WOMEN'S SELF-PERCEPTIONS:

AN EXPLORATORY STUDY OF OPTICAL ILLUSION GARMENTS

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by

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The undersigned, appointed by the dean of the Graduate School, have examined the dissertation entitled

WOMEN'S SELF-PERCEPTIONS:

AN EXPLORATORY STUDY OF OPTICAL ILLUSION GARMENTS

presented by Jessica Lee Ridgway

a candidate for the degree of doctor of philosophy

and hereby certify that, in their opinion, it is worthy of acceptance

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DEDICATION

I would like to dedicate this to my parents, John and Vickie Ridgway. Your love and support throughout the past five years has been overwhelming. You have been my strength, inspiration, and encouragement whenever I have needed it and for this I cannot thank you enough. I would also like to dedicate this to my sister, Jen Ridgway, for her words of wisdom and continual excitement about my endeavors. And to Russell Clayton, for all your support and for inspiring me to be a "real" researcher.

And finally, to my fellow graduate students over the past five years, who have been my support system throughout this journey. I know that the journey together does not stop here and for that I am blessed!

Too blessed to be stressed

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ABSTRACT

Although previous research provides insight into how women construct and idealize their appearance through clothing, the connection to the design elements of a garment is lacking. Using an exploratory approach, the current study, theoretically grounded in the self-discrepancy theory, investigated a woman's perceptions of her body shape. The primary goal of this exploratory study was to understand how garments created with optical illusion prints or patterns, can affect women's perceptions of body shape and if optical illusion garments can increase body satisfaction while helping a woman achieve the appearance of a more ideal body shape. Fifteen women were body scanned to determine their body shape and then participated in an in-depth semi-structured interview while viewing a personalized avatar (created from their body scan) depicted in the seven different optical illusion garments created by the researcher. Data analysis revealed seven themes: (1) Perception of Self, (2) Clothing and the Body, (3) Defining Ideals, (4) Optical Illusion Applications, (5) Preferences by Body Shape Category, (6) Effects of Wearing Optical Illusions, and (7) A More Ideal Self. Results from this study showed that optical illusion garments do effect the visual perception of body shape and can result the perception of a more ideal body shape.

CHAPTER I: INTRODUCTION

Chapter I contains the following sections (a) background of the study, (b) purpose of the study, and (c) significance of the study.

Background of the Study

Women are capable of going to extremes in order to manage their appearance by participating in behaviors such as "dieting, exercising, cosmetic use, surgical procedures, and apparel selection" (Rudd & Lennon, 2000, p. 152). The task of apparel selection can be overwhelming to some, but is thought to be a viable way to change one's physical appearance. According to Fan, Yu, and Hunter (2004) there are very few women that think they have a perfect body, but in most cultures many would like to improve their appearance through the use of clothing. Clothing is a broad term that focuses on the covering of the body, but is limited, as it does not include physical modifications of the body (Roach-Higgins & Eicher, 1992). The accepted definition of clothing implies that there is an interaction with the body. This interaction along with the "features of the undressed body" (Roach-Higgins & Eicher, 1992, p. 3) results in the perception of a woman's physical appearance. Although clothing can be used to improve a woman's physical appearance, in some cases clothing can be linked to dissatisfaction with her body.

The self-discrepancy theory can be used to help explain the dissatisfaction that women have with their bodies. This theory states that when incongruence occurs between

people's actual, ideal, and ought selves it will result in that individual having negative emotions and feeling discomfort. Within the field of Textiles and Apparel, several studies have used the self- discrepancy theory to examine consumer reactions to media images related to clothing (Rudd & Lennon, 2000; Kim & Damhorst, 2010) and clothing fit issues as related to body image (Alexander, Connell, & Presley, 2005; Chattaraman & Rudd, 2006). Kim and Damhorst (2010) used the self-discrepancy framework to understand how viewing thin models (i.e. cultural ideal body), impacted the self-perception of female consumers. Findings indicated that "perceived body-related self-discrepancy was positively associated with body-dissatisfaction" (Kim & Damhorst, 2010, p.248). Kim and Damhorst surmised that, based on their findings, participants who had an inconsistency between their actual and ideal selves were dissatisfied with their bodies. Body cathexis, commonly studied in Textiles and Apparel, is a person's satisfaction with his or her appearance and is an evaluation of body image and self-concept (Fan, Yu, & Hunter, 2004). Many women directly relate apparel fit issues to dissatisfaction with their body resulting in a low self- concept (Kim & Damhorst, 2010). Apparel fit issues caused consumers to be unhappy and this dissatisfaction can be related to perception of their own body shape (Istook, Simmons, & Devarajan, 2002).

Recent research in Textiles and Apparel has investigated the relationship between apparel fit satisfaction and body satisfaction or body cathexis (Song & Ashdown, 2013; Alexander et al., 2005; LaBat & Delong, 1990). Song and Ashdown's (2013) recent study added to this line of research by investigating a third component: body shape. In their study, which focused on the lower half of the body, Song and Ashdown (2013) found a discrepancy between participant's self-perception (perceived body shape and size) and

actual body measurements (data collected from body scanning). Although body shape is rarely physically changed, clothing's interaction with the body, along with garment design, can help to change the visual perception of body shape resulting in more satisfied consumers (Fan, Yu, & Hunter, 2004)In fact, Fan, Yu, and Hunter (2004) stated, "the principles of illusion can be applied to the design of dress so as to camouflage the undesirable body attributes and to make the person's appearance closer to the ideal" (p.11). Illusion can be defined as the experience of an object appearing where the object really does not exist (Kalderon, 2011). Therefore, knowing how illusion can be applied to garment design can give apparel designers the insight to be able to manipulate the illusion and control the perception of appearance (Davis, 1980).

Purpose of the Study

Although previous research provides insight into how women construct and idealize their appearance through clothing, the connection to the design elements of a garment is lacking. Using an exploratory approach, the current study, theoretically grounded in the self-discrepancy theory, investigated a woman's perceptions of her body shape. The primary goal of this exploratory study was to understand how garments created with optical illusion prints or patterns, can affect women's perceptions of body shape and if optical illusion garments can increase body satisfaction while helping a woman achieve the appearance of a more ideal body shape. The current study body scanned participants to: (1) obtain body measurements in order to classify the participant's body shape and (2) capture cloud point data used to create avatars for each participant. Height and weight of each participant was collected in order to identify the participant's body mass index category. Seven digital optical illusion garments were

designed and custom fit to each participant's avatar. Participant perceptions of their body shape dressed in optical illusion garments was investigated through viewing their clothed avatars during in-depth interviews.

Significance of the Study

Gaining an empirical understanding of the complex relationship among self-perception, body shape, and optical illusion garments provided scholars a better understanding of the factors that guide a woman's judgment in the perception of her clothed body. The current study has significance for both academia and the apparel industry.

Regarding academia, two gaps in the current literature were identified. The first was that there is extremely limited research which investigated the relationship between a woman's perceptions of her body shape and garment design (optical illusion garments). This study of the relationship between body shape and garment design is important for researchers who wish to gain a better understanding of how garment design can be used to change the visual perception of body shape. This information also provides insight into garment design projects and can help designers to better understand the complex relationship between the body, clothing, and wearer. The second gap identified was the lack of research regarding body shape self-discrepancy and clothing's ability to bridge the gap between the wearer's actual and ideal self. The current study used the self-discrepancy theory to explain the role clothing (optical illusion garments) plays in the construction of the self and how clothing can be used to increase body satisfaction.

In addition to academia, this study has implications for the apparel industry. Currently many fashion designers are producing optical illusion garments. Findings from

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this study will provide insight into how optical illusion garments can be used to change the visual perception of the wearer's body shape. Not only does this study identify which types of illusions work best for certain body shapes (hourglass, rectangle, and spoon), it also provides information regarding woman's self- perceptions of their body shapes while wearing optical illusion garments. Many designer's today are using optical illusion in their design work, however very few have actually examined their consumer's perceptions of their optical illusion designs. Most importantly, understanding women's thoughts regarding wearing optical illusions helps garment designers create more successful designs which could result in garments that help women achieve the perception of a more ideal body shape.

Additionally, this study used digital avatars to represent its' participants. The avatar was a tool used in order gain a better understanding of women's self-perceptions. This use of avatars and knowledge gained from exploring the perceptions that women have to their own avatar will also be important to the apparel industry. With the increase of online shopping and virtual models, gaining an understanding of how women perceive avatars that are representative of themselves will aid online retailers in understanding how they can use avatars as a more effective sales tool.

CHAPTER II: THEORY AND LITERATURE REVIEW

This chapter provides the theoretical foundation for the current study, in addition to a review of the literature pertaining to the main constructs that will be examined. First, the self-discrepancy theory provides a theoretical framework for how women perceive themselves. Second, constructs supporting the central concept of body shape were examined. Third, a review of the constructs supporting the central idea of optical illusions when used on apparel was discussed.

Self-Discrepancy Theory

The self-discrepancy theory, originally explained by Higgins (1987), was established in the psychological sciences. The self-discrepancy theory is often used in the field of psychology when studying eating disorders (Altabe & Thompson, 1996; Strauman & Glenberg, 1994; Strauman et al., 1991; Szymanski & Cash, 1995) and body dysmorphic disorders (Veale, Kinderman, Riley, & Lambrou, 2003). Higgins (1987) explained that there can be many definitions of the self, but "there are three basic domains of the self" (p.320-321): the actual self, the ideal self, and the ought self. These three sub-dimensions comprise an individual's self-concept and can be defined as the following: (1) the actual self contains the attributes a person actually possess, (2) the ideal self comprises the attributes that someone would ideally like to have, and (3) the ought self comprises the attributes that one should possess and are constructed by society

(Higgins, 1987). Self-discrepancy emerges when there are differences among these sub-domains (Kim & Damhorst, 2010; Jung, Lennon, & Rudd, 2001). Thus, when there is incongruity among the three domains of the self, an individual will experience negative emotions or discomfort.

For instance, in the field of Textiles and Apparel, the self-discrepancy theory was used to understand the relationship between body image dissatisfaction and when viewing various media images (Jung, Lennon, & Rudd, 2001; Kozar & Damhorst, 2009). Jung, Lennon, and Rudd (2001) found that after viewing media images women "who perceived themselves to be discrepant from the ideal had higher body dissatisfaction…" (p.180). Furthermore, Kim and Damhorst (2010), when examining online shopping experiences, found a positive relationship between body self-discrepancy and body dissatisfaction.

Recent research, conducted by Kim and Sunder (2012), used the self-discrepancy theory to help investigate if creating avatars that resembled the ideal or actual self could aid in counteracting the negative impacts of self-discrepancy. While the study's main focus was examining health related issues, the findings provide insight for the current study. Kim and Sunder (2012) found that those individuals who created an avatar that represented their ideal self were more likely to engage in healthy preventive behaviors and those who had avatars that represented their actual self were less likely to engage in proactive behaviors. The connection that the participant has to their avatar is indicated by these findings and the researchers suggest that avatars are an effective model to reflect a participant's identity.

Additionally, Shin and Baytar (2014) recently used the self-discrepancy theory to explore if images of female bodies (virtual models) depicted on a website affected female consumers' body satisfaction. Their results showed that women with lower levels of body satisfaction were more likely to experience anxiety related to clothing fit and size. Furthermore, in connection with the current study, their exploration of the use of virtual models (avatars) revealed that those women who had greater body dissatisfaction and greater concern with clothing fit were more like to use virtual models to digitally try on clothes. The study conducted by Shim and Baytar (2014) begins to bridge the gap and build a connection between self-discrepancy, shopping behaviors, and virtual models, however further researcher is needed to understand the role that clothing plays.

Therefore, the current study investigated whether body satisfaction can be increased through the use of clothing by bridging the gap between a woman's actual and ideal self. It also seeks to investigate the role in which the use of virtual avatars will affect a woman's self-perception and body satisfaction. Additionally, Optical illusion garments were be used as a way to alter the visual perception of a woman's actual body shape and to help to create the appearance of a more ideal body shape.

Body Image

Body image is closely linked to self-discrepancy as body image consists of both perceptions that a woman has of herself (actual self) and the perception of what she desires to be (ideal self). The evaluation of one's own body image is known as body cathexis (Chattaraman & Rudd, 2006) and is the feelings (positive and negative) that a person has towards his or her own body (LaBat & Delong, 1990). Moreover, body image can be described as the mental image that a woman has of her own body including

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attitudes and perceptions of body size and shape (Rudd & Lennon, 2000; Fan, Yu, & Hunter, 2004). The perception of body size and shape is closely linked to cultural ideals of beauty and can perpetuate the development of self-discrepancy (Jung, Rudd & Lennon, 2001). In fact, researchers have found that "women are less satisfied with their physical appearance after viewing ideal images in the media" (Jung, Rudd & Lennon, 2001, p. 173). The ideal body shape is an evolving concept.

Ideal Body Shape

Ideal body shape is dependent upon the time and space in which the body exists and can differ among cultures (Lee, Istook, Nam, & Park, 2007). The original conceptualization of body shape in western cultures was established by the proportions of the Greek gods (Fan, Yu, and Hunter, 2004). Historically, a woman's beauty was often influenced by the perception of women's "reproductive potential" (Fan, Yu, & Hunter, 2004, p. 5) and therefore, the appearance of a larger bust and wider hips was often found to be most beautiful. This appearance draws parallel to that of an hourglass body shape and may explain why the hourglass shape is often thought to be ideal in western cultures. Coleman (2011) suggested that all women strive to achieve an ideal hourglass figure which is classified by equal proportions on the top and bottom with a narrow waist. This was supported by a study that examined body shape ideals for both white and black women. The researchers found that a majority of the participants, 59.9% of black women and 50.0% of white women, identified the hourglass body shape to be the most ideal (Overstreet, Quinn, & Agocha, 2010). Furthermore, a study conducted by Grogan et al. (2013), recorded the responses of women as they tried on dresses revealing that all participants in the study believed that a slim hourglass figure was most ideal. Participants idealized a proportionate body with fuller breasts, a small defined waist, and fuller hips.

The study also indicated that women selected clothing in order to try and achieve the look of an hourglass figure (Grogan, Gill, Brownbridge, Kilgariff, & Whalley, 2013). In other words, women who didn't view their actual body shape as an hourglass attempted to select clothing that would create the illusion of the hourglass (ideal) shape.

Alternatively, it is argued that recently there has been a shift in this ideal and that today curves are no longer seen as ideal (Bonafini & Pozzilli, 2010; Polivy & Herman, 2004). Ideal body shape for women may be "slender and tubular rather than rounded and curvaceous" (Polivy & Herman, 2004, p. 1) and linear and masculine in appearance (Bonafini & Pozzilli, 2010). In fact, Bonafini and Pozzilli (2010) speculate that today's ideal body weight is actually considered underweight consisting of a BMI between "18 and 20 or even less" (Bonafini & Pozzilli, 2010, p. 64). The obsession with thinness and emphasis on beauty is not just a western ideal, but is a global phenomenon (Bissell & Chung, 2009; Bonafini & Pozzilli, 2010; Polivy & Herman, 2004). For instance, Bissell and Chung (2009) investigated the concept of Americanized beauty in South Korea and found that the shift from curves to thinness also occurred there, resulting in an increase in plastic surgery within Korean culture. This increase in plastic surgery illustrates the increased pressure that women feel to achieve the culturally defined ideal appearance and body shape. Regardless of the ideal, the female body exists in multiple shapes and sizes (Chen, LaBat, & Bye, 2010) and actual body shape can be determined in several different ways including the analysis of body silhouette and body measurements.

Body Shape Categorization

Body shape has been studied within the field of Textile and Apparel and directly corresponds to the proportions and measurements of the body (Chattaraman & Rudd,

2006; LaBat & Delong, 1990; Kim & Damhorst, 2010; Pisut & Connell, 2007). One problem with current identifications of body shapes are the multitude of terms currently used within industry, among consumers, and by researchers. Current body shape names fit into the following categories: shapes (i.e., oval, hourglass, and rectangle), letters/numbers (i.e., O, X, H, A), and fruits/vegetables (i.e., apple, pear) (Istook, Simmons, & Devarajan, 2002). Body shape names can be confusing as some shape designations have similar proportional differences and the names used are interchangeable.

Somatotyping is the study of human body types and visual somatometry was used by Douty (1977) to categorize body forms with an aim to improve apparel fit. However, while an examination of the outline or silhouette of the body can define a general size and shape (i.e. large and round or small and boxy), using body measurements provides a more scientific and accurate way of determining body shape. Those techniques that incorporate body measurements for examining body types, use the measurements by evaluating the ratios among different areas of the body, most commonly, bust, waist, and hip. Thus, the ratios found between each of these sections of the body (i.e. bust to waist and waist to hip) classify the body as a specific shape. For example, two tools which use body measurements to define body shape are the woman's body shape analysis tool (WBSAT) (Connell, Brannon, & Ulrich, 2002) and the female figure identification technique (FFIT) software (Simmons, 2002). The women's body shape analysis tool (WBSAT), developed by researchers at Auburn University, used the hourglass shape as a standard for understanding other shapes and identified the following additional shapes: rectangle, pear, and inverted triangle (Connell, Brannon, & Ulrich, 2002). The FFIT was developed

by Simmons (2002), at North Carolina State University, and was created to develop a starting point for classifying female body shapes by a mathematical method. Nine body shapes were identified by the FFIT software. The aim of the FFIT was to generate software that could be used in mass customization strategies (Devarajan & Istook, 2004). The FFIT provides detailed criteria used for the classification of the female body shape including shape name and the ratio that corresponds to the shape. Due to the detail of information provided by the FFIT to classify body shape, the current study will use the guidelines and ratios provided by the FFIT software in order to classify participant's body shapes.

The nine different body shapes identified in the development of the FFIT were: hourglass, bottom hourglass, top hourglass, spoon, rectangle, diamond, oval, triangle, and inverted triangle (Simmons, 2002; Devarajan & Istook, 2004). Simmons used body scanning technology to obtain measurements of the bust, waist, hip, high hip, abdomen, and stomach. The measurements of these areas of the body were reported as circumference measurements. Each of the nine shapes was defined by its own unique body measurement ratio. For example, an hourglass has equal bust-to-waist and hips-to-waist ratios with significant differences between the two. Simmons (2002) identified the bottom hourglass as a subset of the traditional hourglass category. The bottom hourglass shape is indicative of a "larger hip circumference than bust circumference and if the ratios of their bust-to waist and hips-to-waist are significant enough to produce a definite waistline" (Simmons, 2002; p.106). It should be noted that the third category of hourglass identified by the FFIT is the top hourglass, which is classified as a woman that has a larger bust circumference than hips, but still has a defined waistline. However, Simmons'

study (2002) resulted in zero participants being identified as a top hourglass; thus, she considered this body shape to be rare. Given the minimal differences between the classification of bottom hourglass, top hourglass, and hourglass, the current study will use one category of hourglass to encompass all three hourglass shapes.

In contrast to the hourglass shape, the rectangle shape has a fairly even bust and hip measurements and the bust-to-waist along with hip-to-waist ratios are low (Simmons, 2002). For example, a woman that has a rectangle shape has little definition at the waist and is reported to be straighter from the shoulders through the hips (Pisut & Connell, 2007). The spoon shape is classified as having a larger circumference difference between the hip and bust and the bust-to-waist ratio is lower than the hourglass shape while the high-hip-to-waist ratio is larger than that of an hourglass shape.

Simmons (2002) reported that over 40% of a sample of 222 subjects were considered to be a bottom hourglass, 21.6% were hourglass shaped, while 17.1% were spoons, and 15.8% were considered rectangles. Furthermore, additional research confirmed that the most common body shapes for women are hourglass, rectangle, and spoon (pear) (Devarajan & Istook, 2004; Lee, Istook, Nam, & Park, 2007)). Therefore, the current study will utilize the three body shapes (hourglass, spoon, and rectangle) which have been found to be the most common among the population.

Current sizing standards based on body measurements, updated in 2011, specified by the American Society for Testing and Materials (ASTM), reflect body measurements that are consistent with the bottom hourglass. The ASTM D5585 standard table of body measurements for adult female, Misses figure type, show the following measurements for

a Misses size 8: Bust = 36 ¼ in., Waist = 28 in., and Hip = 39 ¼ in. Generally, these

measurements are representative of an hourglass body shape because the bust and hip

measurements are similar and the waist is defined. However, if the measurements are

examined according to the FFIT, the three inch difference between the bust and hip

would classify these measurements as a bottom hourglass. This information could be

used to support the argument that currently a majority of American women are

considered a bottom hourglass shape. An examination of sizing charts for Lands' End,

Brooks Brothers, and Talbots further supports this argument as all three retailers have a

difference of three inches between bust and hip measurement listed on their Misses size

chart. Measurements for a Misses size 8 from all three retailers can be found in Table 1.

Table 1. Size Chart Data from Retailers

Retailer Name	Bust Measurement	Waist Measurement	Hip Measurement
Lands' End	36	29 ½-30 ½	39
Brooks Brothers	36	28 ½	39
Talbots	36	29	39

Based on the literature above, body shape is an important factor that should be

considered when designing garments for a target market. With this in mind, the current

study aimed to investigate the effect of color theory, specifically optical illusion

garments, on a woman's perception of her own body shape. Optical illusion garment may

provide a way for women to change the visual perception of their body shape. It would be

important for companies like those mentioned above to understand how their target

consumer (perhaps a woman with a bottom hourglass shape) is affected by the colors and

prints used in their clothing. To gain a better understanding of how optical illusions can

be applied to dress and how they are used to alter the visual perception of body shape, concepts central to understanding illusion were examined, starting with the principles of color theory.

Color Theory

One of the best ways to conceal body flaws or attract attention to a specific area of the body is through the use of color and pattern. Color theory provides an explanation of how color can affect the visual perception of appearance. In this section an explication of the physiology of perception and opponent theory will aid in understanding how the human eye sees color and illusions. The occurrence of illusions and how color theory can be applied to dress will also be discussed.

Physiology of Perception

Color is a function of light. White light is refracted in order for color to be seen. Color is measured in wavelengths and the visible color spectrum is the range of wavelengths that the human eye can see. We refer to the colors of the rainbow as the spectral hues: red, orange, yellow, green, blue, and violet. Red has the longest wavelengths and violet has the shortest. The way in which the human eye sees color is by light passing through the cornea, allowing for the iris to adapt to light being admitted in to the pupil. The light passing through the pupil is reflected onto the back of the eye known as the retina. The retina is covered in several layers and the layer that aids in seeing color is known as the photoreceptor layer (Zelanski & Fisher, 2010). The photoreceptor layer consists of rods and cones. Rods are responsible for seeing lightness and darkness, and cones are what allow humans to see color. The human eye has approximately 10 million rods and 6 million cones which send neuronal messages from

the optical nerve to the brain. There are various theories that relate to how the human eye perceives and processes color including the opponent processing theory.

Opponent Processing Theory

The opponent processing theory (Zelanksi & Fisher, 2010; Itten, 1961) states that the rods and cones operate in receptor pairs. Rods have a black and white receptor. Cones have a red-green receptor and a yellow-blue receptor. Within these pairs only one can work at a time, red is dominant within its pair while yellow is dominant within its pair. Understanding how the eye sees color and contrast allows us to explain how optical illusions are perceived by the eye. When one receptor gets fatigued the other receptor activates. An example of this phenomena occurs when looking at a black and white newspaper for a long time. The reader will start to see red and if continued will begin to see yellow (Zelanski & Fisher, 2010). The rods in this case are starting to fatigue so the cones activate, which is why the reader sees red first and then begins to see yellow. There is a sense of vibration that occurs, blurring the black and white lines when the receptors start to fatigue, which allows for this illusion to occur.

<div align="center">

Illusion

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Illusions have long been investigated by the social sciences, but the implications and practicality of them in the area of dress is currently a frequent topic of discussion (Swami & Harris, 2012). Illusion is the experience of an object appearing where the object really does not exist (Kalderon, 2011). Moreover, Davis (1996) defined illusion as a "misinterpreted visual" (p. 367) cue. This occurrence of illusion is clarified through a variety of explanations grounded in the principles of color theory. For this study, illusion will be addressed through a review of three known optical illusions (the Helmholtz illusion, the Muller-Lyer illusion, and the illusion of MacKay's rays) and two established

design elements (simultaneous contrast, spatial effects). In the current study, these five

optical illusions were applied during the garment development in order to create optical

illusion garments. Furthermore, the selected five optical illusions served as inspiration for

more complex textile prints and were subject to the researcher's creative interpretation of

the illusion. However, for some of the illusions, like the Helmholtz illusion, the

interpretation was simplistic and only involved the manipulation of scale. The garments

were digitally constructed and viewed on the participant's avatar.

Simultaneous Contrast

Simultaneous contrast occurs when the eye views any given color and because the

eye simultaneously requires the complementary color and it spontaneously generates it if

it is not already present (Itten, 1961 & Zelanski & Fisher, 2010). Leonardo da Vinci, who

was one of the first to have pointed out this visual effect, stated that: simultaneous

contrast is when complementary hues intensify each other if juxtaposed (Zelanski &

Fisher, 2010). Another color theorist, Chevreul, stated that simultaneous contrast occurs

when adjacent colors on the color wheel are positioned next to each other, resulting in an

intensified line where they meet (Zelanski & Fisher, 2010). Davis (1996) pointed out that

when simultaneous contrast is used, bright colors become brighter when placed next to

dull colors in the same way that light colors get lighter when placed next to darker colors.

A source of inspiration for the current study is Sonia Delaunay, who was famous

for her use of simultaneous contrast in both her paintings and her textile designs.

According to McQuaid and Brown (2011), Delaunay was fascinated by the juxtaposition

of colors to create a sense of movement. Simultaneity was a term used by Delaunay to

describe the "sensation of movement when placing contrasting colors side by side"

(McQuaid & Brown, 2011, p. 10). Delaunay's first dress was created in 1913 titled the

robe simultanée translated as the simultaneous dress (McQuaid & Brown, 2011). The

current study employed similar textile design techniques to those used by Delaunay in

order to create a sense of movement by placing contrasting colors next to one another.

The current study used a pair of hues such as blue and yellow so that the visual receptors

in the eye were activated to create a sense of movement. This sense of movement can be

used to draw the eye to, and away from, selected areas of the body aiding in the creation

of an optical illusion garment.

Spatial Effects

Spatial effects occur when the eye perceives hues that are lighter as being larger

and closer (Zelanski & Fisher, 2010). The opposite occurs for darker colors in that they

appear to be smaller, further away, and often appear as if they are fading into the

background. Spatial effects can be applied to optical illusions, in that a large area of a

light hue can make a section of the body appear larger, whereas a large area of dark hue

can make a section of a body appear smaller. Since this is also a basic principle of color

theory, it is possible that some of the other optical illusion garments also have textile

prints that employ the principles of spatial effects.

