually (for example, a designer may select thin lines rather than thick to visually demonstrate the concept “light weight”). According to design rules, all viewers should respond similarly to these visual features, but this has never been scientifically investigated. This study will answer the question, “How do people respond emotionally to visual design features of typefaces?” I would appreciate your help in inviting friends and colleagues to participate, both designers (or typographers) and non-designers alike. To access the survey click here https://www.measuring-emotions.com/typedesign (or copy paste into your browser).

Beth E. Koch, MFA, researcher 
University of Minnesota Duluth
1201 Ordean Ct HUM317
Duluth, MN 55812
bekoch@umn.edu
(218) 726-6961
APPENDIX D
Questionnaire

Designing Type: A Design Research Study

Thank you for your willingness to participate in this research about type design being conducted at the University of Minnesota.

This study is among a very few experiments to investigate type design. We would appreciate your help in inviting friends and colleagues to participate, both designers and non-designers alike.

Confidentiality: Your response to this survey is confidential. The data collected from this survey cannot be connected back to you—no identifying information is being collected. The data will be used for design research that will be reported in written articles including a dissertation and academic journals. The data will be destroyed and the URL will be removed at the end of the research.

The researcher conducting this study is Beth E. Koch. You may email the author with questions before continuing or, if you have questions later, you are encouraged to contact them at University of Minnesota Duluth, (218) 726-6991, bekoch@d.umn.edu, or you may contact the researcher’s advisor, Brad Hakanson, Ph.D., at (612) 234-4919, brah@umn.edu.

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher you are encouraged to contact the Research Subjects Advocate Line, D859 Mayo 420 Delaware St. SE, Minneapolis, MN 55455; (612) 625-1150

This questionnaire will take roughly 15 minutes to complete, and consists of three general questions and six experimental questions.

Press the Next button if you agree to participate in the study (to acknowledge your informed consent) and to receive further directions. Otherwise, if you do not consent, please close this window.

Introduction

To express your responses you can use a set of animated characters (see picture below).

Before the actual study starts, we will start with a short introduction to the animated characters.

General mood

Before we start the actual test, we want to ask you to indicate your general mood. You can use the scale below. Select one of the seven bullets to represent your current mood state (left if your mood is unpleasant, and right if your mood is pleasant). You can select a bullet by clicking on it with the mouse.

Next >>
Questionnaire — Question 1 of 3

1. Have you had training or education concerning any form of design (ex. graphic design, Interactive design, industrial design)?
   - Yes
   - No

Next >>

Questionnaire—Question 2 of 3

2. Please indicate your gender:
   - Male
   - Female
   - Gay/Lesbian
   - Transgender/Bisexual

Next >>

Questionnaire—Question 3 of 3

3. Is your vision normal or corrected with glasses or contacts to at least 20/20 or 20/15?
   - Yes
   - No

Next >>

Exercise

Now you will do a small exercise to get acquainted with the animated characters.
When you click on 'Next' the exercise will start.
Please remember to turn up the sound of your PC, the sounds made on this website are very important.

Next >>
Experiment Questions—1 of 6

Please look at this alphabet for a few seconds. Click on 'next' to continue.

ABCDEFGH

I do feel this strongly
I do feel this
I feel this somewhat
I feel this a little
I do not feel this

4 3 2 1 0

MNOPQRSTUVWXYZ

How much do your feelings about the alphabet design pictured here correspond with the feelings expressed by each cartoon? Click on the cartoons one at a time and rate your feelings for each one. Once you have clicked on each cartoon and made your choice, you will be able to move on to the next page.
Experiment Questions—2 of 6

Number Two

Please look at this alphabet for a few seconds. Click on 'next' to continue.

ABCDEFGHJKLMNOPQRSTUVWXYZ
QRSTUVWXYZabcdefghijklmnopqrstuvwxyz
&0123456789Æ

Next >>

Experiment Questions—2 of 6

I do feel this strongly  4
I do feel this  3
I feel this somewhat  2
I feel this a little  1
I do not feel this  0

How much do your feelings about the alphabet design pictured here correspond with the feelings expressed by each cartoon? Click on the cartoons one at a time and rate your feelings for each one. Once you have clicked on each cartoon and made your choice, you will be able to move on to the next page.

Next >>
Experiment Questions—3 of 6

Number Three

Please look at this alphabet for a few seconds. Click on 'next' to continue.

ABCDEFGHIJKLMNOPQRSTUVWXYZ

Next >>

Experiment Questions—3 of 6

How much do your feelings about the alphabet design pictured here correspond with the feelings expressed by each cartoon? Click on the cartoons one at a time and rate your feelings for each one. Once you have clicked on each cartoon and made your choice, you will be able to move on to the next page.

Next >>
Experiment Questions—4 of 6

Number Four

Please look at this alphabet for a few seconds. Click on 'next' to continue.

ABCDEFGHIJKLMNOPQRSTUVWXYZ
defghijklmnopqrstuvwxyz
&012345678

Next >>

Experiment Questions—4 of 6

I do feel this strongly
I do feel this
I feel this somewhat
I feel this a little
I do not feel this

ABCDEFHGIJKLMNOPQRSTUVWXYZ

defghijklmnopqrstuvwxyz
&012345678

How much do your feelings about the alphabet design pictured here correspond with the feelings expressed by each cartoon? Click on the cartoons one at a time and rate your feelings for each one. Once you have clicked on each cartoon and made your choice, you will be able to move on to the next page.

Next >>
Experiment Questions—5 of 6

Number Five

Please look at this alphabet for a few seconds. Click on 'next' to continue.

How much do your feelings about the alphabet design pictured here correspond with the feelings expressed by each cartoon? Click on the cartoons one at a time and rate your feelings for each one. Once you have clicked on each cartoon and made your choice, you will be able to move on to the next page.

Number Five
Experiment Questions—6 of 6

Number Six

Please look at this alphabet for a few seconds. Click on 'next' to continue.

ABCDEFHGIJKLMNOPQRSTUVWXYZ

nopqrstuvwxyz&0 123456789ÆÅÂ

Next >>

Experiment Questions—6 of 6

How much do your feelings about the alphabet design pictured here correspond with the feelings expressed by each cartoon? Click on the cartoons one at a time and rate your feelings for each one. Once you have clicked on each cartoon and made your choice, you will be able to move on to the next page.

I do feel this strongly — 4
I do feel this — 3
I feel the somewhat — 2
I feel this a little — 1
I do not feel this — 0

ABCDEFHGIJKLMNOPQRSTUVWXYZ

nopqrstuvwxyz&0 123456789ÆÅÂ

Number Six
Thank You!

Your privacy is vital to this research. No identifying information has been collected.

The researcher conducting this study is Beth E. Koch. You may contact the author if you have questions, you are encouraged to contact them at University of Minnesota Duluth, (218) 726-9861, bekoch@d.umn.edu, or you may contact the researcher’s advisor, Brad Hulander, PhD, at (612) 624-4018, trad@umn.edu.

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher you are encouraged to contact the Research Subjects Advocate Line, D528 Mayo 420 Delaware St. SE, Minneapolis, MN 55355; (612) 625-1150

Thank you for your participation!
Experiment: Typographic Design Research Study

Step by step

1. Add stimuli
   6 stimuli added

2. Add pages
   14 pages added

3. Open experiment
   Opened at 6 August 2010 22:14 hrs

4. Gather data
   Data is being gathered (161 respondents)

5. Close experiment
   Scheduled at 22 Sep 2010 09:00 hrs

Publication details

Experiment URL: https://www.measuring-emotions.com/typodesign
Access control: Public experiment

Experiment details

Created: 16 July 2010 11:53:55 by SusaGroup
Status: open
Language: English (United Kingdom)

*Typographic Design Research Study conducted by Beth E. Koch at the University of Minnesota

© 2017-2018 SusaGroup

Creating Meaningful Experiences

177
THANK YOU FOR ORDERING PrEmo!

Thank you for your interest in using PrEmo. We have created an account for you, so you can use PrEmo yourself in our online environment.

You can access PrEmo using the following details:
http://www.measuring-emotions.com
E-mail address: bekoch@d.umn.edu
Password:

ABOUT PrEmo

Emotional responses elicited are difficult to measure because their nature is subtle (low intensity) and often mixed (more than one emotional response at the same time). However, scientific research at the Technical University of Delft by Dr. Pieter Desmet has resulted in an instrument, PrEmo, to measure emotions. PrEmo is the only self-report instrument available that measures distinct (pleasant and unpleasant) emotions in a non-verbal manner that is validated cross-culturally.

ABOUT PrEmo online

The PrEmo online toolbox has an intuitive user interface that allows you to add stimuli, add and arrange pages, including the PrEmo assessment. Summarized, measuring emotions has become as easy as in a few clicks to:

• Add and upload stimuli
• Create (explanation) pages
• Organize your experiment
• Schedule and publish your study

More information can be found on:
http://www.premo-online.com

You can view a prepared demo on http://www.measuring-emotions.com/demo [password: dec2008]
The Product Emotion Measurement Instrument (PrEmo)

Pieter Desmet; Delft University of Technology: p.m.a.desmet@tudelft.nl

People are expert at interpreting emotional expressions. In the face-to-face encounters of everyday life we constantly monitor the emotions of others. Does my question annoy him? Is she amused by my story? In some cases facial expression provides a means of communicating emotions that is even more effective than verbal expression. This interpretation skill was the starting point for the development of PrEmo. PrEmo is a non-verbal self-report instrument that measures 14 emotions that are often elicited by product design. Of these 14 emotions, seven are pleasant, and seven are unpleasant (see table below).