Helmholtz Illusion

The Helmholtz Illusion, created by Hermann von Helmholtz (1867), appears as

two squares consisting of 7 evenly sized and spaced lines. In the first square, the lines are

positioned horizontally and in the second square the lines are positioned vertically

(Figure 1). Hermann von Helmholtz argued that when comparing the two squares, the

one in which the lines are positioned horizontally appears to be more narrow and taller

than the square with the vertical lines. When applied to apparel, Helmholtz's theory that

horizontal lines make a person appear taller than vertical lines contradicts the common

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belief that wearing horizontal lines makes a person appear wider. Research conducted by

Thompson and Mikellidou (2011) supports Helmholtz's theory, finding no support for the

assumption that horizontal lines make an individual appear wider. In fact, when vertical

stripes were applied to 3-D images of a mannequin, researchers found that the mannequin

was reported as appearing almost 11% wider than the mannequin that was depicted in

horizontal stripes (Thompson & Mikellidou, 2011). Additionally, another study

conducted by Thompson (2008), compared the visual effect of the Helmholtz illusion in

2D images and on 3D bodies. This study again confirmed Helmholtz's theory, finding

wearing horizontal stripes actually can make the wearer appear taller.

Figure 1. Helmholtz Illusion. This figure illustrates the Helmholtz Illusion.
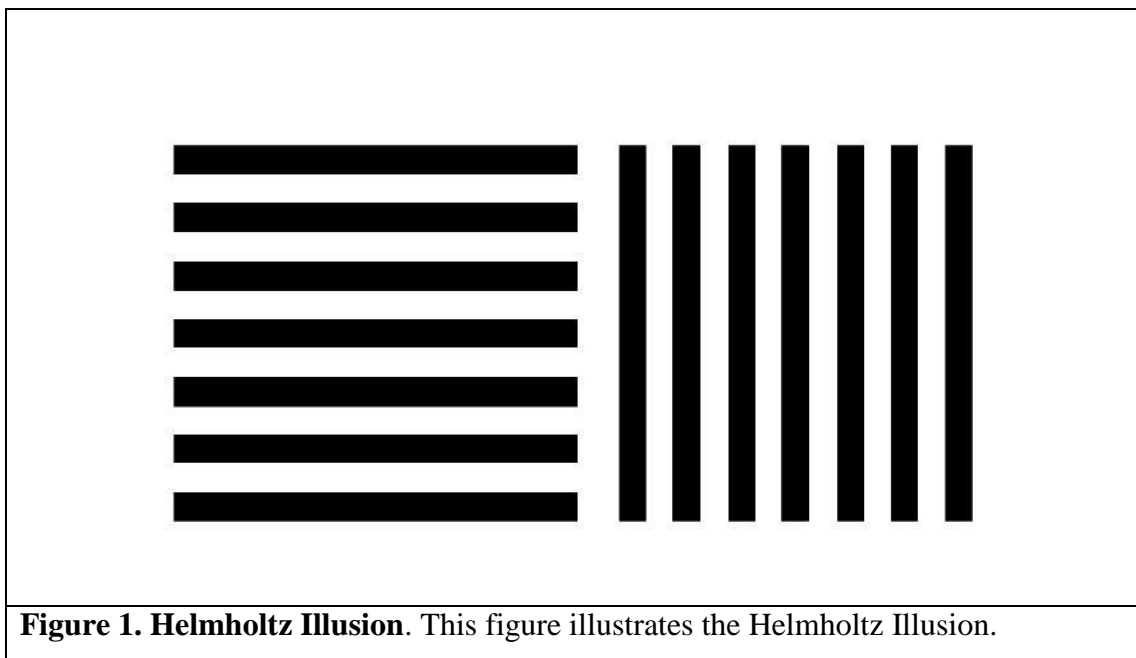
Alternatively, in a study conducted by Swami and Harris (2012), in which

participants were exposed to a confederate (an actor playing the role of a participant) who

was wearing a dress with either horizontal lines, vertical lines, or no stripes, participants

perceived a large body size when the confederate was wearing horizontal stripes

compared to vertical or no stripes (Swami & Harris, 2012). Furthermore, Chen and Peng (2013) also examined application of the Helmholtz illusion to clothing, and the effect that body size had on people's perception of the Helmholtz illusion. The researchers divided the participants into four body size groups: short-thin, short-heavy, tall-thin, and tall-heavy. Each group tried on two tunic length dresses, one consisting of vertical stripes and the other consisting of horizontal stripes. Participants were asked to determine which version of stripes they perceived as most flattering. Results indicated that for all four body groups', participants felt that the dress with vertical lines was the most flattering (Chen & Peng, 2013). There is no clear answer for which type (horizontal or vertical) of line makes the wearer appear most slender. Thus, the current study investigated the Helmholtz illusion with the hopes to gain a better understanding of women's perception of body shape when wearing both vertical and horizontal stripes.

Muller-Lyer Illusion

Davis (1996) identified the Muller-Lyer illusion (Figure 2) as useful for creating illusion with dress. She explained the Muller-Lyer illusion as when "a line with angled extensions at each end appears longer than another line of equal length in which the angled lines at each end double back" (p. 40). An example of this illusion used in dress was a V-neck jacket in which the hem line had a lower V that reflects the V in the neck line. It is suggested that this illusion will make the wearer look taller (Davis, 1996). Although not included for analysis in the study conducted by Chen and Peng (2013), the Muller-Lyer illusion is noted as an illusion frequently found in dress. Chen and Peng (2013) claimed that when this "illusion is applied to fashion design, the lines with arrows seems to be shorter than the other kind" (p. 101).
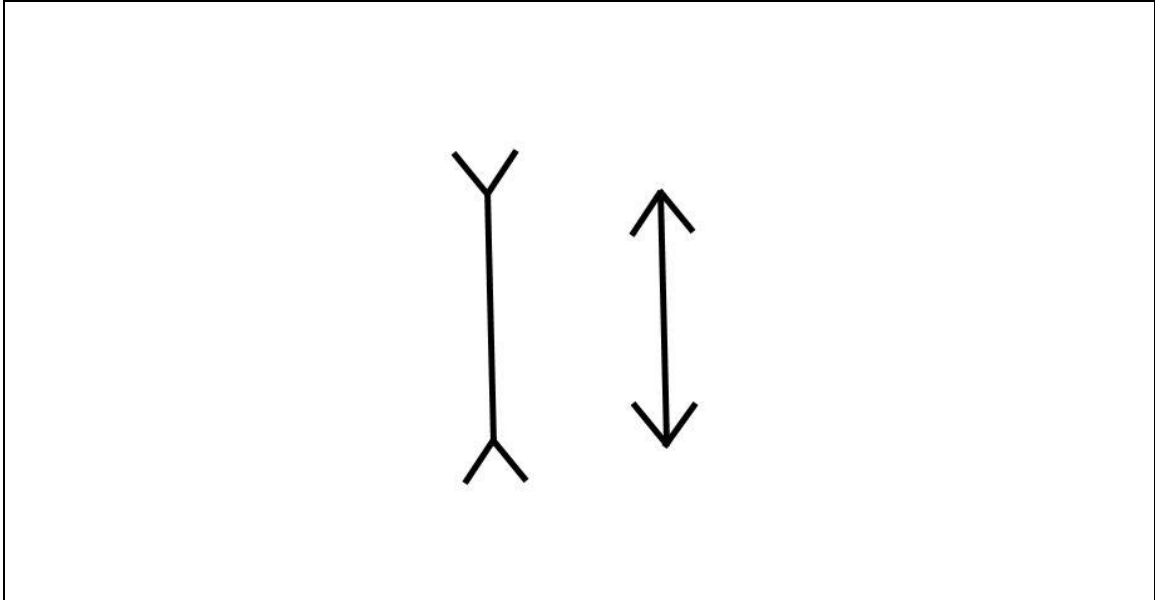
Figure 2. Muller-Lyer Illusion. This figure illustrates the Muller-Lyer illusion.

MacKay's Rays

The MacKay's Rays illusion (Figure 3) is defined as an auto kinetic illusion, which indicates that the illusion creates a sense of movement. Martinez-Conde and Macknik (2008) stated that this illusion was created by neuroscientist Donald M. MacKay in 1957. The illusion creates the perception of motion as the simple radial lines are repeated (Martinez-Conde & Macknik, 2008). Davis (1996) stated that this type of illusion can be very distracting to the viewer when used in clothing. However, this sense of movement can also be used to draw the viewer's attention to different parts of the body, hiding areas that are undesirable or highlighting areas that are desirable.
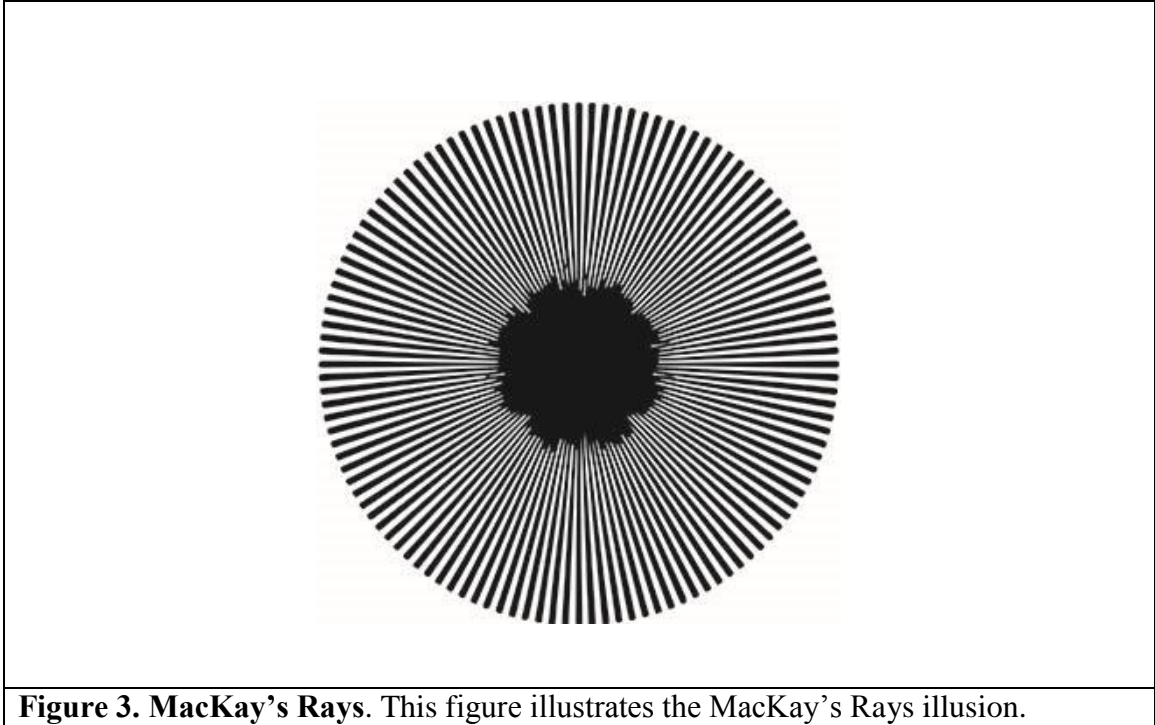
Figure 3. MacKay's Rays. This figure illustrates the MacKay's Rays illusion.

Illusion and Dress

Fan, Yu, and Hunter (2004) stated that illusions can be applied to the design of dress and can act in a way which changes how the body is perceived. For example, researchers suggest that a shorter person can look taller by wearing minimizing lines and that a slender figure might look curvier by increasing the appearance of the bust and hips (Fan, Yu, & Hunter, 2004, p. 11). Davis (1996) described various illusions that are found in dress, including geometric illusions, depth and distance illusions, irradiation, brightness contrast, and auto kinetic illusions. Knowing how to apply these illusions can give designers the option to be able to manipulate the illusion and control the perception of appearance (Davis, 1996).

To gain a better understanding of how illusion and dress intersect, a brief historical analysis of advice literature given to women on application of illusion to dress was discussed, followed by a review of current literature.

History of Illusion and Dress

Prescriptive literature from 1910-1950 was reviewed to gain a brief historical perspective on illusion and dress. Literature review included etiquette books, dressmaker books, and school textbooks that contain advice on dressing for body shape through the use of illusion. These texts discussed the "ideal standard of beauty" (Whitney, 1916, p. 57). Advice included how to maintain correct proportions through dress (Farnsworth, 1915; Picken, 1940; Ryan & Phillips, 1947), how to hide flaws (Rittenhouse, 1924), and why some dress styles look better on certain figure types (Whitney, 1916). As Whitney (1916) explained, "a tall woman may wear a dress skirt that is very wide at the bottom, but the plump stout woman will be a ridiculous figure in the same enormous sweep of skirt" (p. 58).

Illusion in dress was often discussed in terms of the use of line. Line could be defined as the outline of silhouette, the seam lines of a garment or lines that were contained in the print of the fabric used for the garment. There was attention to what stripes can and cannot do to create illusion, including the ubiquitous importance of narrow stripes for "stout" women, and Cocks' (1927) assertion that "horizontal lines and broken lines should be the choice of the tall thin women" (p. 231). Interestingly, much of the advice from the past is still relevant today and similar recommendations are found in current literature regarding illusion and dress.

Current Illusion and Dress

There is much contemporary comment on the use of optical illusions in dress, both online and in the popular press. Haynes (2013) told readers that they could "cheat themselves slim"(p.14) by dressing in a way that included creating a more ideal hourglass shape, slimming the waist, and creating an elongated torso. Her suggestions for creating an hourglass shape included selecting garments with black side paneling (use of spatial effects) or a dress with flattering vertical lines. To slim the waist, it was recommended to play with changing proportions of the body by selecting a garment with lines that create contrast at the waist, thus resulting in the illusion of a slimmer waistline. Finally, to create an elongated torso, she advised that one opt for geometric prints or even color blocking as long as the print creates clean long lines.

Conversely, Rochell (2012) warned that it can be difficult to find the right optical illusion for your body. In her discussion of illusion, she stated that illusion apparel can make you look larger in areas that are already large and can make already small areas appear awkwardly tiny. However, Rochell (2012) suggested that women don't believe the myth about wearing horizontal stripes and told readers that actually horizontal stripes do the opposite. She even mentioned the Helmholtz Illusion in support for horizontal stripes. Finally, Rochell (2012) also suggested that optical illusions are more effective in a garment that fits closely to the body.

According to the Adams (2011), many designers have recently explored the concept of optical illusions in their fashion lines. One of the most popular optical illusion garments, a dress designed by Stella McCartney for her fall 2011 collection, used color blocking to enhance curves and create the illusion of an hourglass figure. According to Bernard (2011), who pictured several celebrities in the Stella McCartney dress, the lighter

colors used in the McCartney design draw attention to areas of the body such as the bust, while the darker sections of the dress "recede into the background" (p. 1) and "draw in an exaggerated waistline" (p. 1). This is of dark and light colors is a perfect example of the application of spatial effects.

In an article written for Elle Magazine Online, Solomon (2011) identified Alexander McQueen and Herve Leger as other designers creating optical illusion garments that emphasize curves while slimming a woman's overall appearance. For his Spring/Summer 2013 Collection, Marc Jacobs used line in his textile prints to create the illusion of length, using both horizontal and vertical lines to achieve this illusion. The opening look for the show was a t-shirt with evenly sized and spaced vertical lines, perhaps a reference to the Helmholtz illusion. These examples show that optical illusion garments are a current trend within the fashion industry and provide relevance to the current study. While several of the optical illusion garments that are seen on the runway and on the red carpet were considered a success, many left the viewer wondering what the wearer was thinking when they selected their dress (Rochell, 2012). It could be argued that optical illusion garments may be designed with certain body shapes in mind and may not be effective for all body shapes. For this reason, the current study examined a set of optical illusion garments on three different body shapes to gain a better understanding of how the same optical illusion garments affect the perception of the three body shapes (hourglass, spoon, and rectangle).

Research Gap

There is limited research in the field of Textiles and Apparel that looks at optical illusion garments and how these illusions can affect the self-concept of the wearer.

Coleman (2011) argued that regardless of whether one is too thin or too fat, the ideal body shape can be faked with optical illusion garments whether that ideal is a personal construction by the woman herself or is dictated by the society in which she lives. Therefore, after an examination of the literature, the following research questions are proposed:

RQ1: How do optical illusion garments affect the visual perception of body shape?

RQ1a: Does the effect of optical illusion garments vary depending on body shape (hourglass, rectangle, and spoon)?

RQ2: Do optical illusion garments positively or negatively affect a woman's perception of body shape?

RQ3: Do optical illusion garments aid the wearer in moving from their actual self toward their ideal self?

RQ4: Do optical illusion garments increase a woman's body satisfaction?

CHAPTER III: METHODOLOGY

The current study, theoretically grounded in the self-discrepancy theory, aimed to investigate the effect that optical illusion garments have on a woman's self-perception of her own body shape. First, the researcher created seven different optical illusion garments. Second, women were recruited to participant in the study and went through a screening process (stage one) in order to determine if they met the established selection criteria. The screening process included a short survey and a semi-structured interview. The women were also body scanned at this time to determine their body shape. Third, fifteen women, who met the selection criteria, participated in the second stage of the study. In the second stage of the study the women participated in an in-depth semi-structured interview while viewing a personalized avatar (created from their body scan) depicted in the seven different optical illusion garments created by the researcher. A more in-depth explanation of the procedure of the current study is contained here in Chapter 3.

Chapter 3 contains the following sections: (a) exploratory approach, (b) research design, (c) data collection, (d) validation strategies, and data analysis.

Exploratory Approach

The current research study used an exploratory approach to investigate a new methodology for studying optical illusion garments and to gain an understanding of how avatars and digital garments can be used in design research. According to Babbie (2008), exploratory research is conducted when the subject of the research is relatively new and

this approach is often conducted for three reasons. The first reason is to explore a topic in which the researcher wants to gain a better understanding (Babbie, 2008). Additionally, the second reason to use an exploratory approach is to examine the feasibility of conducting further research on this particular topic (Babbie, 2008). And finally, the third reason provided by Babbie (2008) is to develop a methodology that can be used in additional studies that examine the specified topic. It is for these three reasons that an exploratory approach was selected for use in the current study.

Although optical illusions have been previously studied within a Color Theory and/or a Perception framework, the application to dress has yet to be explored, making it a relatively new line of research. With that said, the researcher aimed to investigate whether future research on this topic would be feasible. It was unknown if participants would be able to connect to their avatars and feel as if they were viewing themselves. Moreover, understanding how the connection to their avatar would affect the way participants perceived the optical illusion designs has yet to be explored. These unknowns within the methodology further lent itself to the use of an exploratory approach and the development of a pilot study.

A pilot study was conducted in the spring of 2013 in order to start exploring the integration, use, and application of technology to be used the current study. This aided the researcher in the establishment of the methodology used for the current study. Additionally, the pilot study afforded the opportunity to explore the use of avatars and provided a baseline for how participants would interact with and respond to the avatars. It also allowed for the exploration of the application of optical illusions to clothing and to

determine if optical illusion would affect the visual perception of body shape. The following section outlines the methodology and findings of the pilot study.

Pilot Study

This pilot study aimed to gain a better understanding of how optical illusion textile prints influenced the way in which body shape was perceived. A focus group was conducted because group dynamics can often bring up questions or point out aspects of the topic that the researcher may not have anticipated (Babbie, 2008). Additionally, according to Babbie (2008), conducting a focus group is a typical first step in exploratory research. With this in mind, a pilot study was developed which proposed the following research question: How do optical illusion textile prints affect the way in which different body shapes are perceived? Some additional questions that the pilot study aimed to investigate were: How does the scale of the textile print change the perception of body shape? How does each textile print vary when applied to different body shapes and how is the perception of each shape changed? Does the application of optical illusions camouflage body shape?

A five participant focus group was conducted in order to gain a better understanding of how optical illusion textile prints can influence the way in which the body is perceived. The participants gathered for one hour and viewed 42 different combinations of three body shapes, four textile prints, and three different scales of those textile prints.

Optitex (a computer aided design patternmaking software was used to construct three avatars that represented hourglass, spoon, and rectangle body shapes, which are

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considered the most common body shapes among women today (Simmons, Istook, &

Devarajan, 2004). The bust-waist-hip measurements for the hourglass avatar measured

36"-26"-36". The measurements for the spoon shaped avatar were 34"-28"-40" and the

measurements for the rectangle shapes avatar were 36.5"-33"-36". The measurements for

these avatars were based on the mathematical ratios as presented by Simmons (2002). All

of the avatars used in the pilot study are pictured in Figure 4.
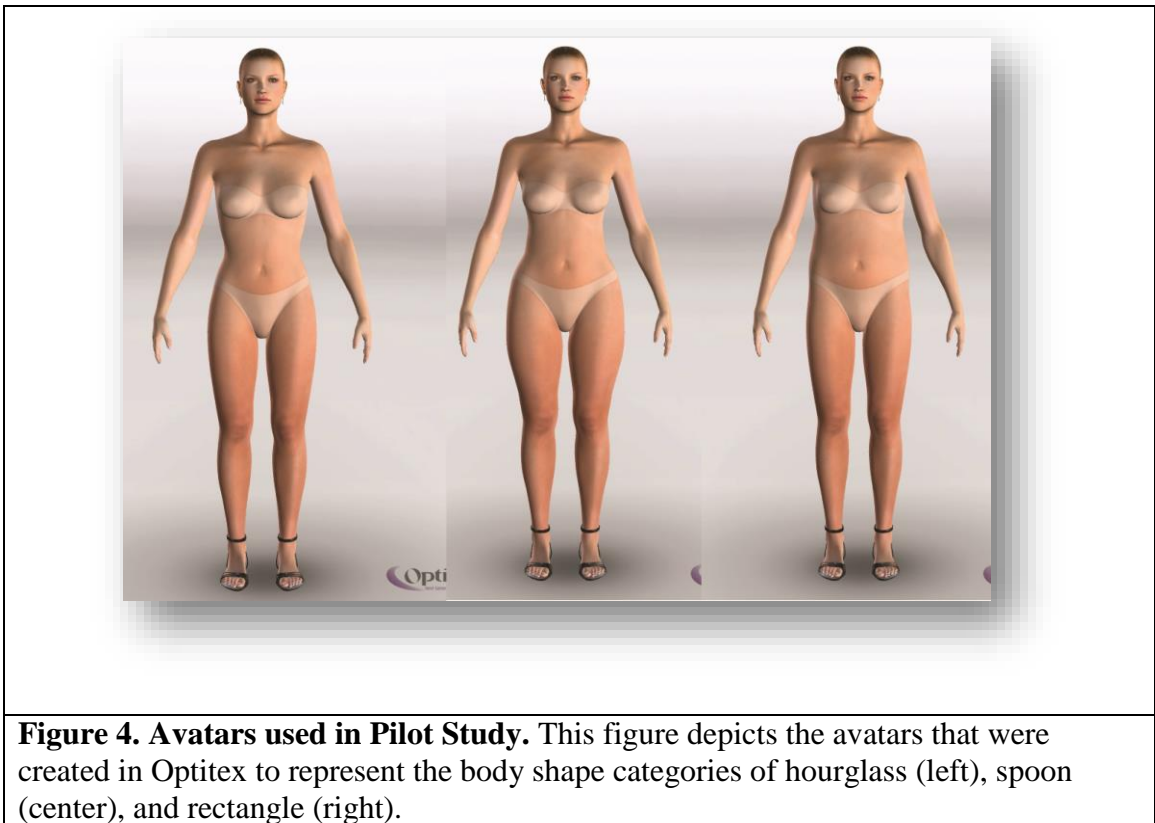
Figure 4. Avatars used in Pilot Study. This figure depicts the avatars that were
created in Optitex to represent the body shape categories of hourglass (left), spoon
(center), and rectangle (right).

Four optical illusion textile prints were created using Adobe Illustrator and

Photoshop and represent different shapes and lines that can be placed on the body. The

textile prints were created by the researcher for the purpose of this pilot study. The prints

were identified as square, stripe, zigzag, and circular (Figure 5). Additionally, the prints

were created in black and white in order to eliminate any distraction (i.e. associations and preferences) that color may have caused.