<table>
<thead>
<tr>
<th>Pleasant emotions</th>
<th>Unpleasant emotions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desire</td>
<td>Indignation</td>
</tr>
<tr>
<td>Pleasant surprise</td>
<td>Contempt</td>
</tr>
<tr>
<td>Inspiration</td>
<td>Disgust</td>
</tr>
<tr>
<td>Amusement</td>
<td>Unpleasant surprise</td>
</tr>
<tr>
<td>Admiration</td>
<td>Dissatisfaction</td>
</tr>
<tr>
<td>Satisfaction</td>
<td>Disappointment</td>
</tr>
<tr>
<td>Fascination</td>
<td>Boredom</td>
</tr>
</tbody>
</table>

These scales represent the following ratings: “I do feel the emotion,” “to some extent I feel the emotion,” and “I do not feel the emotion expressed by this animation.”

Instead of relying on the use of words, respondents can report their emotions with the use of expressive cartoon animations. In the instrument, each of the 14 measured emotions is portrayed by an animation by means of dynamic facial, bodily, and vocal expressions. Figure 1 shows some examples of the cartoons, and Figure 2 shows the measurement interface.

The procedure of a PrEmo experiment is self-running. The computer screen displays instructions that guide respondents through the procedure, which includes an explanation of the experiment and an exercise.

The program’s heart is the measurement interface, which was designed to be simple and intuitive in use. The top section of this interface depicts stills of the 14 animations. Each still is accompanied by a (hidden) three-point scale.

The rating scales are ‘hidden behind’ the animation frames. A scale appears on the side of the animation frame only after the animation is activated by clicking on the particular still. The lower section of the interface displays a picture of the stimulus and an operation button. During an experiment, the respondents are first shown a (picture of a) product and subsequently instructed to use the animations to report their emotion(s) evoked by the product. While they view an animation, they must ask themselves the following question: “Does this animation express what I feel?” Subsequently, they use the three-point scale to answer this question. Visual feedback of the scorings is provided by the background colour of the animation frame.

The unique strength of PrEmo is that it combines two qualities: it measures distinct emotions and it can be used cross-culturally because it does not ask respondents to verbalise their emotions. In addition, it can be used to measure mixed emotions, that is, more than one emotion experienced simultaneously, and the operation requires neither expensive equipment nor technical expertise. And, also important, respondents reported that the measurement task with PrEmo is pleasant or even enjoyable.
Example study using PrEmo

Below you will find a typical flow of a basic experiment using PrEmo. This kind of experiment can be set-up by yourselves using some of the functions our PrEmo online toolbox. Using this toolbox you can also use multiple stimuli, randomise stimuli, etcetera.

For additional functionalities we can always build and implement a custom made experiment.

Basic PrEmo experiment

A typical PrEmo experiment flow looks like this:

- Welcome screen
- PrEmo explanation
- PrEmo character explanation
- PrEmo scale explanation
- Exercise introduction
- Exercise stimulus
- Exercise PrEmo assessment
- Exercise end
- General mood measurement
- (A) Study stimuli 1
- (B) Study PrEmo assessment 1
- Continue A and B for all stimuli
- Thank you screen

Welcome screen

First of all you can compose a welcome screen, explaining something about the study and for example who to contact in case of any questions.
APPENDIX E. Statistical Information Graphics. Copyright ©2010 Scott Roby • Created as an undergraduate independent study at University of Minnesota Duluth.
## Intensity of Emotional Response

<table>
<thead>
<tr>
<th></th>
<th>Glyph Medium</th>
<th>Helvetica Bold</th>
<th>Helvetica Bold Condensed</th>
<th>Helvetica Extended Bold</th>
<th>Helvetica Light</th>
<th>Helvetica Round Medium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desire</td>
<td>34</td>
<td>34</td>
<td>43</td>
<td>19</td>
<td>68</td>
<td>41</td>
</tr>
<tr>
<td>Satisfaction</td>
<td>81</td>
<td>57</td>
<td>62</td>
<td>35</td>
<td>12</td>
<td>68</td>
</tr>
<tr>
<td>Pride</td>
<td>59</td>
<td>52</td>
<td>37</td>
<td>26</td>
<td>62</td>
<td>51</td>
</tr>
<tr>
<td>Hope</td>
<td>35</td>
<td>29</td>
<td>33</td>
<td>23</td>
<td>38</td>
<td>34</td>
</tr>
<tr>
<td>Joy</td>
<td>57</td>
<td>40</td>
<td>46</td>
<td>23</td>
<td>60</td>
<td>54</td>
</tr>
<tr>
<td>Fascination</td>
<td>46</td>
<td>33</td>
<td>38</td>
<td>20</td>
<td>63</td>
<td>39</td>
</tr>
<tr>
<td>SUM n=42</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>81–90</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>71–80</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>61–70</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>51–60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>41–50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31–40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21–30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11–20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0–10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Copyright ©2011 Monique Rogers • Created as an independent study during graduate studies at University of Minnesota Duluth*