Figure 5. Four Textile Prints. This figure depicted the four optical illusion textile prints (square- top left, zigzag – top right, circular-bottom left, stripe-bottom right) that were created by the researcher to be used in the pilot study.
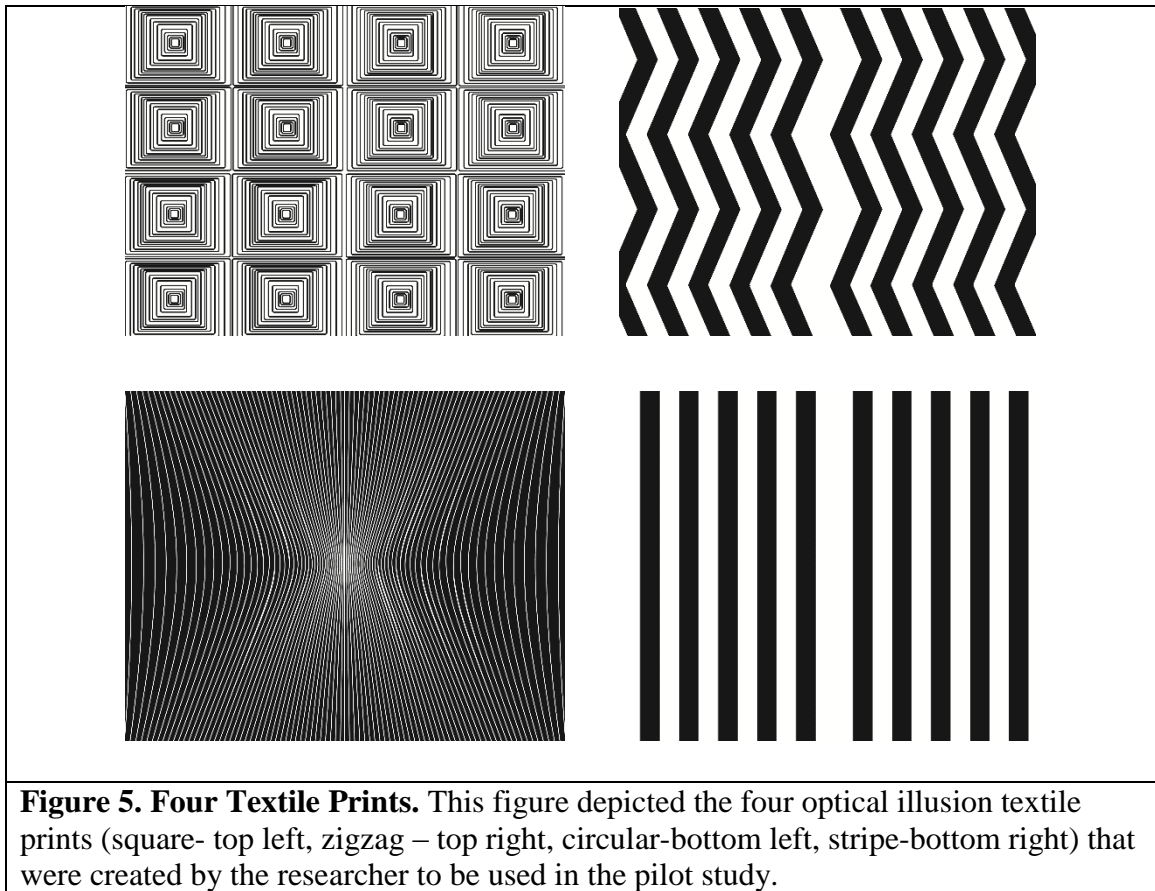
The four different prints were presented in three different scales (1, 1, 3, 3 and 5, 5). The scales were manipulated in Optitex and allowed to increase in the size of the print when placed on the body. A visual example is provided in Figure 6. Viewing the prints in different scales allowed for determination of the greatest visual impact of the optical illusion prints. Additionally, a basic sheath dress pattern was used for the garment that was digitally stitched and draped onto the avatars. The pattern pieces were adjusted in order to present each of the three body types in a well fit garment.
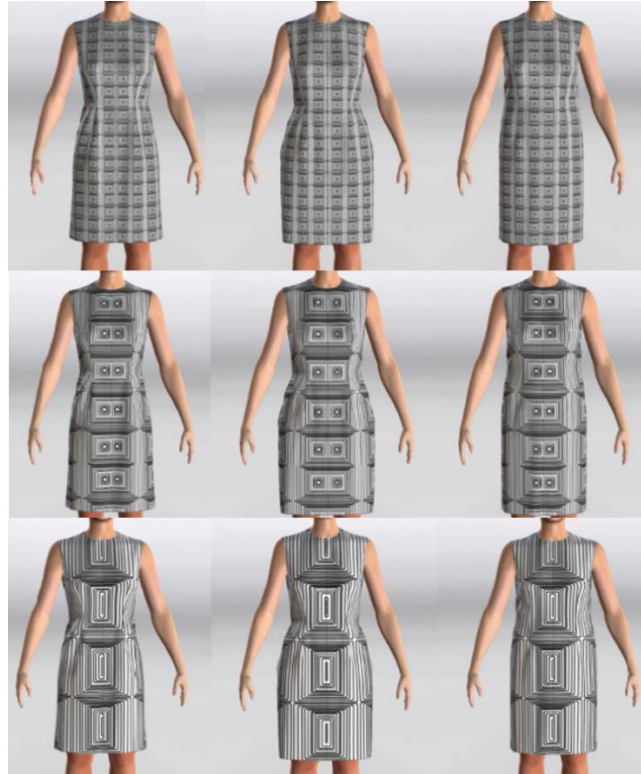
Figure 6. Scale of Prints. This figure depicts the same print presented at three different levels of scale. The top images is the (1, 1) which was the print in its original size. The middle image is the (3, 3) scale which means the original size is increased by three times in equal proportions of height and width). And the last image is the (5, 5) scale which means the original size has been increased by five times.

The focus group participants viewed the avatar body unclothed and were asked to identify characteristics and differences between hip, bust and waist. They were able to identify each of the bodies as the anticipated body shape and named them correctly. The participants then viewed the avatars dressed in solid black and white in order to have a comparison when viewing them in the optical illusion prints. The following themes

emerged: (1) perception of width and length, (2) effect of print design, and (3) shape effect.

The first theme of perception of width and length addressed the idea that the optical illusion print could add width or length to the body shape. When it came to the visual effect of added length, the group thought that in general "those [prints] that emphasized the vertical [line] were most successful." The focus group participants talked extensively about how the optical illusion print could change the way in which the body shape was perceived by accentuating or camouflaging the width and length of the body. For example, when the spoon shaped body was viewed wearing the large scale stripe print it was noted by one participant that "it makes her shoulders look wider which makes her hips look more balanced".

The second theme that emerged was print design. The elements of the print that were most impactful were "the way it moved the eye, placement of the print [on the body], and scale of the print." In regard to their preference for scale they "could not say one [scale] over the other looked better because it really depended on print." The zigzag print created the most visual change for all three body types because of diagonal lines which create a strong optical illusion while keeping the eye moving across the body. Also, color was mentioned as a factor of print design and that the placement of large blocks of color can change the way the body is seen. One participant said, "I would say even for color, just where you have white, like large on the shoulders changed the way we see it."

The finally theme of shape effect referred to how each body shape was affected by the optical illusion prints and how they were compared to each other. The focus group

recognized that the avatars "maintain their [body] shapes, but [with the optical illusion print applied body shape] is not the first thing you see about them, maybe it draws the eye to a different part of the body rather than what you would assume to be their problem area." In regard to body shape "with the rectangle, the print had much more of an option or much more of an ability to change the way the body was perceived…especially with the zigzag print." They pointed out that "the spoon could get really wide hips [in the stripe print]." Regarding the hourglass they stated that "nothing made her look horrible, but nothing made her look better" and that "you could only ruin her figure it seemed". When viewing the hourglass shaped body in the square print one participant noted, "She just looks flat and wide, this is really not doing anything for her figure". In conclusion the group believed that "if you want to attempt to emphasize something different [about your body] you need to go with a print that would pull the eye somewhere different."

The results and methodology from this pilot study were used to inform the research design in the current study. Several key pieces of information were obtained from the pilot study and were used when developing the methodology of the current study. The pilot study illustrated that the sheath dress was a viable option for the test garment. Participants were still able to identify the body shape of the avatar while wearing the sheath dress, yet the dress covered the bust, waist and hips of the body, allowing the optical illusions to also have an effect on the perception of body shape. Finally, the pilot study allowed the researcher to gain experience in the implementation of textile prints using Optitex which would play a large role in future research.

Although the researcher was able to gain extensive knowledge by conducting the pilot study, several unknowns still needed to be addressed to determine if future research

in this area would be feasible. For example, since the participants of the pilot study were viewing avatars that were not representative of themselves, it was difficult to gain an understanding of the participants' connection to the avatars. Also, body shapes were manipulated by the researcher using computer software and therefore it could be argued that the body shapes used in the pilot study were too obvious and did not represent real women's bodies. To gain a more realistic representation of the body shapes being explored, body scanning technology would need to be implemented in the current study. Upon conclusion of the pilot study, it was clear that much further investigation was needed for both the topic being explored and the methodological approach. Therefore, the current study used an exploratory approach to help solidify the feasibility of this research line and the best methodological approach for future investigation.

The current study used an exploratory approach to investigate women's perceptions of their own body shapes while wearing optical illusion garments. Provided the information gained from the pilot study, more knowledge could be gained from observing women viewing an avatar that was representative of themselves. This would hopefully allow the participants to connect with the avatar on a deeper level and to be more invested in the study. Therefore, in the current study, the researcher body scanned participants, created individual avatars for each participant, and conducted a semi-structured in-depth interview with the participants. In this in-depth interview, the participants viewed their avatars wearing five different optical illusion garments. In order to have a comprehensive understanding of the methodology used, an explanation of the test garment and the design process used for creating the optical illusion garments is necessary.

Test Garment

A test garment was needed for the current study so that all participants would be viewing their avatar wearing the same garment, thus making an equal evaluation of the textile prints possible. Similar to the pilot study, the test garment used for the current study was a basic sheath dress (Figure 7). A sheath dress is a semi-fitted garment that covers the bust, waist, and hips of the avatar without altering the visual perception of the woman's body shape. Thus, the sheath dress defines a woman's basic body shape and silhouette with minimal accentuation of any one area of the body. The sheath dress was selected because of its simple design and fit. This design also allowed for the implementation of textile prints without interference from complicated seaming. Five optical illusion textile prints were applied to the test garment to create the optical illusion garments that the participants viewed during the in-depth interview.
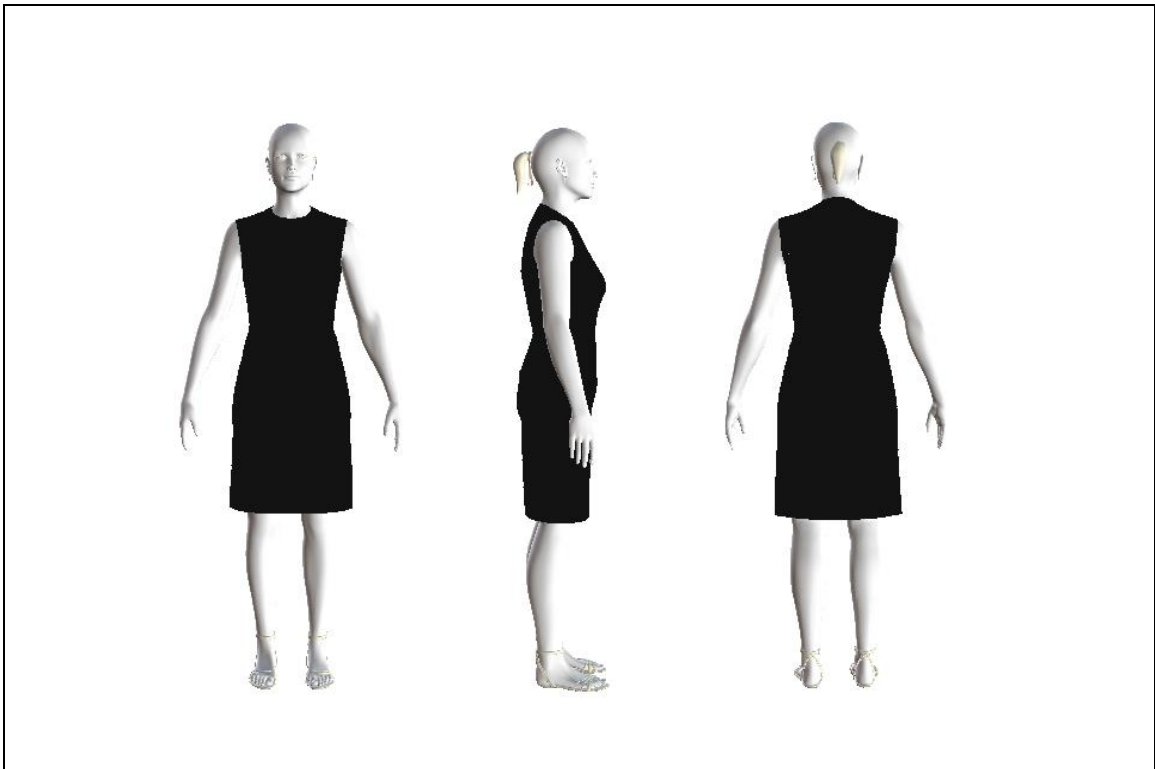
Figure 7. Test Garment. This figure depicts the basic sheath dress, created in Optitex that was used as the test garment for the current study.

Print Design

The optical illusion textile prints were developed based on five previously

established illusions: simultaneous contrast, spatial effect, the Helmholtz illusion, the

Muller-Lyer illusion, and the illusion of MacKay's Rays. The optical illusion prints were

produced using both Adobe Illustrator® and Photoshop®. Adobe Illustrator® was used to

draw and create the actual elements of the textile prints and Photoshop® was used to

manipulate and create a repeat print that could be implemented in Optitex (CAD

software). A total of six textile prints were produced. One textile print was created for

each of the established illusions except for the Helmholtz illusion which required two

separate textile prints, one for the horizontal stripes and another for the veritcal stripes.

Figure 8 shows the textile prints that were imported into Optitex in order to create the

optical illusion garments.

Figure 8. Textile Prints Produced in Adobe Illustrator and Photoshop. This figure depicts the textile prints that were used to create the optical illusion garments : (A) Helmholtz horizontal stripes, (B) Helmholtz vertical stripes, (C) MacKay's Rays, (D) Muller-Lyer – used for both the up and down arrow garments, (E) Simultaneous Contrast, and (F) Spatial Effects
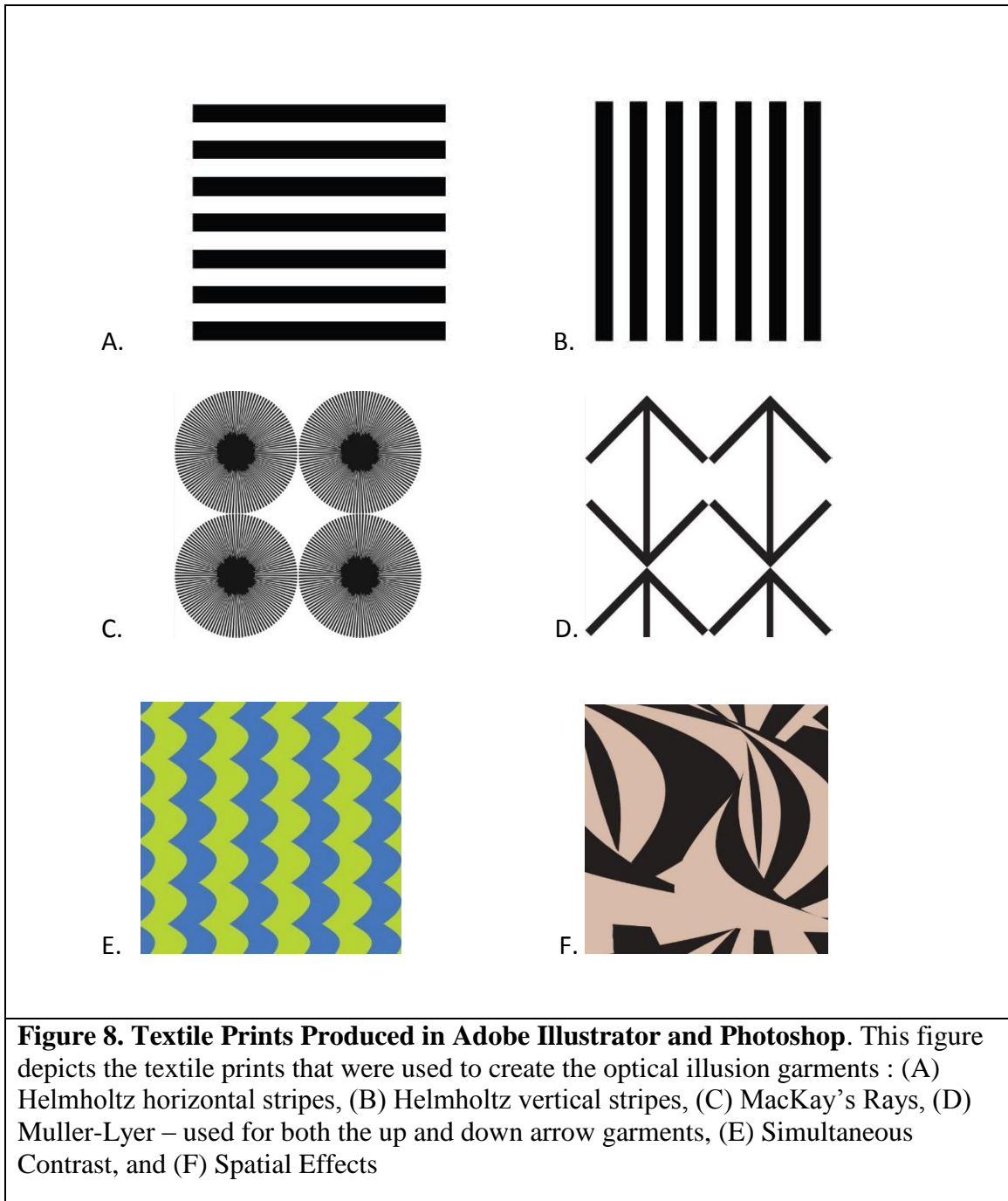
Print Implementation. Optitex was used for the importation and application of the textile prints to the test garment. Optitex also allowed for the manipulation of each of the prints to create the optical illusion garment. The scale (how large or small the print

appears) and placement (where the print sits on the body) was changed once the print was imported into Optitex. The scale of the print when imported into Optitex was equal to one. In some cases the textile prints were used at such as large scale only a small part of the overall print was actually used to create the optical illusion garment. This was especially true for the spatial effect garment. As a result of the increase in scale, the garment that was created does not reflect the original print. This evolution from print to garment is part of the design process that is further explained later in this chapter.

Print placement was changed by adjusting the X and Y coordinates of where the print sat on the body. Additionally, the prints could be mirrored and/or flipped in Optitex which gave the researcher additional options when creating the optical illusion garments. The manipulation of the scale and print placement in Optitex also assured that there was consistency in how the print was implemented regardless of body shape. The researcher was able to document scale and print placement (Table 2), which not only aided in consistency for what was being presented to each participant, it also ensured that the textile prints were aligned across the seams of the sheath dress for all participants. The implementation of the textile prints resulted in a total of seven optical illusion garments.

Table 2. Optical Illusion Print Placement for Optitex

Optical Illusion Print	Offset (X,Y)	Scale (X,Y)
Simultaneous Contrast	(-18.48,-102.85)	(0.5, 2)
Muller-Lyer Up Arrow	(88.12,-11.35)	(6,6)
Muller- Lyer Down Arrow	(100.41,-11.66)	(5,5)
MacKay's Rays	(1.95,.49)	(5.5,5.5)
Helmholtz Vertical	(-2.78,-1.39)	(3,3)
Helmholtz Horizontal	(-4.47,-16.54)	(6,6)
Spatial Effect	(24.75,-0.14)	(15,15)

Optical Illusion Garment Design Process

The optical illusion garments were developed by the researcher based on five previously established illusions: simultaneous contrast, spatial effect, the Helmholtz illusion, the Muller-Lyer illusion, and the illusion of MacKay's Rays. The Helmholtz illusion and the Muller-Lyer illusion involved the comparison of two types of lines, therefore, both aspects of the illusions were included, resulting in a total of seven different optical illusion garments. For the Helmholtz illusion, both the horizontal stripes and vertical stripes were represented as their own garments (i.e. one horizontal striped garment and one vertical striped garment). Similarly, for the Muller-Lyer illusion two garments were created, one which represented a line with an arrow facing up at the top (the up arrow design) and an additional garment with the arrow facing down (the down arrow design).

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Additionally, it was important to understand that while the garments were designed to reflect the five established illusions, the garments also contained other color theory principles, which would affect the way the optical illusion garments were perceived. For instance, all of the garments that were designed with light and dark colors (i.e. black and white) also reflect the principle of spatial effects. The areas of the body in which there is white placed may appear larger than the areas of the body covered by black. Therefore, the use and placement of color cannot be negated from the study and the optical illusion garments cannot be studied independently of general color theory principles (i.e. spatial effect, contrast, shape, and form). This in effect increases the number of variables that were analyzed. With this in mind, all seven optical illusion garments were designed for the purpose of the current study.

Helmholtz Illusion. The Helmholtz Illusion was constructed to be representative of the line drawings that are used in the orginal construction of the illusion. The horizontal and vertical lines were placed on the body so that they appeared evenly sized and spaced and the scale was also adjusted so that the front and back views would contain seven lines reflecting the original illusion. The design decision to keep this illusion representative of the original illusion meant that the stripes differed in scale between the vertical and horizontal garments. It also meant that the black was placed at the edges (top and bottom on the horizontal and left and right on the vertical) of the garment. The Helmholtz Illusion when applied to the sheath dress visually reflected the orginal illusion which meant that there was limited intrepretation of this illusion by the designer.

Figure 9. Helmholtz Illusion Garments. This figure depicts the horizontal striped (left) and the vertical striped (right) garments that are the Helmholtz illusion garments.

MacKay's Rays. The MacKay's Rays illusion has a dark center which was placed at the waist, at the side seam, to create the presumed effect of a narrowed waist. The placement of this auto kinetic illusion was strategic as it was meant to keep the viewer's eye moving with the only real focal point accentuating the waist. The black placed to the outside of the avatar's waist was meant to narrow the waist and create the overall effect of an hourglass shape.

Figure 10. MacKay's Rays Illusion. This figure depicts the optical illusion garment created with inspiration from the MacKay's Rays Illusion.

Muller Lyer Illusion. This illusion consists of two groups of lines that are meant to be compared. The two groups of lines were referred to by the researcher as the up arrow design and the down arrow design. For this illusion, the body represented the straight line, which in the original illusion connects the two arrows on either end. It is meant to be representative of the original Muller Lyer illusion, but was interpreted by the researcher. The shoulders and the knees were used as anchor points for the arrows in both of the designs. Furthermore, the points of the arrows were aligned with the center of the

body so as to use the body as the line that connects the two arrow heads. This was

intended to keep the viewer's attention on the arrows themselves and to explore how

framing the body would affect the perception of body shape. Furthermore, it is important

to note that this design decision to remove the line that connects the arrows, which was

present in the original illusion, changed the intent of the illusion from that which was

specified in the original illusion. Meaning, that this illusion is based on different factors

than the original and was interpreted by the designer in a way which looked at how the

body was framed rather than examining the perceived length of the connecting line.
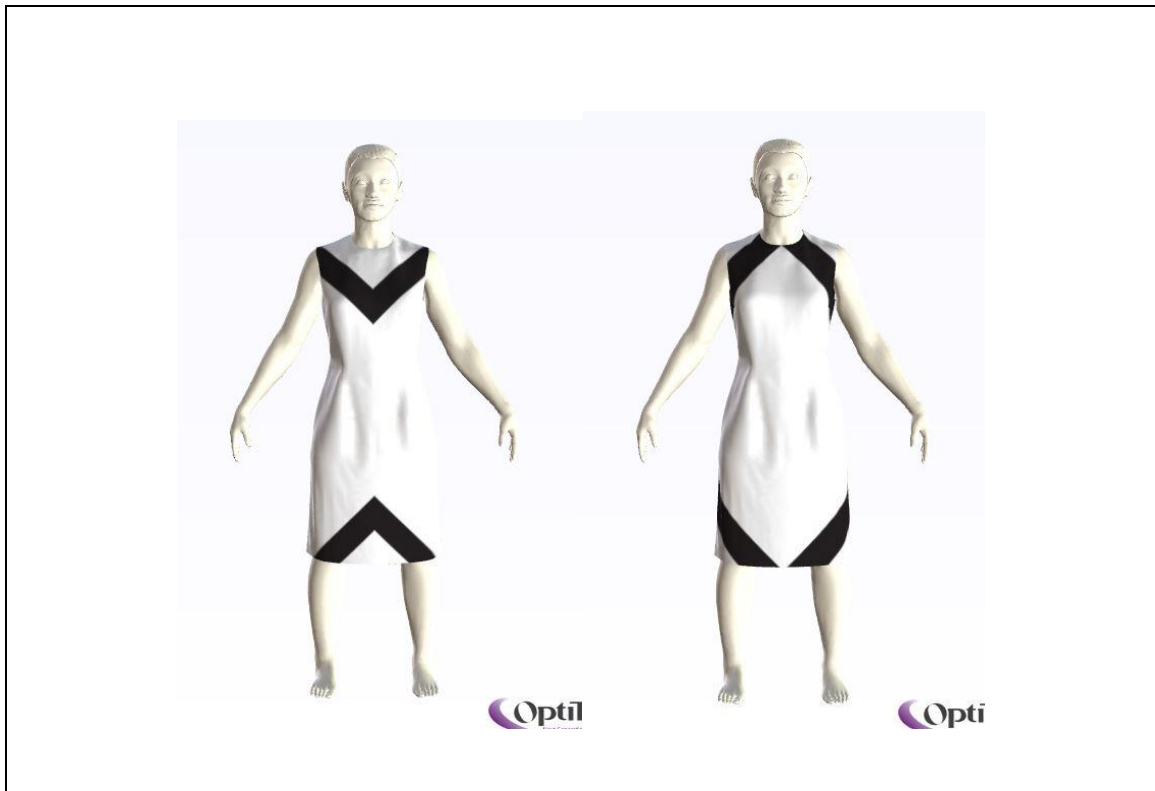
Figure 11. Muller-Lyer Optical Illusion. This figure depicts the two comparison garments for the Muller-Lyer Illusion, the down arrow (left) and the up arrow (right).

Simultaneous Contrast. Simultaneous contrast is the result of the receptors in the

human eye becoming fatigued and the visual eye receptors compensating for this fatigue

by creating the illusion of the appearance of an additional complementary color. The researcher chose to work with the visual receptor pair that perceived the colors of yellow and blue. The reasoning behind this design decision was that the researcher felt that creating an additional black and white garment might result in the participants being confused with the other illusions. Additionally, the red/green receptor pair was explored, however this combination of the colors has many color associations (i.e. Christmas) and it was feared that the overall effect would be lost if the viewer was distracted. Therefore, the design for this garment was created using the two colors (yellow and blue) side by side in a linear pattern. Although the pattern was linear, a scalloped line was created so that there would not be any confusion between this garment and the Helmholtz vertical stripe. Additionally, the curves used in this linear print helped to accentuate the curves of the body and the indent of the curve was purposefully placed at the waist to help create a more hourglass appearance. The repetition of the colors yellow and blue in the textile design allowed for the visual receptors in the eye to grow tired after viewing the garment for a short period of time. An illusion of a red line appears between the yellow and blue lines creating a sense of vibration which gives the viewer a feeling of movement within the textile print. The researcher had another designer evaluate this illusion by viewing the avatar for a short period of time to ensure that the illusion of the red line did occur. The other designer confirmed that after gazing at the garment for a brief period of time she was able to see a faint red line appear where the blue and yellow lines met.

Figure 12. Simultaneous Contrast. This figure depicts the simultaneous contrast illusion.
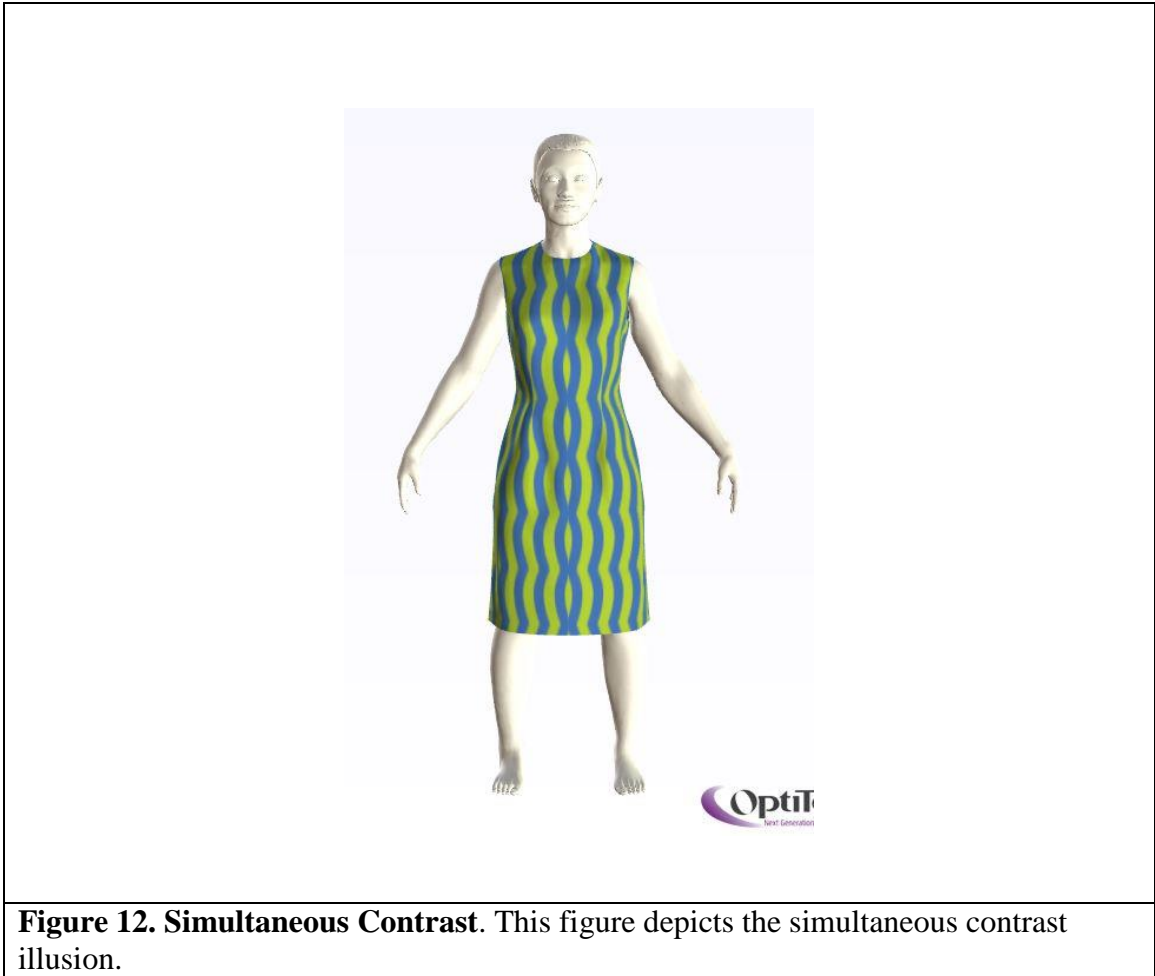
Spatial Effect. The use of light and dark colors can create a sense of size and space within a design. For this illusion the researcher wanted to create a garment that was similar to those that have been seen on the runway and in stores which create a false hourglass shape. To do this, a light pink flesh tone color was paired with black to create a print that narrowed in at the waist and expanded back out to the bust and hips. The use of black in the foreground also helped to create the sense that the body of the wearer was smaller as a contrast to the lighter color outlining the sides of the body. Additionally, the central black area may also be viewed as actually representing the wearer's silhouette.

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Figure 13. Spatial Effect. This figure depicts the spatial effect optical illusion
garment.

The researcher further documented the design process involved in the creation of

the optical illusion garments through documentation and reflection. However, a more in-

depth discussion of the design process, as research through practice, is beyond the scope

of the current study.

Research Design

Participant Recruitment

After the approval of the university's Institutional Review Board (IRB # 1207172) the researcher started the recruitment process. A participant recruitment flyer (see appendix A) was created and was used as the primary recruitment tool. Flyers were distributed across a larger Midwestern university campus and also in various locations throughout the community. The goal was for the participants to be women over the age of 21, thus recruitment flyers were placed in female oriented businesses such as tanning, nail, and hair salons. The flyer contained contact information for the researcher and asked individuals to email or call to schedule an appointment to complete stage one of the research project. Participants were compensated for their time and received a $10 gift card to Target for each stage of the research project that they completed. Upon completion of stage one, participants were asked to recommend others to participate.

Snowball Sampling. Although the main method for recruiting participants was through the advertising of the study (the recruitment flyer), the technique of snowball sampling was also employed. The method of snowball sampling has been previously used within the field of Textile and Apparel in order to achieve a diverse convenience sample (Ridgway & Myers, 2014). According to Babbie (2008), snowball sampling is named for the process of accumulating participants, such that in the first stage of snowball sampling each individual is asked to recommend others to participate (Goodman, 1961). This method of recommendation proved to be an effective way to obtain a greater number of participants.

Selection Criteria. As previously mentioned in Chapter 2, previous researcher defined the three most common body shapes for women as hourglass, spoon, and rectangle. The researcher's aim was to investigate these three body shape categories. A total sample of 15 women was desired with five women classified per body shape category. The researcher believed that five women per body shape category was not only a feasible sample to obtain, given the difficulty of finding participants who would meet the selection criteria, but that it would also provide enough data for analysis across shape categories. Additionally, a non-student sample was also desired to obtain a wider variety of body types so the researcher only recruited participants who were older than the age of 21.

With this in mind, initially, every woman that responded to the recruitment flyer was invited to the Knipschild Design and Research Lab to be body scanned and participate in stage one of the research study. Stage one also included a short survey and a semi-structured interview. It was predicted that an excess of the fifteen women would have to be body scanned because the selection criteria for the current study was somewhat strict. There were two main criteria that participants had to meet in order to qualify to participant in the second stage of the study. The first was that participants had to have body measurements that classified them as one of the body shapes being explored (hourglass, rectangle, and spoon). And the second main criteria was that the participants had to have a height and weight measurement that categorized them as having a normal BMI. A normal BMI was required of participants in order to control for body size and help to diminish high levels of body dissatisfaction.

Body Measurements and Shape Classification. The first part of the selection criteria that the participants had to meet was they had to have body measurements that classified them as one of the body shapes being investigated (i.e. hourglass, rectangle, and spoon). A 3D body scanner was used in order to obtain the participant's measurements. Once a participant was scanned the body measurement data was extracted using the ASTM Size USA data profile. The TC2 body scanner comes with multiple profiles already loaded. Each of the different profiles extracts a different set of body measurements. The ASTM Size USA data profile was selected for the current study because it provided the four circumferential measurements (i.e. bust, waist, high hip, and hips) that would be used to classify body shape.

According to Simmons and Istook (2002), the TC2 body scanner takes the bust measurement "across the bust points at the fullest part of the chest" (p. 584). Additionally, the waist measurement is taken at the natural waist and is considered to be at the horizontal level of the navel (Simmons, K.P. & Istook, C.L., 2002). Therefore, the waist measurement is collected at the level of the participant's belly button which is considered to be at the natural waistline, as opposed to lower on the body which is a commonly used waist placement in contemporary fashions. Finally, the hip measurement is taken at "the largest circumference defined between the waist and the crotch" (Simmons, K.P. & Istook, C.L., 2002, p. 584). This definition of the hip measurement seemed problematic as the hip measurement could be take anywhere from the high thigh area to the high hip area, therefore the researcher conducted a visual analysis of where hip measurements were being taken for those women that were body scanned as part of the current study. It was determined that for all of the participants the hip measurement

was taken just slightly above the crotch line. A visual example of where each of the body measurements were collected can be seen in Figure 14.

Figure 14. Body Scan Image. This figure depicts the areas and levels on the body from which the bust, waist, high hip, and hip measurements were obtained by the TC2 Body Scanner when data was extracted using the ASTM Size USA profile.
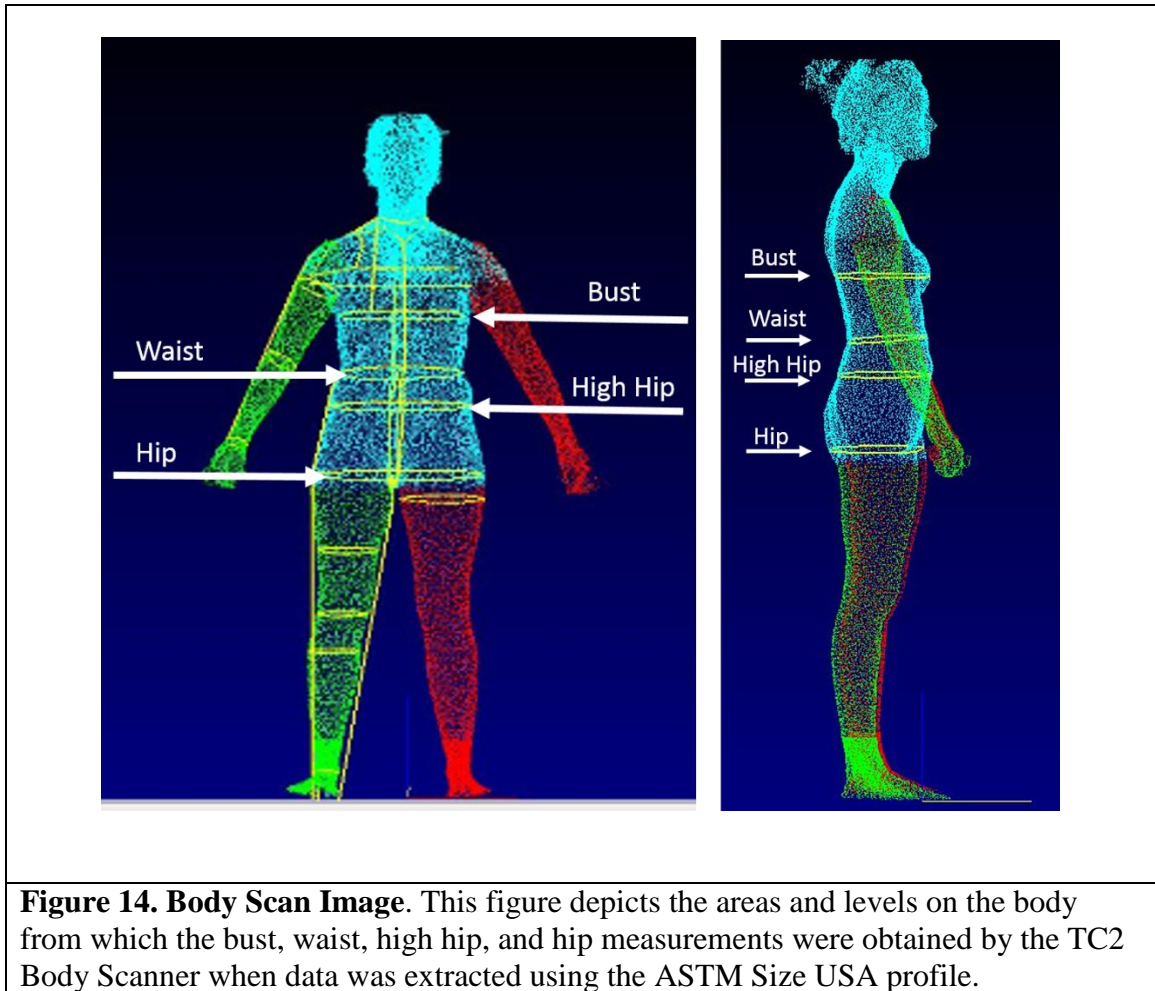
The measurements obtained from the body scanner were then analyzed in order to determine body shape. The instrument, a set of mathematical equations, used for analysis of body shape was derived from the Female Figure Identification Technique (Simmons, 2002) and was adopted from Lee, Istook, Nam and Park (2007). This method of classification was selected not only because it had been previously used in Textile and Apparel research, but because it provided the most definitive way of classifying body shapes. Other methods provided textual descriptions of the differences between the bust,

waist, and hips measurements, but did not provide concrete mathematical equations. The set of equations adopted from Lee, Istook, Nam, and Park (2007) used the bust, waist, high hip, and hip measurements in order to determine body shape.

It should be noted that FFIT was a software program that was created to be used in conjunction with a 3D body scanner in order to sort body shapes into categories and was based on the calculation of algorithms performed by the computer (Simmons, 2002). The below equations were provided by Lee, Istook, Nam and Park (2007) and were said to be derived from those algorithms used in the FFIT. The researcher used the body measurements collected during the body scanning process and plugged the measurements into the formulas doing the calculations by hand. The calculations were computed twice in order to check for accuracy. Additionally, based on findings and assessment of the participants in the current study, the tolerance of the number meant as the cut off point for the high hip to waist ratio was changed. According to Lee, Istook, Nam and Park (2007), the cut off point for the high hip to waist ratio for both the bottom hourglass and spoon was at 1.193. However, when classifying the participants the decision was made to decrease this number to 1.170 because two of the participants had high hip to waist ratios that did not exceed the original 1.193 that was needed to be classified as a spoon shape, yet the participants met every other criteria for this classification. Additionally, these two participants did not meet the criteria to be classified as any other shape. The researcher also visually analyzed the body shapes of these two participants and felt that they could be clearly identified as a spoon shape. The following is a breakdown of the equations per body shape category (hourglass, rectangle, and spoon) as explained by Lee, Istook, Nam,

and Park (2007) that were used in order to determine the body shape of each woman who participated in stage one of the study.

Hourglass. As previously mentioned in Chapter 2, the current study examined only one category of hourglass, a shape usually comprised of three types of hourglass (hourglass, bottom hourglass, and top hourglass) when identified by the FFIT. It should be noted that none of the women who participated in the current study were identified as a top hourglass. Thus, only the equations and criteria for hourglass and bottom hourglass will be further explained.

Hourglass. Women considered to be an hourglass body shape had the appearance of equal proportions for their bust and hips while still having a defined waistline. The body measurements used when defining the hourglass shape were the bust, waist, and hips. The main criteria for a women to be defined as an hourglass was that she had a very small difference between the circumferential measurements of her bust and hips. Additionally, the ratios between her bust-to-waist and hips-to-waist were about equal. The following mathematical equation was used to identify a woman as an hourglass body shape:

If (Bust-Hips)< = 1 Then
If (Hips-Bust)< 3.6 Then
If (Bust-Waist)> = 9 OR (Hips-Waist)> = 10
Then shape = "Hourglass"

Bottom Hourglass. Women considered to be a bottom hourglass had a slightly larger hip circumference than bust circumference, but still had bust-to-waist and hip-to-waist ratios that were significant enough for them to have a defined waistline. The

following mathematical equation was used to identify a woman as a bottom hourglass

body shape:

> If (Hips-Bust)> = 3.6 And (Hips-Bust)< 10 Then
> If (Hips-Waist)> = 9 Then
> If (High Hip / Waist) <1.170
> Then shape = "Bottom Hourglass"

Rectangle. Woman considered to be a rectangle body shape had the defining

characteristic of not having a clearly defined waistline, where the bust, waist, and hips

appear to be in line with each other. The bust and hips circumferential measurements

were similar, however the bust-to-waist and hips-to-waist ratios were low, resulting in the

appearance of an undiscernible waistline. The following mathematical equation was used

to identify a woman as a rectangle body shape:

> If (Hips-Bust)<3.6 And (Bust-Hips)< 3.6 Then
> If (Bust-Waist)< 9 And (Hip – Waist)<10
> Then shape = "Rectangle"

Spoon. Woman considered to be a spoon shape had a larger circumferential

difference between her hips and bust and a bust-to-waist ratio that was lower than a

woman with an hourglass shape. Additionally, they had a greater high-hip to waist ratio

than the bottom hourglass. The following mathematical equation was used to identify a

woman as a spoon body shape:

> If (Hips-Bust)>2 Then
> If (Hips-Waist)> = 7 Then
> If (High Hip / Waist)> =1.170
> Then shape = "Spoon"

Body Mass Index. In addition to having one of the three body shapes being

explored, the second part of the selection criteria was that participants needed to have a

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normal BMI. Body Mass Index (BMI) is a common measure of body fat and is used as in indicator of overall health. It is calculated (BMI = weight (kg) / [height (m)] ^{2}) by the height and weight of adult men and women (Noda, 2008). This part of the selection criteria was employed because the researcher believed that those women who had a normal BMI might would have less body satisfaction issues. Although the researcher acknowledged that body satisfaction issues can occur at any height and weight, it was thought that participants with a normal BMI might be able to more objectively evaluate the optical illusion garments and their body shapes and it would thus not create an additional variable for analysis. Furthermore, due to the method of textile print application, having participants who greatly ranged not only in shape but also in size, would have meant there was a greater variation of print placement on the body. For the purpose of the current study, it was important that all participants viewed optical illusion garments that had identical print placement on the body.

BMI was calculated using the participant's height and weight measurements which were collected just prior to bodying scanning. BMI scores occur in ranges and are defined as follows: Underweight (Below 18.5), Normal (18.5-24.9), Overweight (25.0-29.9), and Obese (30.0 and above) (Healthy Weight - it's not a diet, it's a lifestyle!, 2011). Therefore, in order for a women to qualify for stage two of the research project she needed to have a BMI between 18.5 and 24.9.

Sample

A total of 21 women participated in the current study. All of them participated in stage one of the study and 15 of the women who met the selection criteria previously mentioned continued onto the second stage of the study. The six women that did not

qualify for stage two of the current study did not have one of the body shapes being examined and/or did not have a normal BMI. The data that was collected for these six women in stage one was not included in data analysis.

The 15 women that participated ranged in age from 24 to 56 with an average age of 31. Nine of the women identified themselves as Caucasian, five as Asian, and one participant identified herself as Native American. The height of the participants ranged from 4"11 to 5"8 with an average height of 5"4. Regarding weight, participants ranged from 117 lbs. to 152 lbs. with an average weight of 129 lbs. All participants had a BMI considered normal, ranging from 19 to 24.4, with an average of BMI score of 21.5. Full demographic information for the sample can be found in Table 3. Additionally, Table 4, contains the participant's bust, waist, high hip, and hips measurements along with their perceived and actual body shapes as calculated by the researcher. Participant's names have been changed and pseudo names have been given to each participant.

Table 3. Participant Demographic Information

Name	Height (ft.in)	Weight (lb.)	BMI	Age (yr.)	Race
Hannah	5.7	129	20.2	27	Caucasian
Hope	5.3	110.4	19.6	27	Asian
Heather	5.2	117	21.4	34	Caucasian
Holly	5.7	139	21.8	33	Caucasian
Helen	5.4	142	24.4	25	Caucasian
Rachel	5.7	131.4	20.6	28	Asian
Rebecca	5.6	124.4	20.1	56	Caucasian
Rose	5.85	152.5	23.2	26	native American
Renee	5.5	145	24.1	53	Caucasian
Robin	5.4	130	22.3	25	Asian
Sarah	5	120	21.9	30	Caucasian
Sam	4.11	117.6	23.6	26	Asian
Steph	5.5	114.2	19	33	Asian
Susan	5.7	140	21.9	24	Caucasian
Sharon	5.5	118	19.6	24	Caucasian

Table 4. Participant's Measurements and Body Shapes

Name	Bust	Waist	High Hip	Hips	Perceived Shape	Actual Shape
Hannah	33.71	29.24	33.83	39.63	hourglass	hourglass
Hope	32.61	27.9	32.3	36.83	hourglass	hourglass
Heather	36.02	27.23	32.95	39.33	hourglass	hourglass
Holly	35.27	30.76	36.17	40.88	hourglass	hourglass
Helen	39.1	32.51	37.18	42.47	hourglass	hourglass
Rachel	35.29	30.09	34.33	36.91	rectangle	rectangle
Rebecca	36.09	32.55	35.8	37.24	rectangle	rectangle
Rose	37.52	33.38	37.92	41.45	hourglass	rectangle
Renee	39.86	35.14	40.23	41.73	hourglass	rectangle
Robin	37.76	34.58	37.08	38.08	oval	rectangle
Sarah	36.79	30.36	36.41	39.07	hourglass	spoon
Sam	35.41	29.65	34.75	38.55	oval	spoon
Steph	32.86	27.2	32.19	35.81	inverted triangle	spoon
Susan	36.57	28.38	34.55	42.39	diamond	spoon
Sharon	34.63	27.92	33.73	38.75	hourglass	spoon

Data Collection Procedure

The data collection process outlines the procedure used to collect the data that would be used later in the analysis process. As previously mentioned, the current study was conducted in two stages. Stage one consisted of a pre-body scan semi-structured interview and questionnaire. Additionally, body measurement collection and body shape analysis were conducted in stage one of the research study. The second stage of the research study consisted of a semi-structured in-depth interview in which the participants viewed their avatars dressed in optical illusion garments. The following section outlines the procedure for both stages one and two of the research study. At the beginning of both

stages, the participants were asked permission to audio record the interviews being conducted. All 15 participants granted the researcher permission to audio record the interviews.

Stage One

  The Screening Process. Stage one of the research study acted as a screening process in order to obtain the desired sample which met the selection criteria to continue onto stage two of the study. The screening process started off by the participants meeting with the researcher at the Knipschild Design and Research Lab. The participants were provided with a consent form (Appendix B) that gave them a brief overview of what to expect if they qualified to participate in the second stage of the study. Once consent was obtained, participants were asked to fill out a brief questionnaire (Appendix C) containing demographic questions and a few questions regarding body shape. Once participants completed the questionnaire, the researcher conducted a brief semi-structured interview (Appendix D) which asked participants to identify their ideal body shape and talk about their clothing selection process. Additional questions asked participants to discuss their opinion of what current societal ideals are for body shape. Upon completion of the interview, the participants were body scanned to collect body measurements.

  Body Scanning. Body scanning technology has been used in a variety of fields including film, medicine, and the apparel industry. Connell et al. (2006) provided reasoning for using the method of body scanning by stating: "body scanning provides a new means to study body shape in a more scientific manner than older techniques could" (p. 81). It is a quick and easy way to obtain consumer measurements (Alexander, 2003;

Devarajan & Istook, 2004) and helps to eliminate error in the measurement procedures (Apeagyei, 2010). Body scanning allowed for the collection of multiple body measurements (i.e., bust, waist, hip, and high hip) used to evaluate and classify body shape. Critical to the current study, the body scanning process records cloud point data which was used to generate personal avatars for each of the participants. Body scanning is the only method that allowed for the creation of avatars and therefore was the body measurement technique chosen for this study.

  TC² KX-16 3D Body Scanner. The Textile/Clothing Technology Corporation (TC²) body scanner was used to collect body measurements for each participant. According to TC² (2013), the circumferential measurements collect during scanning have an accuracy within 3 millimeters and the data density that is produced is between 1.5-2 million data points per scan. The scanning process takes about 7 seconds and data was collected by 16 sensors places at four different angles and heights ([TC]2, Turning Research into Reality, 2013).

  Body Measurement Collection. Participants were given step-by-step instructions on how the body scanning process worked. They were instructed to step into the changing room and undress down to their undergarments. They were also instructed to pull back their hair and make sure that it is kept off their neck as this can affect the outcome of the scan (Apeagyei, 2010). Participants then moved into the body scanner where they placed their feet on the marked locations and held onto hand grips to ensure proper positioning. Participants were instructed to follow along with the automated instructions throughout the scanning process. Once the scan was complete participants were asked to get dressed and were free to leave. Participants were not be allowed to see

their body scans because viewing their scan could potentially influence the participants' perceptions of their bodies.

Participant Selection. As previously discussed, participants needed to meet the selection criteria in order to qualify to move onto stage two of the research study. They needed to not only have body measurements that classified them as either an hourglass, rectangle, or spoon, but they also need to have a BMI that was classified as normal. The researcher continued to interview and body scan women as part of stage one until a total of 15 women, five from each shape category, were identified. Once the sample had been obtained the researcher moved on to prepare for stage two of the study. The next step was to create a personalized avatar for each of the 15 women selected to participate in stage two.

Avatar Creation. An avatar was created for each of the 15 women who qualified and agreed to participate in stage two of the research study. The body measurements and cloud point data that was collected during the body scanning process was used to create the participants' avatars using the TC2 Image Twin software. This software in connection with the 3D body scanner allowed the researcher to create custom avatars for each participant. The avatars not only had the participant's exact body measurements, the Image Twin software allowed for the avatars to also have the facial features of the participants. Image Twin required a front and left profile facial photo of the participant in order to create an accurate depiction of the participant's face for the avatar. Digital sensors were placed on the front view photo at 6 different locations of the face including (1) pupils, (2) edges of the nose, (3) corners of the mouth, (4) edge of face at ear level, (5) edge of face parallel to mouth, and (6) bottom of chin. Additional sensors were placed

on the left profile photo at (1) top of forehead, (2) top of nose, (3) bridge of nose, (4) end of nose, (5) top and bottom of lips, (6) bottom of chin, and (7) the point at which the chin and neck meet. The data from the placement of these sensors allowed the Image Twin software to create a face for the avatar that was representative of the participant. This was essential as it allowed the participants to feel as if they were actually viewing themselves on screen. Once an avatar for each participant was created, the avatars were imported into Optitex so that the test garment could be custom fit to each participant.

Digital Garment Fit Process. A size 6 block pattern for a basic sheath dress was used as a starting point and was manipulated for fit. The first step was to digitally adjust the pattern to fit each of the participants' body shapes correctly. According to Sohn and Bye (2012) factors to look for when assessing fit are the following: (1) check to make sure that center front and center back are aligned with the center of the body, (2) check to make sure that shoulder seams are centered across the shoulder, (3) make sure that side seams are hanging straight down, (4) make sure that the waist hits the body at the waist, (5) check to make sure there is no gapping in and around the neck, and (6) finally make sure that the skirt is hanging parallel to the floor. These indications of fit were used when making fit adjustments to the sheath dress in order to ensure a well fitted garment was created.

Keeping the fit criteria defined by Sohn and Bye (2012) in mind, fit process was started by taking a screen capture of participant avatars and overlaying them on top of the Optitex Model (Eva) on which the original pattern size 6 fitted (Figure 15). This technique allowed the researcher to determine the points of difference and make notes about pattern adjustments that would have to be made. The researcher frequently

observed differences in shoulder slope, position and size of bust, waist width, and hip height. All of these required different amounts of adjustment depending on the overall body size difference between the participant and Eva. Differences in posture and weight distribution also made the custom fitting of the garments more challenging. The original sheath dress pattern was a size 6, but could be graded up or down in order to better fit each participant. The bust, waist, and hips measurement of the participants were compared with Eva's body measurements in order to determine the starting size of the block pattern. For example, if the participant's waist was two inches larger than Eva's, the pattern would be graded up to a size 10 before additional fit corrections were made. Even though traditional grading practices use the bust as the determining measurement, this study used the waist because the bust shape and size of Eva was not representative of the sample. For all of the participants the bust darts needed a lot of adjustment, it could be argued that Eva's bust does not represent a natural bust shape, therefore it made grading the pattern based on bust size extremely difficult. This helped to eliminate making large alterations to the pattern while still ensuring a well-fitting garment for each of the participants.

If additional adjustments were needed, further corrections to the pattern were made, and then the dress was again digitally draped to check the fit. This process continued until the garment met the fit criteria as established by Sohn and Bye (2012). Additionally, the length of the garment was adjusted so that the bottom hem of the dress hit each participant exactly at the bottom of her knees. Once the garment was determined to fit the avatar well, the optical illusion textile prints were placed onto the sheath dress.
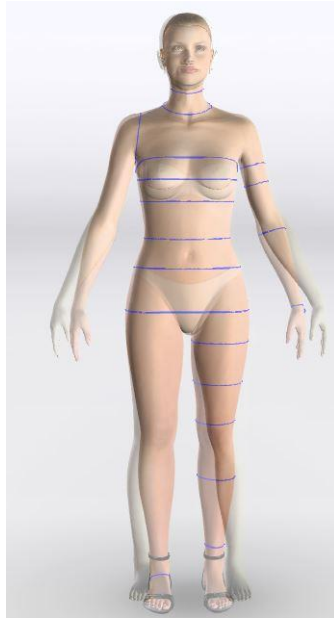
Figure 15. Overlay of Avatars to determine differences in body shape for fit purposes. This figure shows an example of a participants avatar transposed on top of Optitex Eva Avatar.

Optical Illusion Garments. The next step in the process was to implement the digital textile prints created by the researcher to the custom fit sheath dress for each participant. Optitex PDS was used for this implementation. Each textile print was individually placed, and once the scale and placement of the print was adjusted the Optitex software allowed the file to be saved as a model. A model consisted of the participant's personalized avatar dressed in a custom fit optical illusion garment (see Figure 16). A total of eight models per participant were created (seven optical illusion

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garments and one solid black garment). The models were viewed by the participants in stage two of the study.

Figure 16. Example of Models Created for 3 Different Body Shapes. This figure depicts three of the participants' avatars dress in the MacKay's Rays Illusions. Their body shapes were defined as follows: Hourglass (Left), Spoon (Center), Rectangle (Right).
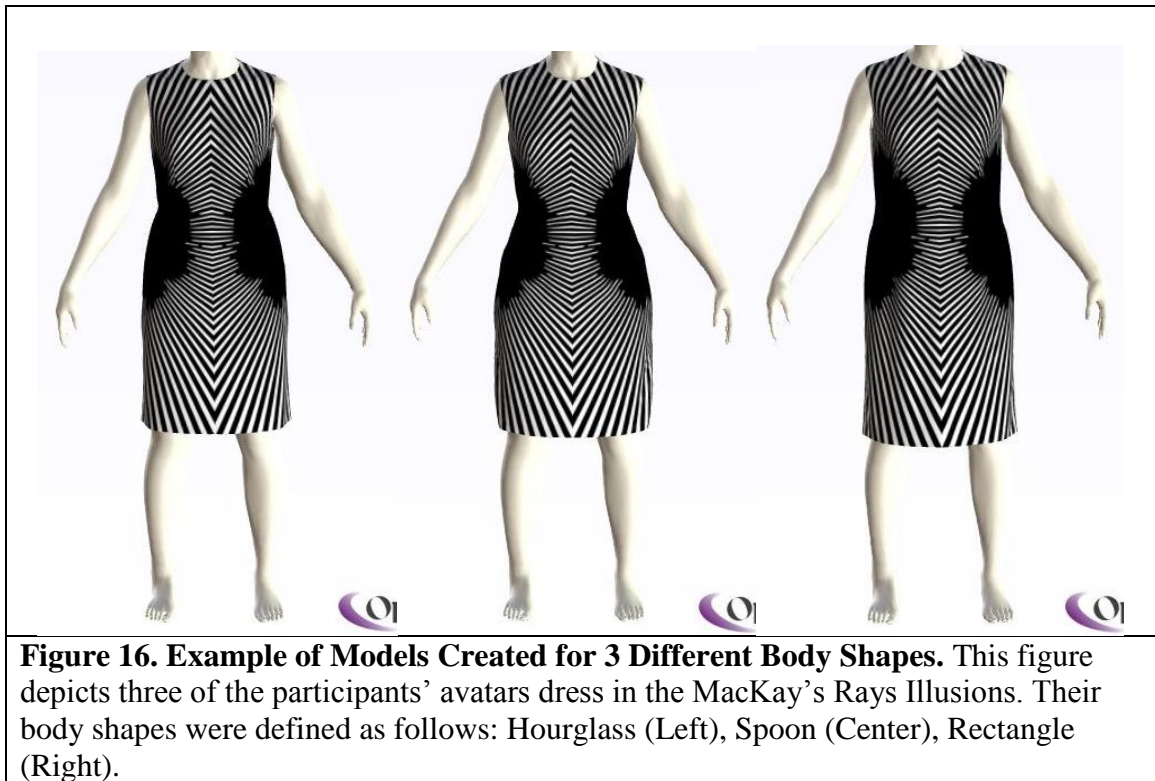
Stage Two

The 15 women who qualified to participate in stage two of the study were contacted via email. This occurred approximately two to three weeks after the participants had completed stage one.

Participants each met individually with the researcher in the Knipschild Design and Research Lab to participate in a semi-structured in-depth interview (Appendix E) that lasted about 40-50 minutes in duration. The participants sat at a computer station with the researcher and were first asked to again describe their definition of ideal body shape,

their opinion of what constitutes the current societal ideal, and to talk about their clothing selection process. Participants then viewed their avatar for the first time wearing the custom fitted sheath dress pictured in all black.

Optitex Runway Viewer software was used so that the participants could view their avatars (all 8 models that had previously been created). Runway Viewer allowed participants to rotate their avatar 360 degrees and also gave them the option to zoom in so that they could examine their avatar more closely.

While viewing their avatar in the all black garment, participants were asked to give their initial reactions to the avatar and describe how closely they considered what they were viewing represented themselves. They were told that the avatar had been created from their body scan and was based on their own body measurements. Additionally, participants were asked to describe what they were seeing on screen regarding their body shape, proportions, and anything else they noticed regarding their body shape. Finally, participants were asked to identify how ideal their body shape looked in the all black sheath dress.

Next, the participants viewed their avatar wearing the seven different optical illusion garments. Each illusion garment was viewed individually and the participants were asked a similar set of questions to those they were asked when viewing the all black garment. The researcher asked participants for initial reactions to each garment and then probed further to gain a better understanding of how the participants felt the optical illusion garments affected the way they perceived their body shape. For the Helmholtz and Muller-Lyer illusions, the participants viewed each half of the illusions individually

and then after both halves were viewed singularly, the researcher pulled both halves up on screen so that the participants could compare them side-by-side. The optical illusion garments were presented to the participants in the following order: (1) Helmholtz Horizontal Stripes, (2) Helmholtz Vertical Stripes, (3) Helmholtz Comparison (both horizontal and vertical), (4) MacKay's Rays, (5) Muller-Lyer Down Arrow, (6) Muller-Lyer Up Arrow, (7) Muller-Lyer Comparison (both up and down arrows), (8) Simultaneous Contrast, and (9) Spatial Effects. The participants were asked to explain their initial reactions, point out anything new that they were observing, described what they were seeing regarding their proportions, and then also to identify which one they preferred.

Upon completion of viewing the seven optical illusion garments the researcher asked several follow up questions. The questions included the participants' thoughts on wearing optical illusion garments, a discussion of whether optical illusion garments aided in achieving a more ideal body shape, and how participants felt that their personal style and preferences affected their opinion of the garments.

Validation Strategies

Validation strategies are used to make qualitative research credible and rigorous (Creswell, 2007). For the purpose of this study the following validation strategies, as noted by Creswell (2007), will be used: (1) triangulation, (2) clarification of the researcher's bias through research reflection, and (3) rich, thick descriptions.

Methodological Triangulation

Triangulation was achieved by collecting multiple types of data which consist of the initial stage one interview and questionnaire, body measurements, and the stage two in-depth interview. These three types of data represent three different sources of information which allow for the voice of each participant to be heard. The data that was collected in both interviews, the questionnaire, and through the analysis of body measurements (i.e. shape classification) provided different types of data that could be used for cross-data validity checks (Patton, 1990). The interviews provided the participants a voice for how they were perceiving their own body shapes. The questionnaire provided additional background information of each participant and also gave insight into how the participants perceived their body shapes. And finally, the additional data collected during the body scanning process allowed the researcher to gather the information about the participants which resulted in classification of the their body shapes. Therefore, triangulation provided multiple perspectives in order to provide validity.

Research Reflection

Research bias and reflection are addressed in Chapter 4, the results section of this study. As the researcher I fully acknowledge any biases that I had while conducting this research and acknowledge how my experiences might influence me as a researcher. In order to achieve this validation strategy I fully disclosed my "past experience, biases, prejudices, and assumptions… [and how those] have likely shaped the interpretation and approach to [this] study" (Creswell, 2007, p.208).

Rich, Thick Descriptions

The final validation strategy was the use of rich, thick descriptions which involved including long, full quotes so that the reader can truly hear the voice of each participant. It also included the incorporation of interconnected details and the context in which the remarks were made. It is important to describe the participants and setting in detail so that the reader can transfer this information to other settings and determine if the findings are transferable due to shared characteristics (Creswell, 2007).

<center>Data Analysis</center>

Prior to data analysis the researcher transcribed all the interviews and analyzed the data that was collected in the questionnaire from stage one of the study. Transcribing allowed the researcher to become familiar with the data. All files associated with this study were kept on a flash drive that was password protected and was locked in the researcher's office when not in use. An additional copy of the transcribed interviews was kept on the researcher's password protected laptop for which the researcher is the only one with access to the account.

Thematic analysis was conducted and the transcripts were then coded following the guidelines set out by both Braun and Clark (2006) and McCracken (1988). Regarding thematic analysis, Braun and Clark (2006) provide the following as steps for analysis: (1) become familiar with the data, (2) generate initial codes, (3) read each transcript, (4) review themes, (5) name themes, and (6) produce a report. Furthermore, McCracken (1988) suggested that data analysis move from the specific to the general. Therefore, the researcher first did a detailed analysis of the language/text in each of the transcripts and then compared for themes, trends, and patterns across all of the transcripts. This lead to

the development of overarching themes (categories), trends established within those

categories, and finally patterns found within those emergent trends.

CHAPTER IV: RESULTS

This chapter presented the results from the qualitative data analysis that was collected in

the first and second stage of the current study. It is divided into two parts and includes:

(1) theme interpretation, and (2) the researcher's reflection.

Theme Interpretation

Interpretation of the study data was divided into seven overarching themes: (1)

Perception of Self, (2) Clothing and the Body, (3) Defining Ideals, (4) Optical Illusion

Applications, (5) Preferences by Body Shape Category, (6) Effects of Wearing Optical

Illusions, and (7) A More Ideal Self. For each of these seven themes additional trends

were analyzed within the themes themselves.

The first theme, Perception of Self, examined participant responses to viewing

their personal avatars. The second theme, Clothing and the Body, explored these

women's beliefs about how clothing can affect the way in which their body shape is

perceived. Defining Ideals, theme three, discovered how the participants defined ideal

body shape personally and for the society to which they belong. Theme four, Optical

Illusion Applications, explored research question one, by examining the effect that

optical illusions have on the visual perception of body shape. This section explored each

of the optical illusions individually and examined emergent trends for each optical

illusion. The fifth theme, Preferences by Body Shape Category, explored the next

research question (RQ1a) by examining the differences between body shape categories.

Each body shape category (hourglass, rectangle, and spoon) was examined individually and trends found within each shape category were explored. The second research question was explored in theme six, Effects of Wearing Optical Illusions. This theme examined whether optical illusion garments positively or negatively affected the women's perception of their body shapes. Finally, theme seven, A More Ideal Self, explored the final two research questions by addressing whether optical illusions can aid in achieving a more ideal body shape and if body shape satisfaction was increased.

Perception of Self

Regarding perception of their own body shape, seven out of the 15 women correctly perceived their own body shape. That is, the participants identified themselves the same way as the researcher categorized them. Interestingly, all five of the women identified as an hourglass shape had identified themselves as such. This could be because hourglass is the most commonly known shape, in fact nine out of the 15 women identified themselves as an hourglass which may be attributed to their knowledge of this particular shape. None of the women identified by the researcher as a spoon shape had perceived themselves to be a spoon shape. Furthermore, none of the women even chose the spoon shape when asked to identify their own body shape which could indicate that the women were not as familiar with this shape category. As for the rectangle shape category, two of the five correctly perceived themselves to be a rectangle. It can be argued that the women were familiar with the rectangle shape category, but may not have viewed themselves as such.

While exploring women's self-perceptions through viewing their avatars, two prominent trends emerged: (1) expectations and (2) shape realization. The first trend

addressed the expectations that women had for how their avatars would look and their preconceived ideas regarding their body shape. The second trend of shape realization explored the women's analysis of their own body shape and the realization of actual body shape that occurred while viewing their avatars. This theme of *Perception of Self* was closely linked to the self-discrepancy theory. This theme examined whether there was a difference between how the women perceived their own body shape and the image which they observed on screen.

Expectations

When first faced with viewing their avatars, seven of the participant's initial reactions to what they were seeing on screen was that it was not what they were expecting. This is not surprising based on the fact that about half of the participants incorrectly identified their body shape. This reaction could be attributed to the fact that the avatars were viewed in 3D. The traditional way of viewing oneself through a photograph only allows for a 2D perspective so viewing oneself in 3D was foreign to most of the participants. Two of the participants even questioned whether or not they were actually viewing themselves by asking "is this from my body scan?" and "is that me?" After the initial shock of seeing themselves as an avatar both of these participants felt that the avatar was a good representation of their body shape. Most of the participants who correctly identified their body shapes were less surprised by the appearance of their avatars. For instance, Helen, who correctly identified herself as an hourglass shape, stated that "it's pretty similar to what I thought it would be actually." Additionally, Holly, who also correctly identified herself as an hourglass shape, told the researcher while viewing her avatar that "…in regards to body shape I guess it is what I would expect to see."

Despite their expectations, all but one of the participants believed their avatars were an accurate representation of themselves. Robin felt that she was curvier in the bust area than the front view of her avatar depicted. Additionally, several participants commented that it was an unusual way to see themselves. Heather explained that "you are not used to seeing yourself in 3D" and Susan thought that it was an interesting perspective to view her body shape stating, "I mean I never see myself all the way around. I mean I only see myself from the front or from the side." Susan further explained this by relating viewing her avatar on a computer screen to seeing herself on TV.

> **Susan**: I mean I think it is interesting to see yourself, but not like yourself,
> like on video or on here [the computer screen], like everyone says
> watching yourself on TV you gain like 10 lbs. or whatever, I think it is just
> different because I am not use to seeing myself from those angles.

Furthermore, for some participants viewing their avatar gave them new insight. Seeing their bodies in 3D afforded some of the participants the opportunity to see their body shapes differently.

Shape Realization

For several participants, viewing their avatar was an eye opening experience which allowed them to see their body shape differently. This was particularly true for the women classified by the researcher as having a spoon body shape. The spoon shape was the only category in which none of the participants correctly identified their own body shape. This was illustrated by Sarah who observed that her hips stuck out more and were

"rounding out at the bottom more than [she] expected." She also commented that she looks "more spoon shaped" than she initially believed herself to be. Renee, also classified as a spoon shape, had a similar experience noting that she felt she appeared larger in the hip area than she thought.

> **Renee**: [my body shape is] not so bad from the shoulders down to the waist, I have a little waist, but the hip area is bigger than I thought it would be, to me the hip area should be the same size as your shoulder area or smaller. I am just seeing a big rump – my hips stick out past my shoulders.

Some participants who initially identified themselves as the correct body shape were able to further articulate how they perceived their shapes. Hannah, an hourglass, discussed her shape body by pointing out the narrowing of her waist and describing the proportions of her hips and shoulders.

> **Hannah**: I have a little bit of a waist although it is higher, like a more natural waist… I kind of see an hourglass, not very dramatic, but for sure the mid-section is tapered in and hips and shoulders are about equal distance so I think that's good.

Hannah's statement here indicates that she places value on having an hourglass shape and expresses satisfaction with the way her body shape looked. Moreover, Rebecca, who correctly identified herself as a rectangle shape, pointed out that she doesn't "have a waist line, so [she] can see that rectangle look." This comment from Rebecca revealed that she defined the rectangle shape as having a lack of a defined waist

and showed her knowledge of this shape category. Whether the participants were seeing themselves as a particular shape for the first time or had previously identified themselves as the correct shape, the initial viewing of their avatar allowed a new perspective and opened up the conversation for participants to more accurately evaluate their body shapes.

Clothing and the Body

The theme of Clothing and the Body addressed the role that clothing plays in how the women not only perceived their body shape but also how others might perceive it. The two trends that emerged while exploring this theme were (1) conceal/reveal and (2) dressing for shape. Participants of all body shape categories believed that clothing could be used to alter body perception including hiding or accentuating areas of the body. They also thought that clothing would play a large part in how others perceived their shape, and were conscious of this when selecting clothing.

Conceal / Reveal.

The trend of conceal and reveal focused on how clothing can be used to accentuate or hide areas of the body. Many of the participants in the current study expressed that this was something they often think about when purchasing clothing and when getting dressed. Sarah, Susan, Rachel, and Heather all made the comment that they use clothing to accentuate areas of their body which they are most satisfied with and hide areas of their body that they are least satisfied with. Rachel, who was dissatisfied with the size of her shoulders but was content with her legs, talked about how this affected the way she dressed.

Rachel: I will never try to wear anything that makes my shoulders look

bigger. My legs are the most part that I am most satisfied with, so I just try

and wear a skirt and accentuate the part that I am most satisfied with.

Helen also expressed that clothing can be used to hide certain areas of the body by stating, "if you are having a fat day you can wear an oversized shirt and hide it." This comment illustrated the use of clothing to hide perceived flaws. Robin expressed a similar opinion, asserting that she doesn't like clothing that "reveals [her] curves too much" and that clothing should fit in a way that hides "extra fat." Robin also mentioned that she is content with her bust size and likes to have clothing that "highlights these curves." In a similar manner, Renee explained that she thinks clothing plays a large role in the perception of body shape. She elaborated by saying that clothing can "make you either look shorter or fatter or you can look thinner or even smooth out your figure." With this in mind, the next trend that emerged was dressing for shape which seemed to be at the forefront for many of these women.

Dressing for body shape

Many of the women in the study expressed that they thought about their body shape when selecting clothing and felt that it was best to dress in a way that worked best for their body shape. Sarah said that the first thing she considers when putting an outfit together is "what works for [her] shape." Rebecca agreed, stating that she "will go with whatever looks best and it has to be in the context of [her] body shape." Additionally, Hannah stated that there are several styles that she chooses not to wear because they do not work well for her body shape. For example, she avoids low rise jeans because they

"cut off [her] waist making [her] hips look bigger." Holly had an interesting perspective on dressing for her shape.

> **Holly**: I think clothing is how people are going to typically see your body shape, so I guess if you can dress to suit your body type that is something that people will see.

Correspondingly, this perception of what others think is directly linked to the ideals that are defined by the women for themselves, and also how they perceive the ideals that are constructed for them by the society in which they live.

<div align="center">

Defining Ideals

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For this overarching theme, Defining Ideals, participants discussed and defined both personal ideals and the women's perception of those ideals deemed desirable in the society in which they live. For some participants these ideals corresponded, but for others these were two very different ideals. Two trends emerged when exploring this concept of ideal body shape: (1) hourglass as the ideal and (2) fit and healthy. The first trend, the hourglass as ideal, explored the hourglass body shape as both a personal and a societal ideal. The next theme, fit and healthy, addressed a shift in ideals identified by many of the women, to a more fit and healthy body regardless of shape.

Hourglass as the Ideal

The hourglass body shape has long been accepted by many as the ideal body shape (Coleman, 2011) and according to many of the participants it is still the ideal shape that they strive to achieve. Seven of the participants in the current study expressed that they felt an hourglass shape was ideal for their body type. Some of them used the term hourglass in describing their ideal and others described the proportions of their bust, hips,

and waist which fit the definition of an hourglass shape. Sarah, Hannah, Heather, Rose, Robin, Sharon, and Helen all stated that hourglass would be ideal for them. Rose elaborated by saying that she would prefer "a smaller waist, not huge on top or the bottom, but definitely a difference between the two- a more hourglass shape…." Helen made the case for why she felt the hourglass shape was most ideal by telling the researcher that she liked to have curves as it made her feel womanly. Many of the women also expressed that they wanted to be a slim hourglass. For example, Sharon talked about being slim, but also emphasized that she wanted curves.

> **Sharon**: "I would like to be slim and toned, but still I don't want a manly figure, not overly athletic. I want curves, hips, and widened boobs. I don't want to look overly athletic, but I don't want to be fat or chunky, just toned and slim, but still curvy."

When discussing the women's perceptions on how society currently defines the ideal body shape, a two of the women believed that society still prefers an hourglass shape. In fact, Steph talked openly about how she feels that the hourglass shape is still the dominant ideal in society. She stated that she thinks the ideal is still "Barbie-like," describing it as a woman with a "small waist, big boobs, curves, [and] long legs." Similarly, Sarah suggested that she also thinks that society defines the current ideal as an hourglass shape.

> **Sarah**: I think the more dominant culture does still value an hourglass silhouette, taking both men and women's perspectives into account.

While the hourglass remains ideal for eight of the women, the other seven women expressed a belief that they felt there was a shift occurring and that the new trend was for women to just be more fit and healthy. Rebecca explained her view of the shift occurring from the traditional hourglass to a more athletic look by tying the trend to current events like the Olympics.

> **Rebecca**: I think right now there is a little bit more movement for a sort of athletic look… I feel that there is some shift from the hourglass shape towards the athletic look which might be influenced by the Olympics. It is just that we are ready for a change and I think there is a little bit of a shift towards something that is healthy, but it hasn't eliminated other looks like the hourglass as being important, desirable, or ideal.

This athletic look that the Rebecca commented on was seen as ideal by many of the women who felt that it was important to be fit and healthy.

Fit and Healthy

Seven women focused on the importance of a healthy body shape, which they often defined as toned, athletic, or fit. This trend of fit and healthy did not mean that women wanted to completely eliminate the ideal of curves, but that being healthy was the first thing that came to their mind when asked to define their ideal body shape. Susan expressed her ideal as being strong and toned, but also commented that having a little curve is still desirable.

Susan: I think being strong and toned and in shape is more appealing than just being thin. I still like a bit of a curve, but not too curvy, but also not too straight either, somewhere in between [would be ideal].

Rachel had a similar view. She described her ideal as "healthy," but then went on to say that she still desires to have some emphasis on her bust and hips. Other participants, including Rebecca and Holly, described their ideal body shape as an "athletic build." It was evident that this was not only a new personal ideal, but also one that these women thought was becoming mainstream. Sharon addressed this by talking about the changes that she sees occurring in society and how even models today are changing to a healthier look compared to the extremely thin body type that they once were expected to have.

Sharon: I think the trend is becoming that people still want to be slim, but I don't think it's as skeletal, like it used to be with models. I think like Victoria Secret models are now healthier looking. I think that is becoming more popular and that people want to be healthy and fit.

In conclusion, the women did not want to completely abandon the idea of the hourglass body shape as ideal. They still wanted to have a noticeable bust and hips so that they would still appear feminine. However, the underlying pressure of having curves while being extremely thin was no longer accepted. Their ideal was really a combination of both themes, a healthy and fit body with hourglass curves. They also seemed to place less emphasis on achieving the ideals defined by society, but this could be a result of their feelings that society is now more accepting of other body shapes.

<center>**Optical Illusion Applications**</center>

The overarching theme of the application of optical illusions to dress examined each of the optical illusions explored in the current study. This section examined each optical illusion individually and the perceptions that the women had of their body shape while viewing their avatar dressed in each of the optical illusion garments. This section started by exploring the Helmholtz Illusion, followed by the MacKay's Rays Illusion, the Muller-Lyer Illusion, Simultaneous Contrast and finally the Spatial Effects garment.

Helmholtz Illusion

While examining the Helmholtz Illusion three areas of exploration were evident. The first two areas examined the two halves of the Helmholtz illusion, *Vertical Stripes* and *Horizontal Stripes*. The next area that emerged was *Comparison of Vertical and Horizontal* and in this section the women revealed their preferences for either the vertical or horizontal striped garment.

Vertical Stripes. While examining the women's perceptions of their body shapes while viewing the first half of the Helmholtz illusion, Vertical Stripes, a reoccurring pattern was identified. This pattern was the concept that vertical stripes made the women feel that they appeared longer and more slender. In fact, when viewing their avatar in the vertical striped garment, Sarah, Susan, Sam, Steph, and Holly all stated that their shape appeared longer or taller, thus resulting in a skinnier silhouette. Four of these women are spoon shaped which could be an explanation for their similar feelings toward the vertical striped garment. As a spoon shape there was a focus on the width of the women's hips, so for these women the vertical stripes aided them in achieving thinner look by minimizing the perception of wider hips.

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Sarah proclaimed that she, "looked longer in this one" and Holly told the researcher that she believed the vertical stripes made her "body look longer and leaner." Furthermore, Rebecca explained that, "traditional wisdom is that the vertical stripes will make you look thinner." Sam made a similar comment when she stated, "as to common belief, it definitely makes me appear a little longer." This common belief / traditional wisdom that Sam and Rebecca mentioned is also something that Hope spoke about. Hope stated that "I do try to wear vertical stripes on the bottom because I know it will make me look taller and thinner."

In spite of her belief that wearing vertical stripes on the bottom half of her body would make her look taller and thinner, when Hope actually viewed the vertical striped dress she told the researcher that it does "bad things to my hips." When the researcher asked Hope to further explain what she meant by "bad things", Hope revealed that she actually perceived the vertical stripes (Figure 17) to make her look wider, which conflicted with her previously mentioned beliefs about wearing vertical stripes.

> **Hope**: It makes my hips look wider and makes me thighs look wider as well, like how the lines go in and then come out, it makes me look fatter on the lower body.

Figure 17. Hope, Helmholtz Vertical. This figure depicts Hope wearing the
Helmholtz vertical striped garment.

Conversely, Heather also found the vertical stripes to do the opposite of what she
thought they might do and stated, "Vertical stripes make me look more stout… and it
makes me look more boxy instead of curvy."

Horizontal Stripes. Two patterns were evident when examining the women's
perceptions of their body shapes when dressed in horizontal stripes. The first pattern was
that the women felt that their bust area appeared larger while wearing the horizontal
striped garment. The second pattern was the idea that horizontal stripes made the women
feel as if they looked wider than they felt they actually were.

A large bust. For some of the women, the horizontal striped garment resulted in
their perception of an increased bust size. Rebecca explained that she felt her bust looked

larger because of the wide white stripe and how it was positioned across the bust in the

horizontal striped garment. She told the researcher that there was a strong "emphasis on

the bust area with the white stripe." Equally, Sarah stated, "I actually think the white is

bringing more attention to the bust." Rachel also noticed the effect the white stripe

(Figure 18) had on her body shape and made the same comment that her bust looked

"bigger because of the white that is there." Heather also noticed that the black and white

stripes had an effect on how she was perceiving her shape and told the researcher that she

felt the stripes were creating an illusion. She stated, "I feel like my chest looks large here

as well as my lower hip area that could be based on the black and white stripes to create

that illusion."

Figure 18. Rachel, Helmholtz Horizontal. This figure depicts Rachel wearing the
Helmholtz horizontal striped garment.

Wider than I am. The next pattern that occurred was the women's perception that horizontal stripes made them appear wider than they believed themselves to be. Sam's distain for horizontal stripes was revealed when she told the researcher that she felt, "horizontal stripes add to the illusion that I am wider and I just don't like that." Holly also thought that "…horizontal stripes tend to make things look wider." Moreover, Hannah expressed that in the past she has felt that horizontal stripes have made her appear wider especially when the stripes themselves are wide in width. Hannah stated, "I feel like my midsection looks wider, I feel like I know that usually happens with horizontal stripes especially when they are wide." Additionally, Helen also spoke of her past experience with horizontal stripes and said that "in the past I avoided horizontal stripes for the reason that they make me look wider." On the contrary, Rose who also revealed that she thinks horizontal stripes have "the ability to make you look wider with the way the stripes run" also believed that "with how wide the stripes are [on this dress] kind of eliminates that problem." Her opinion opposed the majority of the group, but offered an interesting perspective to how the width of the stripes used in the textile design were perceived.

Comparisons of Vertical and Horizontal Stripes. This analysis occurred while the women viewed the Helmholtz illusion, and examined the women's comparisons of the vertical and horizontal striped garments and also their preference for the horizontal stripes.

Ten of the participants mentioned that they preferred the horizontal stripes over the vertical. Some of the comments made by the participants contradicted statements which they had previously made about the vertical striped garment. Sharon commented

that she liked "the horizontal stripes a bit better." Sarah explain her preference by stating, "the vertical stripes do kind of just blank out any curves that I have." Sarah also suggested that the horizontal stripes made her "look less dumpy." She stated that she was surprised that she preferred "the horizontal over the vertical, which of course is contrary to what everyone has ever been told."

Rose, Robin, and Renee gave similar reasons for their preference to the horizontal stripes. They all felt that their shape looked better in the horizontal compared to the vertical. Rose preferred the horizontal stripes more because she felt that they "defined the waist more" and that she also appeared "taller and slimmer." Robin said, "The horizontal one I definitely prefer. I look a little skinnier and my shape looks better compared to the vertical one." Furthermore, Renee stated, "I do prefer the horizontal one, I feel like I have a better shape in that one."

When viewing the horizontal and vertical striped dresses side by side for comparison, Hope felt conflicted between what she previously believed and what she was actually observing.

> **Hope**: Well initially I thought that I would like the vertical stripe better, but because of this illusion I think I look more proportionate in the horizontal stripe and it kind of flatters my body more. It makes my upper body look better and makes my waist look more like I am and then it kind of camouflages the extra stuff that I have on my lower body. In terms of looking taller, I still feel like even though I think vertical stripes should make me look taller, the horizontal stripe is actually making me look

taller. I mean my mom told me when I was younger that horizontal stripes would make me look fat so this is counterintuitive to that.

Similarly, Rebecca felt her preference for the horizontal stripes was counterintuitive and explained that she thought there were some misconceptions.

> **Rebecca:** I think that the common rule is that you do not wear horizontal stripes and you should wear vertical. I have also heard that is not true like it depends on the width of the stripes and things like that, so I think there are misconceptions.

Steph was also a bit conflicted about which of the garments she preferred since she felt that each garment did something for her shape that she perceived as positive. She told the researcher that she liked the vertical striped garment because it made her look taller, however in the end she made the statement that she "liked the horizontal one much better." Her preference for the horizontal was based on the accentuation of her bust and waist.

Many of the responses when comparing the vertical and horizontal striped garments were contradictory in nature. Since many of the women talked about their preconceived ideas regarding wearing stripes, it could be argued that their responses to both striped garments were greatly affected by their previous experience wearing stripes or the advice that they have received about wearing stripes. With strong convictions about wearing stripes some of the women may not have been able to objectively analyze the Helmholtz Illusion.

Additionally, it was not until the women viewed the two striped garments side-by-side that they discovered their preference for the horizontal striped garment. This preference may have been affected by the placement of the stripes and use of color. Many of the women preferred the horizontal stripes because it increased their perception of their bust size and accentuated their waist, however these highlighted attributes were really the result of color placement and may not have been a result of the overall effect of the optical illusion.

MacKay's Rays Illusion

While examining the women's responses to their body shapes while viewing the MacKay's Rays Illusion, two common trends emerged. The first, Accentuating Shape, explored women's perceptions of their bust, hips, and waist. And the second, Purposeful Design, examined the women's thoughts about what they felt the design is "suppose" to be doing.

Accentuating Shape. Many of the women had initial reactions that focused on certain areas of the body. For instance, Sarah, Susan, Heather, Rachel, Steph, Renee, and Sam all commented that they first noticed a change in their bust size when viewing this illusion. Some of the women noticed a dramatic increase in the perceived size of their bust. Steph stated that she liked this garment "a lot because it covers my bust so it looks much bigger." Rachel also thought that a bigger bust "is a good thing." Although Sarah stated that she "liked what it is doing to my bust" she also went so far to say that she felt she "almost looks a little top heavy." However, not all the women felt that their bust looked larger in the MacKay's Rays Illusion. Susan noticed that her bust sized looked

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smaller, but to her that was a positive attribute because her bust looked in proportion to her hips (Figure 19).

> **Susan:** I think it makes my bust size look smaller. I think the waist looks smaller too, but it is kind of distracting in there with the black around, but then I think it makes the bust look in proportion to the hips.

Figure 19. Susan, MacKay's Rays. This figure depicts Susan wearing the MacKay's Rays garment.
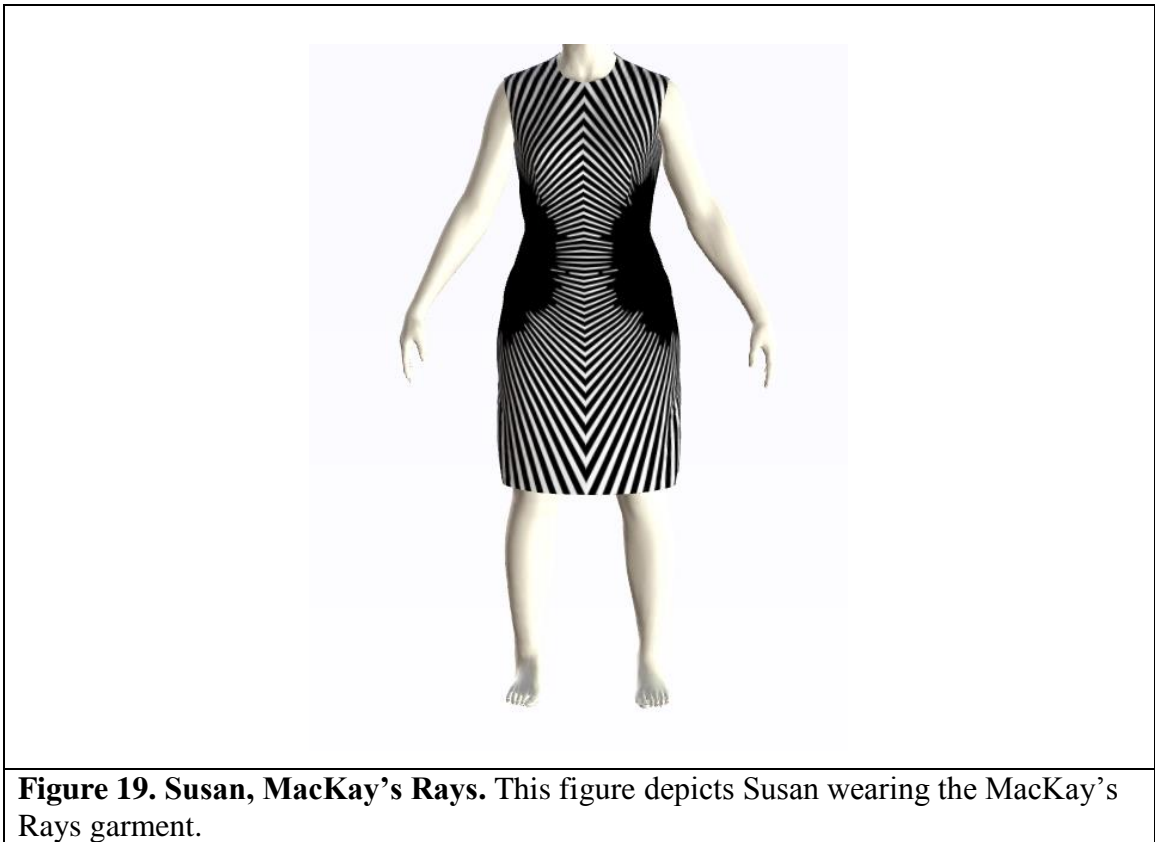
Susan also touched on another common perception of the women; their waist looked smaller in this optical illusion garment. Actually, more than half of the women talked about the change in perception of their waist size while viewing their avatars in the MacKay's Rays design. Holly thought the main change in her shape that she noticed in this garment was a "more narrowed waist." Hannah agreed and suggested that the design

of the garment "makes you focus on the waist area because of the direction of the pattern and the black cut out area." Rebecca noted that she felt like you could see where her waist was and that it was making her "waist go in." Not all of the participants felt that the design had a positive effect on the perception of their waist. For Heather, who is an hourglass shape and had recently lost weight after having children, the accentuation of her waist made her feel that she looked larger then she actually felt she looked.

> **Heather**: I think it makes my stomach area look larger than it really should be… my stomach actually looks like I might be pregnant and after having two kids, I try to not accentuate my stomach at all. I also feel like my hips look kind of large which could be because of the black and where the lines come in.

The final area that women noticed a change was in the perception of the size of their hips. As Heather mentioned, several of the women believed that the MacKay's Rays design increased the appearance of their hips. Helen in particular thought that the look of "more hips" was really ideal and went onto say that she felt like she could see "more curves" in this garment. She also made the statement that this garment "gives an hourglass shape." Moreover, Sharon also mentioned that this design helped to create an hourglass shape. In general, Steph really liked the overall effect of this optical illusion garment, including her perception of bigger hips.

> **Steph**: Ohh I like this. I like it a lot. My waist looks much much smaller, and my bust looks much bigger and yah my hips look much bigger which I like and it covers all the parts [of my body] that I don't like.

Purposeful Design. When examining the MacKay's Rays optical illusion garment there was a strong sense from the women that they felt they were "suppose" to observe a certain effect. Heather told the researcher that the "first thing I noticed on this image is the black on the side and I think it's supposed to make you look smaller." Rebecca also felt that the garment was "supposed to help [her] look thinner in the waist." Furthermore, Jaime pointed out that she could "tell the idea of the design." Sarah was sure that there was intention with the design of the garment, however she wasn't convinced that it was achieving its desired effect.

> **Sarah**: It looks like it should make me look skinnier, but I don't know I think because the black is so wide on the sides, the black isn't doing what it is intended, maybe on a different figure it would have a complete different effect.

The changes in the perception of their body shape that the women perceived align with the intention of the designer for the MacKay's Rays illusion. This intention was acknowledged by the women. The garment was designed in order to create the false sense or illusion of an hourglass shape. The women noticed an increased perception of their bust size, a narrowed waist, and accentuated hips. All of these attributes lend themselves to the illusion of a more hourglass shape, which for those women who defined the hourglass as the ideal, would result in the perception of a more ideal body shape.

Muller Lyer Illusion

The Muller-Lyer Illusion was a comparison illusion and was presented similarly to the Helmholtz Illusion in which the participant viewed each of the parts of the illusion separately and then viewed them side by side on the screen. The areas of exploration that

emerged while viewing the Muller-Lyer illusion were: (1) The Down Arrow, (2) The Up Arrow, (3) Comparison of The Up and Down, and (4) the Illusion of Height. The Down Arrow was used to explore women's perceptions of their body shape while dressed in the garment that has the top arrow pointing down. The Up Arrow was used to examine women's perceptions of their body shapes while viewing their avatar in the optical illusion garment with the top arrow pointing upward. The Comparisons of the Up and Down examined the women's preferences for one of the designs over the other and addressed their perception of which, the up or the down arrow garment, made them feel as if they looked taller.

The Down Arrow. When viewing their avatars wearing the down arrow garment, two prominent patterns occurred. The women focused on a new area of their body, the shoulders, and they perceived a lack of a defined waist.

The Shoulders. Several of the women, when viewing their avatar in the Muller-Lyer Illusion with the top arrow pointing down, began to talk about an area of their bodies that they had not previously mentioned, the shoulders. This could be attributed to the placement of the arrow in the design. Sarah commented that she thought this garment did "nice things for [her] shoulders" and that she "does like the emphasis of the shoulders." Renee also commented that she thought that her chest and shoulder area in this garment looked good. Rebecca, defined as a rectangle, noticed that the garment was emphasizing her shoulders, but for her this was not a positive attribute since she felt like she didn't need to "look broader across [her] shoulders." Holly also pointed out that "it does bring focus to the shoulders." Rose agreed by stating that this garment "showcases the shoulders and arms." On the contrary, Helen pointed out that she felt her "shoulders

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kind of look thinner in this [garment]", however this was the first time that Helen mentioned her shoulders when viewing the optical illusion garments.

Lack of a Defined Waist. The second trend that became evident with the women while viewing this garment was an overall perception that there was a lack of definition in their waist. Sarah pointed out that "the waist is kind of lacking from all of the white." Holly agreed "with the large amount of white in the middle there is really no definition to that part of the body." Hannah also addressed this by saying that she felt that "you can't really see my mid-section." Rebecca made the statement that this garment "is bringing attention to every other area except the waist." Hope felt that the garment overall made her appear boxy and went on to say that the reason for this is that there "is nothing defining my waist." Renee wasn't convinced that she liked the way her body shape looked in this garment and told the researcher that "it doesn't do much for my waist." Contrastingly, Rose really liked the garment because it did not define her waist (Figure 20).

> **Rose**: I actually like this one a lot, it looks very clean and neat, kind of simple, but flattering… I think the two contrasting black arrows kind of takes away from the middle [of the body].

Figure 20. Rose, Muller-Lyer Down Arrow. This figure depicts Rose wearing the Muller-Lyer Down Arrow garment.
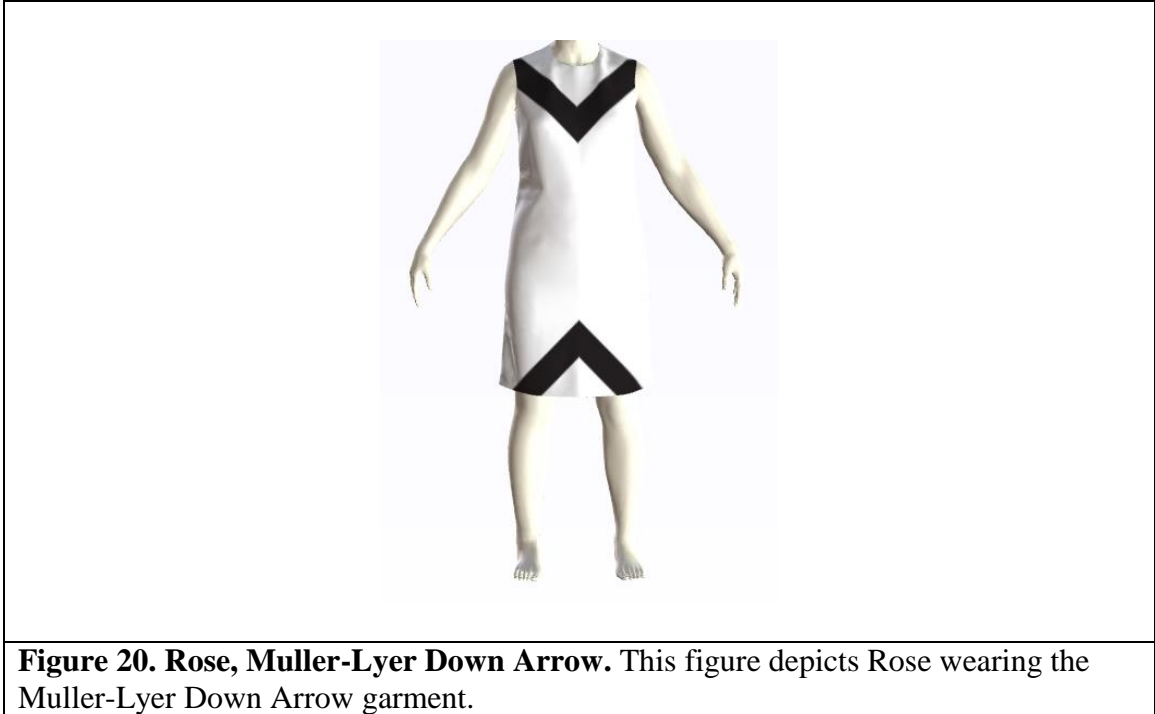
The Up Arrow. Two very prominent patterns emerged when the women viewed their avatars wearing the garment with the top arrow pointing upward. The first pattern that occurred was an increase in the perception of the size of their bust. And the second pattern that occurred was the perception that the women's mid-sections (waist and hips) lacked definition.

Increase in Bust Size. A majority of the women felt that the Muller-Lyer illusion dress with the top arrow pointing up created the appearance of an increased bust size. For many of the women it was the first thing that they noticed when viewing their avatars. Sarah noted immediately that she looked "bustier in this one." Hannah and Sharon both commented that it "accentuates my bust more." Additionally, Rachel made a similar comment by stating, "it makes your bust bigger." Steph also felt that this garment really "focuses on [her] bust." And furthermore, Renee felt like her "bust area looks bigger."

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Heather noted when the garment was first displayed that her attention went straight to the bust area and she liked the affect that it had on her shape.
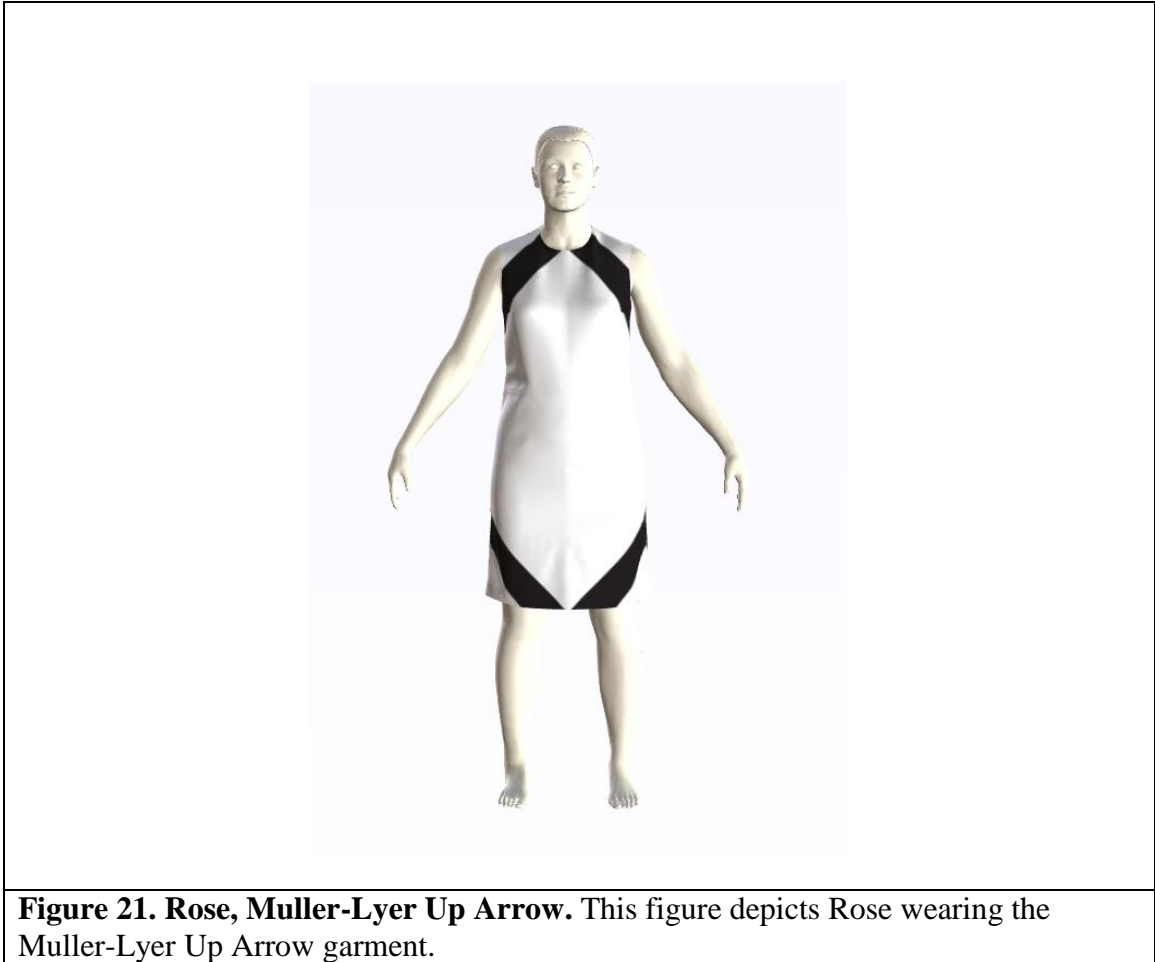
> **Heather**: I also like this garment that you just pulled up that has the black surrounding the chest area which does make the chest look a bit larger… I find that it is flattering on my body.

On the contrary, Robin also noticed immediately that her bust look accentuated, however she did not feel that this accentuation was flattering.

> **Robin**: Yah this looks, definitely the bust looks accentuated, it is like popping up, they look way popping out, I probably would not like myself to be seen with the bust area popping out like that, it brings too much attention here, like it actually looks like popped out.

Lack of a Define Waist. As mentioned previously when discussing the Muller-Lyer with the down arrow, the women again perceived a lack of definition in the waist area while viewing their avatars wearing the Muller-Lyer optical illusion garment with the up arrow. Hope commented that she has the "same issue with the waist line" as the pervious garment. Sam had a similar opinion and felt this garment was "always focusing on that you are wide." Rachel expressed her dissatisfaction with the garment's lack of shape stating that "in the center it is not that good because it creates a large oval." This was an interesting observation since the actual shape of the garment did not vary from one to the other. Rose also felt that this particular garment made her feel broad (Figure 21) and that it closed in the center of the body creating that oval shape similar to that of which Rachel discussed.

Rose: I don't like this one as much, it seems like it makes things look

more broad and it kind of creates an ugly bubble shape in between, instead

of having open lines, it kind of closes the center of the body in.

Figure 21. Rose, Muller-Lyer Up Arrow. This figure depicts Rose wearing the Muller-Lyer Up Arrow garment.

Comparisons of the Up and Down. While comparing the up arrow and down

arrow garments, a preference for the up arrow design emerged. When the women were

faced with comparing the two garments (the up arrow and the down arrow), that make up

the Muller-Lyer illusion, side by side a majority of the women preferred the garment with

the up arrow design. Many of the women preferred the up arrow garment for a variety of

reasons including that they felt they looked longer and that the up arrow showed off their shape more.

Sarah stated that her "immediate preference went to the up arrow one." She further explained her preference for this by explaining how she viewed her body in the up arrow garment.

> **Sarah:** I think it kind of creates more length between my knees and my neck and creates the illusion that I have a longer mid-section, it is a little bit more slimming on the thighs and brings the emphasis more down to the middle.

Hannah explained her preference for the up arrow design by describing what she did not like about the down arrow design. She told the researcher that the down arrow design makes "you just look at your mid-section" and can make you "look wider." With the up arrow design she felt that she was not just focused on the mid-section, but was "looking away or something." Similarly, Heather felt that the up arrow design made her "mid-section look a lot slimmer."

Furthermore, Holly commented that she thought the up arrow design was "more flattering because you can see more of the [body] shape." Steph preferred the up arrow design for a similar reason noting that she looked "more narrow" and felt that this design focused more on her body shape.

It should be noted that although a majority of the women preferred the up arrow design, the women were conflicted when they discussed which garment, the up or down arrow design, made them appear taller. Only eight of the fifteen women discussed the

illusion of increased height when examining the Muller-Lyer illusion. Of the eight, four thought the up arrow made them appear taller and four thought the down arrow made them appear taller. Thus, the researcher was unable to identify a dominate trend when it came to the discussion of height for the Muller-Lyer illusion.

As previously mentioned, this could be attributed to the fact that when the researcher created the Muller-Lyer designs the focus was on framing the body and moved away from the original intention of the illusion which was to increase the perception of height. It is evident here that original intention of the illusion was in fact lost in the design process by not including the center line that was present in the original Muller-Lyer illusion. Although the garments presented to the participants did provide meaningful insight, this insight cannot be directly applied to the original Muller-Lyer illusion. Another explanation for the participant's reaction to this design was the design decisions made in creating this optical illusion design. The effects noted by the participants were attributed to the use of color in this design. A large amount of white was used in this garment design which would make the center of the body appear larger and could affect the perception of the waist. The participant's reaction to the colors used in this illusion was a reasonable explanation for their perceptions of this illusion.
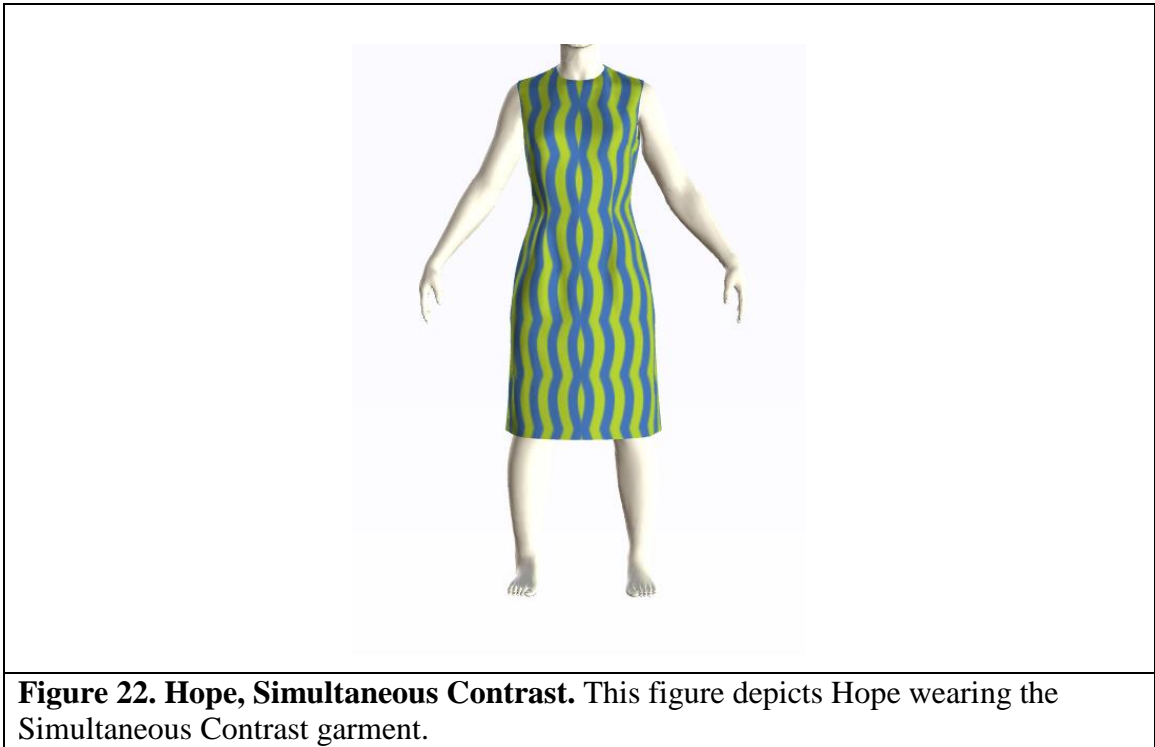
Simultaneous Contrast

There were two trends that emerged when the women were viewing their avatars wearing the simultaneous contrast garment: (1) *Creation of Body Shape* and (2) *Playing Tricks on My Eyes*. The first trend, creation of body shape, addressed the women's perceptions that this garment helped to create a more appealing body shape. The second

trend, playing tricks on my eyes, emerged as the women commented that they could not focus on one area of the garment and felt that the garment was difficult to look at.

Creation of Body Shape. This trend addressed the women's perception that the illusion created a more pleasing body shape. For many of the women, the simultaneous contrast optical illusion garment helped to create a sense of shape or helped to conceal areas of their body shape with which they were not as satisfied. Sarah, Robin, and Hannah all mentioned thought the simultaneous contrast garment was creating the perception of an hourglass shape. Holly also stated that she thought garment showed off her body shape more clearly and that it "accentuates parts which other garments have not." Additionally, Rachel thought that her body looked like it had "more curves" in this garment and Steph liked the way her body shaped looked in this garment stating that her "boobs look bigger and [her] waist looks skinnier." Hope described her thoughts on how the simultaneous contrast dress created a greater sense of shape (Figure 22).

> **Hope**: … it doesn't make my hips look like large, it kind of shapes my body, looks more structured, and as well as I think the lines in the middle draw my vision up and down which makes me look taller. I like the hips and waist and upper part of the body, the back looks really structured which is really good.

Figure 22. Hope, Simultaneous Contrast. This figure depicts Hope wearing the Simultaneous Contrast garment.

Similarly, Heather and Sarah both talked about the creation of shape by analyzing the different areas of their bodies. Heather also spoke about how the simultaneous contrast dress affected her proportions. Sarah further elaborated by explaining that she thought the simultaneous contrast dress gave her more of an hourglass shape.

> **Heather**: I do think that you can see my waist more in this one because it does accentuate it in the right place… I think my bust and hip look fine in this because the illusion makes my body look proportionately correct.

Sarah: It for sure makes my bust look higher and gives the illusion of perkiness, it is nice that the curves hit at my high waist, it draws in right at that point, it is giving me a higher bust, a thinner waist, and scopes out there at my hips, so I would say it is giving me more of an hourglass [shape].

Playing Tricks on My Eyes. Several of the women commented that they felt the garment was hard to look at and that they could not actually focus on one area of the body while viewing this garment on their avatar. Sam commented that she found it hard to "focus on." Additionally, Helen felt strongly about the effect of the design and commented that she felt that it was "very busy", "hurt [her] eyes", and also later commented it "kind of messed with your eyes." Rachel also suggested that this textile print could affect how the viewer physically felt and said that she liked the pattern "but when you look at it for a long time you can get a headache." Furthermore, Susan expressed that due to the complexity of the textile print she couldn't focus on just one section of the body, it is "kind of busy so it kind of keeps me looking at it everywhere." Rose made an interesting observation and commented that she felt that her "eyes go more to the pattern itself rather than the shape of the person wearing it." This trend of the textile print affecting the eyes of the viewer indicated that the color theory principles used in creating a simultaneous contrast optical illusion garment are effective even when placed on the body.

The creation of body shape was intended by the designer as the design was meant to accentuate the bust, waist, and hips of the wearer. Additionally, simultaneous contrast affects the visual receptors in the eye which would yield the unpleasant physical reaction that many of the participants noticed. These observations made by the participants match the intentions of the design and indicated that simultaneous contrast was effective when applied to dress.

Spatial Effects

The spatial effect optical illusion garment was well received by the participants and elicited a positive reaction which can be attributed to the main trend that emerged, the *Creation of Shape*. This trend explored the women's thoughts on how the spatial effect garment interacted with their bodies to create a more desirable shape.

Creation of Shape

Creation of Shape was the primary focus for a majority of the women as they viewed the spatial effect optical illusion garment. Many of the women delighted in their perception of a more ideal shape. For example, Sarah described the effect of the garment in the following way: "It emphasizes the waist, gives a hip shape, and brings it back into the knees, it is doing the hourglass." Rose also explained that "it gives you more of a shape than just a normal dress would with the contrast between the light and the dark. It gives you a very defined shape and gives you the look of an hourglass shape." The illusion of the shape is something that Helen also described by simply stating the garment is "flattering and gives an illusion of an hourglass shape." In a similar manner, Holly told the researcher that "this one clearly outlines that ideal female shape, maybe an hourglass, it makes the shape very evident." Susan also talked about the creation of an ideal or

hourglass shape by telling the researcher that the garment "gives you a shape" and "draws the eyes to those areas" such as the bust, hips and waist. Hannah, an hourglass, really like this garment because she felt it both highlighted her shape and was slimming for her figure (Figure 23).

> **Hannah:** This one I would say is the best because it shaves you off at the
> hips and it brings your eyes to your face, and all the things I said I liked on
> the others are kind of all put together on this one, it kind of has that color
> effect on the side so it gets rid of your love handle area, and focuses on the
> inner part of your body, but again the black is slimming and always looks
> good but the lighter color like makes you focus on different things at
> different times.

Figure 23. Hannah, Spatial Effects. This figure depicts Hannah wearing the Spatial Effects garment.
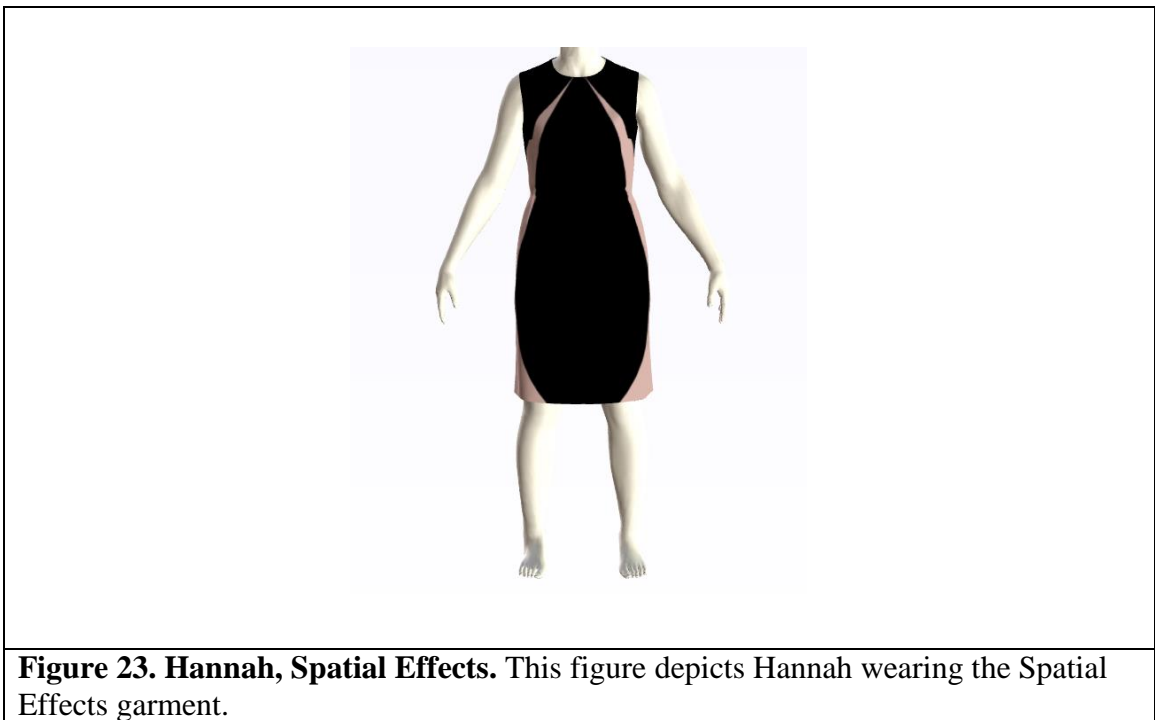
The spatial effect optical illusion garment was created with the intention of using both light and dark colors to create the illusion of an hourglass shape. This intention was confirmed by the participants in their response to this optical illusion garment. Furthermore, this garment, for many of the participants who idealized the hourglass shape, aided the women in achieving the perception of a more ideal body shape.

Preferences by Body Shape Category

This theme, *Preferences by Body Shape Category*, examined the different trends that occurred for each body shape category. For each body shape, the researcher looked for common trends that occurred across all optical illusions. When examining the perceptions of the five women who were classified as an hourglass shape, two trends emerged, *In a Bad Way* and *I think it's fine.* The first trend, *In a Bad Way,* allowed analysis of the hourglass women's perception of having an already ideal shape and not wanting to change the way their shape looked. It explores the negative reactions the hourglass women had to the optical illusion garments that they affected their perception of their proportions. The second trend, *I think it's fine,* described the hourglass women's general lack luster feelings towards the optical illusion garments and explored their inability to observe differences among the garments. For women who were classified as a rectangle shape, two trends emerged, *Create Me a Shape* and *Focus on my Waist*. The first trend, *Create Me a Shape,* explained the desire of women who are rectangles to have an increased perception of a more shapely body. The second trend, *Focus on my Waist,* examined the women's desire for a garment that emphasized their waist. Finally, after examining the perceptions of women classified as a spoon shape, two trends emerged,

Upper Body Focus and *Balance*. The trend of *Upper Body Focus* explored the women's preference for a garment that focused on the upper half of their body. And the second trend, *Balance*, explored the women's focus on balancing their proportions through the use of optical illusion garments.

Hourglass

In a Bad Way. Four of the women who were classified by the researcher as an hourglass shape felt that the optical illusion garments changed the way they perceived their body shapes in a negative way. Many of them indicated that changing their proportions and not showing off their shape was undesirable.

Hannah expressed her dislike for garments that increased the perception of her hips by telling the researcher that it "makes me feel like my hips look bigger and bigger in a bad way." Hannah told the researcher that she didn't like what the simultaneous contrast garment did to her shape because it made her "look heavier on the bottom for sure" and that was undesirable (Figure 24).

Figure 24. Hannah, Simultaneous Contrast. This figure depicts Hannah wearing the Simultaneous Contrast garment.
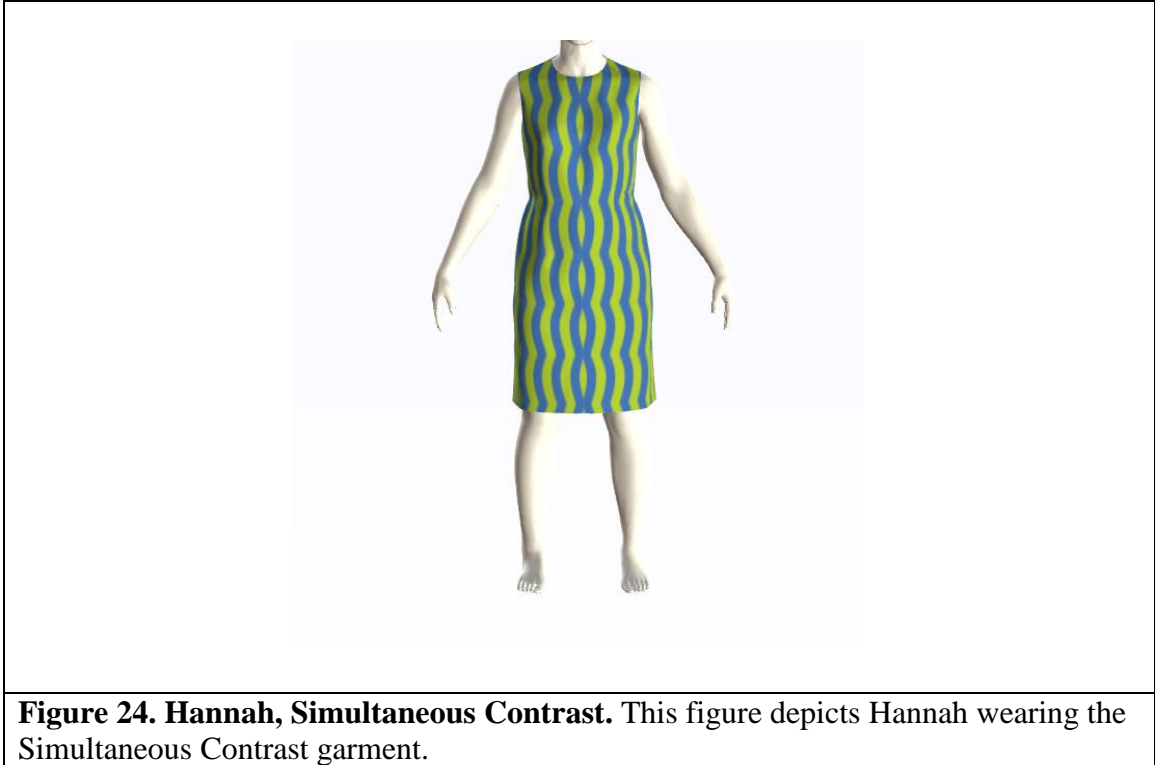
Similarly, Helen often commented that the garments made her look wider in the hips which resulted in her finding several of the designs to be unflattering. She commented, "I kind of think this one is kind of unflattering too actually." Helen also talked about her issues with garments that make her feel she looked wider in general and told the researcher, "in the past I have avoided [garments] that made me look wider." However, Helen felt that the spatial effect garment looked good on her because it just emphasized her hourglass shape and was meant to "give the illusion" of the hourglass shape.

Heather often talked about how her "chest looks large here" which resulted her not being content with the way the garment looked on her body. She perceived that a large chest was an undesirable physical attribute. Heather also talked about the "lack of

shape" that a garment could have when her waist appeared wider and when "there is really no definition to that part of the body." Heather bluntly told the researcher while viewing MacKay's Rays that she felt this particular garment isn't "ideal with an hourglass type figure" since it increased the perception of the waist. This comment indicated that Heather thought the garment did not have a positive effect on her shape. Heather was therefore less satisfied with garments that didn't accentuate the shape she felt she already had.

Additionally, Holly often felt certain areas of her body looked larger in the optical illusion garments which made her feel less content with the way she perceived her body shape. Holly felt that changing the perception of her shape in general was negative. While viewing the MacKay's Rays Illusion she told the researcher that it "makes the waist look narrow" and then went on to say that the garment was not ideal because of the effect that it had on her waist. Also, while viewing the Spatial Effect garment felt that the garment "outlined the body shape too obviously" and that she would rather wear something that is "more subtle."

In a similar manner, Hope frequently talked negatively about the garments that did not focus on her waist and as a result "made [her] waist look wider." When this occurred she felt that the garment made her "appear more boxy" and she was less satisfied with the way she perceived her shape.

I think it's fine. This trend explored the hourglass women's indifference to many of the designs. In general, they had a much harder time than the other body shapes in evaluating how they perceived their shape in the optical illusion

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garments. For example, Heather frequently told the researcher, "I think it looks fine" and often responded, "I think it looks similar to the ones that I have looked at before." Helen also made several comments that she didn't see much of a "difference between" the garments and pointed out that some of the garments in her opinion were "similar to the other ones." Showing her indifference to the garment, Heather commented while viewing the spatial effect garment, "I don't think it makes any part of my body look bad." Hope also made similar comments telling the researcher that she felt the Muller-Lyer illusion was "not awful, but can maybe be better." Hannah had similar thoughts and told the researcher, "I mean it doesn't look bad, but it doesn't look great." Additionally, Hannah stated that she felt garments looked fine, but in her opinion they really "didn't do anything that amazing to [her] shape."

> **Hannah**: "I mean it looks fine, I am not like "ohh yes it's me I am amazing" but I don't think it is bad or anything… I don't think it does anything different, like make my body look different."

Rectangle

Create Me a Shape. All five of the women who were classified as a rectangle body shape were very focused on whether or not the garment created "a shape." Rose was particularly focused on creating a shape and often described the garments as "showing off more shape" and would say, "it creates more of a shape." For example when viewing the Helmholtz Illusion with the vertical stripe Rose made this comment: "I would say I like this one less [than the horizontal striped] because I would say this one has less of a defined shape." In the case of the Muller-Lyer Up Arrow illusion, Rose felt strongly that

it gave her a shape, just not in a desirable way. She stated that it "creates an ugly bubble shape." Rose also had mixed feelings about the simultaneous contrast illusion because she felt like it didn't "do a lot for [her] shape." Furthermore, Rose commented while viewing the spatial effect optical illusion garment that she thought it was "flattering because it gives you more of a shape… it gives you a very defined shape and gives you the look of an hourglass shape."

Robin also often commented on the "shape" that was being created and made several comments stating that she felt that several of the garments "accentuated my body shape" and that her "shape looks better" in many of the garments she viewed. Robin also liked the simultaneous contrast garment and commented, "I like this hourglass shape, and it is what I would kind of prefer." This creation of an hourglass shape was considered more ideal to Robin and she was more satisfied with her shape in this garment.

Renee also talked often about her shape and would frequently state that a garment gave her "a better shape." Additionally, she commented that in the simultaneous contrast dress that she felt her shape looked "pretty good." She also used the term "figure" a lot when she was talking about her perception of her body shape, often stating that a garment gave her "a better figure."

Rachel referred to the creation of shape in terms of the creation of curves and preferred garments that changed her straight up and down shape to a "more curvy" shape. Rachel made this assertion while viewing the simultaneous contrast illusion garment when she positively said, "it makes my body have more curves." Rachel found this garment to be particularly ideal. Moreover, Rachel made a comment while viewing the

spatial effect garment commenting, "I like this design it can make me feel like I have a curve."

Rebecca, who correctly identified herself as a rectangle shape, talked about shape less frequently than the others, however while viewing the comparisons of the Muller-Lyer illusion (Figure 25) stated that her preference was for the down arrow garment because "it just looks like it creates more shape and the other has no shaping created."

Figure 25. Rebecca, Muller-Lyer. This figure depicts Rebecca wearing the Muller-Lyer Up (left) and Down (right) Arrow Illusion.
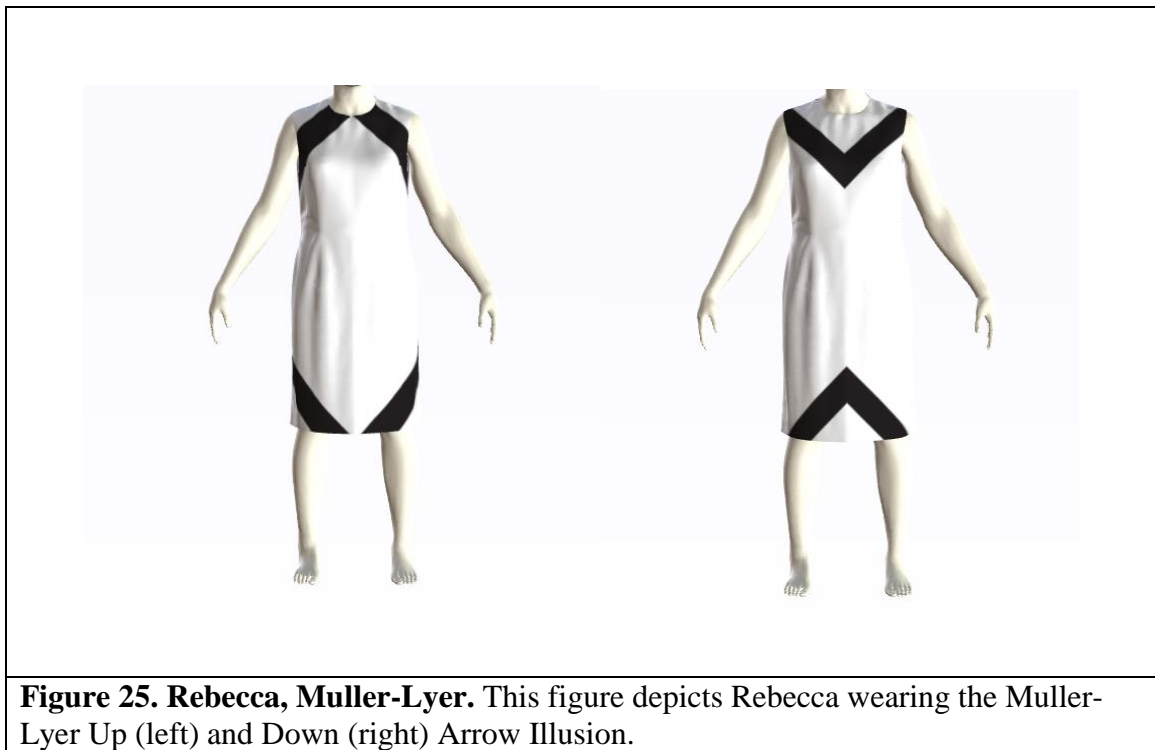
Focus on my Waist. For the women classified as a rectangle shape, not only was the overall shape effect important, but they had a strong need for a garment that focused and defined their waist.

Rebecca often spoke about emphasizing her waist and when the garment did, it resulted in her feeling more content about the way she perceived her body shape. Rebecca told the researcher that she was "most concerned" about the way her waist looked in the garments. Rebecca disapproved of the Muller-Lyer illusion and its effect on her body shape when she stated that, "it is bringing attention to every other area except the waist." Rebecca talked about the spatial effect illusion garment by stating that "there is a lot of emphasis on my middle here" and then told the researcher that she is "okay with how the body shape looks" in this garment. When viewing the Helmholtz illusion the importance of a defined waistline to Rebecca became apparent.

> **Rebecca:** I definitely like the horizontal stripe better and I definitely think it looks like it has more shape in the waist line which I am more concerned about so the horizontal feels like it is achieving that better.

Rose also focused on the garments creating a waistline and would often point out that a garment would "define the waist" more which would result in her feeling more content about the way she was perceiving her overall shape. When Rose viewed the Helmholtz illusion, she, like Rebecca, also preferred the horizontal stripes since she felt it defined her waist.

> **Rose:** It is more flattering because it has more definition and shows off more of a shape… it looks like there is more of a defined waist, a bust that is more noticeable.

In a similar manner, Rachel often pointed out that she liked a design because she felt like her waist was "more defined" and that it gave her the sense that she had more of

a shape. Rachel often talked about how the waist could be more accentuated. She even drew a parallel between the horizontal stripes in the Helmholtz Illusion to wearing a dress with a belt. Rachel stated, "I think it actually looks better because like here it kind of feels like I have a belt here so that can make me feel like my waist is more defined." Later in the interview, Rachel told the researcher she would only wear a dress like the Muller-Lyer Illusion if it had "a belt right here" at the waist. Rachel's discussion of including a belt with some of the garments was her way of indicating the importance of a defined waist to her satisfaction with the overall look of her shape.

Renee evaluated a garment based on her perception of "what the garment was doing to [her] waist." She seemed to never be content with the way her waist looked and even commented that she "would still like a smaller waist." When viewing the Muller-Lyer illusion Renee commented, "I don't know that it does much for my waist." Renee felt less content with the Muller-Lyer illusion because she felt like it "didn't accentuate" her waist.

In contrast, Robin also focused on her waist, but for a very different reason than the other women. Robin mentioned several times that the hourglass shape with a thin waist would be the ideal for her, however, at the time of the interview she was not satisfied with her waist area. She sometimes even used the word "fat" to describe her "tummy." This dissatisfaction with her shape affected how she viewed the garments. For example, she disliked how much the spatial effect garment emphasized her waist because she felt strongly that her waist was a "problem area."

> **Robin**: I don't think I would prefer this because I am really focusing on this, the waist, too much on the waist and this kind of outline makes me look there too much because that is where my tummy is"

Spoon

For the women who were classified as a spoon shape there was a great deal of importance placed on the emphasis on the upper half of their body. Sometimes this was to distract from their hip area and other times it was to create a greater sense of balance among their bust, waist, and hips.

Upper Body Focus. This trend of *Upper Body Focus* explored the women's preference for the garments which focused on the upper half of their body, such as the face, neck, shoulders and upper torso. For instance, Sarah talked often about the garment bringing focus to her bust area and shoulders. She talked about this when viewing the Muller-Lyer Illusion stating, "it does nice things for my shoulders, the emphasis is drawn more up there." She also went on to mention the emphasis on the shoulders again suggesting that the illusion with the up arrow "is still giving me nice shoulders, which is nice." Additionally, she commented that in general she liked the illusions that focus on her upper body. She said, "I like the illusions that emphasize the bust and create a strong shoulder." Steph also told the researcher that she preferred to have a garment that emphasized her shoulders.

> **Steph**: Well, one of my friends told me that I have a very narrow shoulder, so I tend to wear clothing with a very square shoulder, this one if I take a

picture of me wearing it, I will have a very small shoulder, so I would
prefer a more structured garment up top.

Similarly, Susan told the researcher that she liked the Muller Lyer Up Arrow illusion because she "feels like it accentuates the shoulder area." She also felt like it reminded her of a halter top which "points more towards the neck and shoulder line." Sharon also made a similar comment when viewing the Muller-Lyer Down Arrow illusion (Figure 26) stating that she felt this design reminded her of a V-neck. She also said that it "would make the shoulders look wider, broader and emphasize the shoulders a bit more." When asked if broader shoulders was an ideal of hers she told the researcher that she doesn't think it is an ideal in general, but for her personally it is.

Sharon: For me, I have kind of narrow shoulders. I am not saying it is necessary to have rather broad shoulders as an ideal, but I would like it if mine were a bit wider.

Figure 26. Sharon, Muller-Lyer Down Arrow. This figure depicts Sharon wearing the Muller-Lyer Down Arrow garment.

In addition to the shoulders, other areas of the upper body including the neckline, face, and bust were of importance to the participants. Sam frequently talked about her entire upper body by describing it as her upper torso and commented about her "upper torso looking elevated" which she viewed as a positive attribute. While viewing the MacKay's Rays illusion garment, Sam stated that an increase in torso height was something she liked. She explained: "See how the solid colors like actually hide my bulges and the other stripes are actually adding to my torso height, I really like this combination."

Furthermore, Sam tended to focus on the neckline and how it affected her face shape. Sam told the researcher while viewing the Muller Lyer Down Arrow illusion that she "likes how it optically gives me a conceptual perception that my neck is a little longer." Sam also talked about the visual perception of the neck length while viewing the spatial effect garment. She said that she felt as if her "neck height is actually being shown" and did not feel that is was changed by the optical effect of the dress. Additionally, Sam thought a rounded neckline was undesirable because it made her "face look rounder." Comparably, Steph also tended to discuss how a garment would affect her face shape and said this about the vertical stripes shown in the Helmholtz illusion, "I have a very pointy long face and this will extend my face to look longer."

Balance. This theme of *Balance* explored the comments the women made about the garments making them appear more symmetrical, therefore resulting in a more hourglass shape. As a spoon shape, many of the women viewed their hips as a main focus so they were more satisfied with garments which created the appearance of balance among their proportions. Sarah was very focused on the concept of balance and frequently made comments such as, "this does a better job of making me look balanced" and I look "more balanced on the top and bottom." Additionally, Sarah told the researcher while viewing the MacKay's Rays Illusion, "I almost look a little top heavy in this, but front to back I think it makes me look more balanced." When she perceived her bust to appear larger it resulted in her commenting that she "looked more balanced." Furthermore, Sarah felt satisfied with the way her body looked in the spatial effects illusion garment because it "balances out" her proportions. She went on to further express her satisfaction by explaining that it helped to "create an hourglass shape."

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Correspondingly, Sam and Susan all talked about balance in terms of their proportions. Sam noted the "disproportion of her upper torso to her bottom torso." She told the researcher that her ideal involves the "managing of her proportions" and her goal is to look "less wide" in their waist and hip area. Susan often commented on the change of proportion that she noticed between the bust and hips. Susan was quite satisfied with her proportions when viewing the simultaneous contrast garment as she noted, "I think the bust and hips look in proportion and it draws it in at the waist."

Sharon and Steph used the terms of balance and proportion far less than the other women in their body shape category. However, both of them preferred garments that emphasized their bust or shoulder area. This indicates that although they may not articulate their preferences for balance like the other women, they still felt most satisfied when their shape was balanced out by having the perception of a larger bust. This large bust created that sense of balance with their hips.

Effects of Wearing Optical Illusions

This theme, *Effects of Wearing Optical Illusions,* explored the women's opinions on how optical illusions can affect their perceptions of their own body shapes. For most of the women, the illusions had a positive effect on how they perceived their body shape, but for some women the optical illusions highlighted what they considered to be their problem areas. Although the hourglass women were often indifferent to the effects of wearing the optical illusion garments, they still acknowledge that their perception was impacted by the optical illusion garments. In general, the effect of wearing optical illusions was found to be both positive and negative, but the effect was dependent on

body shape and the optical illusion being examined. Two main trends emerged while exploring this theme: (1) Positive Effects and (2) Against the Good.

Positive Effects

This trend explored the positive effect the women perceived about the effect of optical illusions on perceptions of their own body shapes. All of the women at some point while viewing the optical illusion garments felt that the garment improved their perception of their body shapes and therefore increased satisfaction. Some of them expressed this by discussing areas of their body that they felt were improved by wearing an optical illusion garment and others expressed it in more general terms by stating they liked how their body looked in the optical illusion garments.

Helen told the researcher that she "will start thinking about [optical illusions] more because it makes a huge difference obviously." For Holly it was also thought provoking and she admitted to the researcher that optical illusions and changing the perception of her shape was not something she had considered before.

> **Holly:** I never even really considered this before or even with the clothing selection process before, but I think it is really interesting to see your body shape reflected back at you in this way. I think we have an impression of what it is, but I always wear a certain size, but to consider proportions is useful and then maybe what difference designs might accentuate certain things depending on what you want them to do.

Similarly, Heather told the researcher that she also hadn't considered optical illusions as part of dress previously, but because she perceived the illusions to have a

positive impact on her perception of body shape she will consider them in the future while shopping.

> **Heather**: I didn't have any preconceived ideas about wearing optical illusions and I never really wear a color block type item, but I would consider wearing one now even though it doesn't fit my personal aesthetic.

Furthermore, Sam told the researcher that she is ready to go shopping now because she has gained knowledge from looking at herself and all the different optical illusion garments. She said, "I think I knew it, but I saw something new in this." Additionally, Robin had a positive perception of how the illusions affected the way she viewed her body shape and hoped that there would be an opportunity for her to learn more about them in the future.

> **Robin:** I am definitely interested in them and some of them I really like and some of them look really good to me so I would definitely be interested in this and if there is anything that can be scientifically explained about dress and how we look.

While it was clear that many of the women had preconceived ideas about certain optical illusion, such as the Helmholtz Illusion, they seemed to come to the realization that illusions can be used in ways that they may not have been aware of previously. Additionally, the women with rectangle body shapes were more likely to appreciate the benefits that optical illusion could provide. It could be argued that the rectangle shape is most susceptible to the effects of optical illusion garments since they have a strong desire to emphasize different areas of the body (i.e. bust, waist, and hips).

Against the Good

Although far less common, two of the women felt that optical illusion garments could sometimes work against the positive attributes of their body shape. For example, Sarah explained her thoughts about how some of the illusions meant to elongate the body worked against her body shape.

> **Sarah:** I think maybe because I am so short that putting on long stripes just looks absurd and also because I am not long and lean to begin with, it plays against the good parts [of my body shape].

Hannah also thought that sometimes the optical illusion garments could have a negative effect on the perception of body shape. She explained that she didn't think all illusions interacted with the body well.

> **Hannah**: I think that they can all be different, it just depends on what the optical illusion is, like it could help you or it can hurt you, just like when I feel like when I wear a black dress compared to when I wear white, [the black] is more slimming so I think optical illusions can do the same, but they can also not do something good, so it's not saying all optical illusions are good on clothing.

Additionally, Rebecca talked about the good and bad of optical illusions by stating, "People have to have awareness, that is always helpful and [they] need to make good choices in terms personal selection." In summary, Rose said that "I think they work, whether they are the right ones or the wrong ones, depending on the look you are going for, they have an effect on how your body looks."

A More Ideal Self

This theme, *A More Ideal Self¸* examined all fifteen women's opinions on whether they believe that optical illusion garments can aid them in achieving a more ideal self, and as a result increase body satisfaction.

Rebecca told the researcher that she "honestly feels that [optical illusions] can" help her achieve a more ideal self. She went on to say that she feels that optical illusions give her the "opportunity to accentuate or hide areas" of her body. Rachel had similar thoughts, discussing how the illusions hid or accentuated areas of the body, making her feel as if she had a more ideal shape. Rachel expressed, "I actually think that it can, especially with color, it can make areas look bigger or smaller."

Sam felt that the optical illusions could "definitely help get a more ideal shape" and that "it can totally make or break my figure and how I look." Similarly, Heather told the researcher that she does feel that optical illusions can create a more ideal shape "because they can emphasize or deemphasize certain areas of your body" which can lead to greater satisfaction with body shape.

Hope told the researcher that she believed optical illusion garments "can make you have a more ideal shape." Hope and Susan both talked about an increase in body satisfaction by describing their feelings about how the optical illusion garments made a woman feel different about their appearance.

Hope: I do feel like optical illusions can make you look different, like highlight the best parts, they obviously wouldn't make you look something that you're not, but it can highlight the parts of your body that

are good and if you don't want to show off the other parts it can like take away the attention to the bad parts.

Susan: I think they can, they can help with your silhouette, or there are ones that are busy that draw your eye away like if you think you have big hips, it might draw your eye away to other areas when you are looking at the pattern opposed to everyone staring at your hips."

Furthermore, Holly told the researcher that she felt she could be more satisfied with her shape through the use of optical illusions and felt that "if you identify a problem area and you want to correct your proportions then yes I think so, it could if you wanted it to." Holly hinted at the idea that it may not be everyone's goal to change their shape and Sarah also touched on this when she talked about whether or not she thought optical illusion garments could give her a more ideal shape. Sarah explained, "I think that if that was my main goal to change the overall look of my shape, then yeah I think it would be definitely achieved."

Along these same lines, Sharon felt that yes optical illusions could help her achieve a more ideal body shape, but only "to an extent." She further explained that she felt that she must be content with her body regardless of clothing, but did feel that optical illusion could help her feel more confident by "creating curves if you want them or … hide trouble spots." Sharon further talked about hiding trouble spots when she said, "If you have a belly, if you have something you want to minimize, I think they can give you a more ideal shape or give the impression of an ideal shape."

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Rose pointed out that you must feel good in what you are wearing in order to feel more satisfied and "if the optical illusion helps to achieve that then there you go." Regarding achieving a more ideal body shape and increased body satisfaction, Steph said this, "Well I will never be taller, but with the illusion I will look taller and skinnier, I think the optical illusion can definitely help."

Researcher's Reflection

As a researcher, I always try to approach my research from an objective view point, however it can often be difficult as I acknowledge that my own experiences and assumptions might affect how I approach the data. For me, the most difficult part of being objective in the current study is that I was not only acting as the primary investigator, but as a designer. As a designer, my greatest challenge was to view my design work with an objective eye. I created each of the optical illusion garments with an intention and focused on how I wanted the garments to interact with the body, represent the optical illusion being explored, and also took into consideration each of the body shapes the current study was examining.

When it came to the interview process, I had to change roles and approach each of the illusions with total neutrality. I will admit that this was difficult for me. I wanted to engage with each participant to really understand what they were seeing with each design. Sometimes I found it eye opening to hear their perceptions of the illusions and found it surprising when my intentions as a designer were interpreted differently than I had expected. It was in these moments that I had remember my role as the PI and listen to what the participant was really saying, leaving all preconceived ideas of the garments I created behind. It was sometimes difficult to not make justifications or explanations for

each of the garments when the participants provided a critique of the design. With that said, this was a challenge that I knew I would face and was prepared to be open to this critique of my design work. The most important thing to me was making sure that participants felt comfortable enough with me to express their true feelings and opinions, so I was very cautious not to talk about the designs in a way that would indicate to the participants that I was the designer.

Another issue that I knew would occur with exploring this topic is facing the perceptions that I have of my own body shape. I think exploring my own thoughts about how I feel about how clothing affects the perception of body shape allowed me to be very empathetic to my participants. I can honestly say that I am not sure I would have been as open and honest as my participants were with me. I found this research to be a very humbling experience and felt that I really had a connection with each one of the participants. I think getting to interact with my participants on two separate occasions allowed me to build a connection with them which allowed them to feel comfortable during the in-depth interview.

I tried to keep an objective perspective during the data analysis process and again attempted to not allow my role of designer to influence the way I was interrupting the data. I wanted each of the participant's voices to be heard so that maybe through my research I would be able to aid these women in having higher body satisfaction. I think this research is just the first step in the process and I feel blessed that this amazing group of women shared their insecurities, body issues, and feelings of hope and satisfaction with me.

Chapter V: Discussion and Conclusions

Chapter 5 contains the following sections: (1) summary of the study, (2) analysis of exploratory study design, (3) contributions, (4) implications, and (5) limitations and future research.

Summary of the Study

The aim of the current study was to explore how optical illusion garments impacted a woman's self-perception of her own body shape. The seven emergent themes from this study revealed: (1) Women's self-perceptions of their personalized avatars, as well as their connections between the woman and her avatar, (2) Women's perceptions of how clothing and the body interact, (3) How women define "ideal" body shape for themselves and how they perceive ideal body shapes defined by society, (4) (RQ1) How women's self perceptions were impacted when optical illusion garments were applied to the body, (5) (RQ1a) The differences in garment preference per body shape category, (6) (RQ2) Women's perceptions of the effects of wearing optical illusions and finally, (7) (RQ3 & RQ4) Whether optical illusions aided women in perceiving a more ideal self and a resulting increased body satisfaction. Although not directly tested, this study was guided by the self-discrepancy theory in examining women's self-perceptions and body satisfaction.

In exploring women's self-perceptions of their personalized avatars, data analysis revealed two themes: expectations and shape realization. When the women were first

introduced to their avatars there was a mixed reaction. A few of the women had no reaction to the avatar accepting it as themselves, however seven of the women claimed that what they were seeing on screen was not what they were expecting. This reaction could be linked to a discrepancy between the participant's actual and ideal self. As the participants viewed their avatars they saw their actual self from a new perspective and perceived differences from that of their ideal. Although their initial response to the avatar was not what they expected, after a short period of time the women began to accept the avatar as a version of themselves, and believed the avatar to be an accurate representation of their body shape. In fact, seeing their avatar on screen actually helped several of the women recognize their actual body shape.

This process of shape realization occurred for many of the women as they began to analyze their own bodies through viewing the avatar. It became clear that the women felt a connection to their avatar, referring to the avatar as "I", and the women also felt they were able to gain knowledge about their shape through interacting with their avatar. The women who had correctly identified their body shape prior to viewing their avatar seemed to be less surprised by their avatar. Those women who incorrectly identified their shape, especially spoon shaped women, seemed to have a deeper connection to their avatar as they were more engaged as they learned about their body shape from viewing their avatar.

It was important to understand the women's perception of the role clothing played in the perception of their body shape. It was not surprising to find that women considered clothing a tool for concealing or revealing their body shape. In their daily practices of selecting clothing, the women considered areas of their body that they would like to

accentuate or hide, and reported using clothing to achieve this. There was a connection to body satisfaction as several of the women described choosing areas they were most satisfied with to accentuate while using clothing to hide areas that they were least satisfied with. Some of the women even spoke about "fat days" and how their clothing choice changed, based on their perception of their body on that particular day. Additionally, it was found that women tried to select clothing that they felt worked best with their shape. Dressing for body shape, was a common trend among the women and was linked to their perception of how others would perceive their body shape. It was found that the women believed that the proper use of clothing could result in a more positive perception of body shape and increase body satisfaction by bridging the gap between the actual and ideal self. Thus, participants were viewed as being capable of evaluating the optical illusion garments in an objective way.

When examining the concept of ideal body shape two different definitions were identified. The first ideal was the traditional hourglass shape which was defined as a woman with equal proportions for her bust and hips who also has a defined waist (Coleman, 2011). It was found that the women perceived this to be both a personal and societal ideal, supporting Grogan, Gill, Brownbridge, Kilgariff, and Whalley (2013) research on societal ideal body shapes. Additionally, it was found that a new ideal was emerging, at least for these women, in today's society. The women felt that there was a shift occurring from the ideal of extreme thinness to a more fit and healthy body, regardless of shape. Furthermore, it was found that the women felt that it was now more desirable to be healthy rather than just thin. With this in mind, it can be argued that the women in this study idealize a body shape that is a combination of two different ideals.

They did not abandon the traditional ideal of the hourglass, but they strive to achieve a body shape with curves that was also considered fit and healthy. It is interesting to note that this perception of ideal occurred across all ages and body shape categories.

While investigating the application of optical illusions to dress, the current study investigated five different optical illusions: (1) Helmholtz Illusion, (2) MacKay's Rays, (3) Muller-Lyer, (4) Simultaneous Contrast, and (5) Spatial Effects. The following identifies the findings for each of the individual illusions and aims to answer researcher question number one: How do optical illusion garments affect the visual perception of body shape?

The findings for the application of the Helmholtz Illusion were quite interesting as it explored the age old myth that a woman should not wear horizontal stripes. In fact, many of the women addressed this myth stating that they were told at some point in their lives that they shouldn't wear horizontal stripes. The women were conflicted in their evaluation of this illusion and it wasn't until the participants compared the horizontal and vertical striped garments side-by-side that they revealed their preference for the horizontal stripes. Their preference for the horizontal stripes included the fact that the stripes increased the appearance of the women's bust, accentuated their waists, and for some women, made them feel as if their appeared taller. These findings are consistent with the perception of the actual Helmholtz illusion and provides support for its application to dress. However, due to the use of color in this illusion, it could be argued that the women's preference for the horizontal garment could be attributed to the placement of color on the body. A thick white stripe was placed at the bust and a thick black stripe was placed at the waist, which according to color theory principles (i.e.

spatial effects) would indicate that the bust would appear larger and the waist would appear smaller. The effect that color had on the perception of this illusion cannot be ruled out as an explanation for the perceived effect of this particular optical illusion.

While examining the application of the MacKay's Rays illusion, the data analysis revealed that this illusion is effective in accentuating a woman's body shape. Although the design of the garment itself was not liked by all of the participants, it was evident that the auto kinetic nature of the MacKay's Rays illusion helped to highlight certain areas of the body, particularly the bust, although this was not the original design intent. The women felt that this illusion increased the visual perception of their bust, but also narrowed the appearance of their waist. This was the intended effect of this garment designed and aided in achieving the perception of a more hourglass shaped body. This intention of creating a garment that aided in achieving a more hourglass-like shape was acknowledged by the women evaluating the MacKay's Rays garment. Several of the women commented on the effect that they thought the garment was "suppose" to have. These findings indicated that the intention of this optical illusion garment was acknowledged by the participants and the expected effect occurred. However, it is unknown if the participants evaluated this illusion based on their expectations of how the design was supposed to interact with their body shape or if they were able to provide an objective analysis without factoring in the intention of the design.

The Muller-Lyer Illusion which historically used to illustrate an increase in the perception of height was inconclusive. The women were conflicted in their opinions about which half of the illusion made them feel as if they appeared taller which can be attributed to the fact that the garment viewed by the participants was not representative of

the original illusion and excluded the center line needed for the evaluation of height. In addition, because of the need to place the arrows balanced on the body, if lines were added to the garments, they would in fact have been different lengths. However, the findings do indicate that for this illusion the women felt that there was a general lack of a defined waist in both halves of the illusion. The application of this illusion to dress needs further exploration. It is possible that the trends surrounding this illusion are closely related to the design decisions made by the researcher and the use/placement of color, which is further discussed in the analysis of the exploratory design section of this chapter.

This study explored the application of simultaneous contrast to dress using blue and yellow as the contrasting colors. It was found that a majority of the participants had a positive response to this illusion and its creation of body shape. For many of the women the print was distracting enough to hide their flaws, while the curvilinear design defined their waist. It was apparent that the visual effect of a simultaneous contrast illusion still occurred even when applied to the body based on the women's description of the effect that this illusion had on their eyes. Simultaneous contrast interacts with visual receptors of the eyes to create a sense of movement and also creates the illusion of an additional color being present that actually is not in the design. While the participants were not able articulate exactly what was occurring physiologically with their eyes during presentation of the optical illusions, women reported feelings of discomfort. This discomfort ranged from statements that the garment was hard to look at to suggestions that if one was to look at the garment for a long period of time they would get a headache. These findings indicate that the principles of the simultaneous contrast did in fact occur when this illusion was applied to dress.

Findings indicated that participants felt that the Spatial Effect garment could give them the appearance of a more desirable body shape. Many of the women felt that this garment helped to create a more ideal shape by giving the illusion of an hourglass shape. Results indicated that participants could identify the contrast between the light and dark colors used in the design and felt that this aided in the creation of shape. It was evident that the intended use of black in the center of the garment to create the false sense of an hourglass shape was obvious to participants and increased their preference for this garment. This provides support for the use of spatial effects in optical illusion garment design, especially when the paired colors used, produce a slimming effect by placing a dark color in the center of the body and the lighter color on the sides of the body.

Apart from this, the current study also found observed differences in preferences between body shape categories. This section addressed research question 1a: Does the effect of optical illusion garments vary depending on body shape (hourglass, rectangle, and spoon)?

Interestingly, it was found that women, who are an hourglass body shape, felt that changes to the visual perception of their proportions negatively impacted their perception of body shape. These findings are consistent with the pilot study. Additionally, it was found that those women with an hourglass shape were often indifferent to the effect that the garment had on their shape. Next, this study found that women with a rectangle shape were most susceptible to the impact of optical illusion garments. Women with a rectangle body shape, preferred garments which created for them a more ideal shape and focused on their waist. Garments which created a false sense of shape, like the simultaneous contrast and spatial effect garments, were found to aid

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these women in perceiving a more ideal body shape. Furthermore, the data analysis

process revealed that women with a spoon body shape preferred garments that focused on

the upper half of their bodies and also those which created a sense of balance for their

overall shape. This relates to the self-discrepancy theory as it addressed the spoon shaped

women's desire to appear more ideal. It was evident that those women with a spoon

shaped body wanted to appear more like the idealized hourglass shape which was why

they preferred a garment that created the perception of balanced proportions. However,

other factors had an impact on this, especially the sense of shoulder width, an often

discussed variable.

Through research question number two, this study examined the overall effect of

optical illusion garments on the participant's perceptions of their body shapes. The

current study discovered several effects of wearing optical illusion garment which

included both positive and negative effects. It was found that many of the women

perceived that the optical illusions garments could have a positive effect on how they

perceived their shape and could increase their body shape satisfaction. This was closely

associated with the self-discrepancy theory, which has shown that when there are

differences between the actual and ideal self it results in lower body satisfaction (Higgins,

1987). In this case, an optical illusion garment has the potential to bridge the gap between

the ideal and actual self, resulting in higher body satisfaction. This benefit of optical

illusion garments is however dependent on the participant's personal preferences, body

shape, and also the optical illusion that was being examined. There were many variables

that could not be fully accounted for in this exploratory study. Optical illusions garments

must be chosen carefully and designed carefully with body shape in mind in order to

insure that the overall effect on the perception of body shape is positive. Other factors besides the textile print design and use of color need to be taken into consideration.

Finally, the study answered research question three by discovering that women believed that they could achieve the perception of a more ideal body shape through the use of optical illusion garments. Overall, results demonstrated that all of the women who participated in the study agreed that optical illusion garments are a viable way to achieve the perception of a more ideal body shape. Optical illusion garments were found to be able to conceal flaws, accentuate difference areas of the body, balance proportions, and create the sense of a more hourglass shape. Thus, it was revealed in some cases, based on body shape and personal preferences, that optical illusion garments had the ability to increase a woman's body satisfaction. In general, this answers research question number four, which explored whether optical illusion garments could increase a woman's body satisfaction. However, since this study was exploratory, conclusions made here cannot be generalized and further research is needed.

Analysis of Exploratory Study Design

The exploratory nature of this study meant that there were several unknowns when the research began. This section explores the results of these unknowns, addresses whether the outcomes were expected or unexpected by the researcher, and how additional research could be more effectively designed to analyze the impact of optical illusion apparel. Additionally, this section addresses how some of the unexpected issues that occurred should be dealt with in future research. The optical illusion garments that were designed for this study were not without flaw. The researcher designed the illusion

garments with certain intentions, expectations, and assumptions. These expectations were not always met and often led to unexpected results.

In general, designed the optical illusion garments for this study with the assumption that the hourglass body shape was considered most ideal. This meant that the textile prints were placed on the body in a manner that was believed would help create the illusion of an hourglass shape. However, the unexpected finding that many of women felt that there was a shift in the ideal to a more fit or healthy body shape meant that those women who did not place great importance on being an hourglass shape viewed the optical illusion garments very differently than those women who still idealized the hourglass shape. Going forward, research should develop the illusions with no ideal shape in mind and then analyze the positive and negative responses of the participants to the designs.

Some of the optical illusion garment designs were more successful in communicating the researcher's intention than others. The MacKay's Rays, the Simultaneous Contrast, and the Spatial Effect illusion garments were particularly successful. With the MacKay's Rays illusion garment the researcher intended that the black placed at the waist and over the hips of the garment would help to create the illusion of an hourglass shape. This intention was confirmed by the participants and was noted to have the effect that the researcher assumed that it would. Additionally, the simultaneous contrast illusion was intended to create a sense of movement and was expected to have a physical effect on the vision of the participants. Again, both of these expectations were confirmed by the participants. Furthermore, the spatial effects garment was designed with the intention to create a false sense of an hourglass body shape. This

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was also affirmed by the participants through their observations of the intention of the garment and noticeable shape created. In the latter case however, the effect of the illusion was at least in part because of the color placement and not shape/pattern choice. Perhaps in future research, this garment could be paired with an opposing garment that has the light color on the interior/center of the body and the dark color placed at the sides of the body. Additionally, the background color used for display of the avatars may have impacted the way this illusion was viewed. Since the avatars were displayed against a white background the light color used at the sides of the garment may have been slightly camouflaged.

On the contrary, the Muller-Lyer and Helmholtz illusion garments were far less successful. Because of the design decisions made by the researcher, the Muller-Lyer illusion no longer represented the original illusion. The Muller-Lyer illusion garments for this study used the body as the center line instead of actually having a line in the design of the garment. This affected the overall illusion and resulted in the distance between the two arrows in each garment (i.e. the up and down arrow garments) being different lengths. This is problematic as that was a key attribute of the original illusion. This confusion in the intention of the design resulted in mixed opinions of the garments by the participants and also did not allow the researcher to be able to make connections back to the original Muller-Lyer illusion. The emphasis for the participants was now the impact of where the arrow (up or down) led the eye, therefore the analysis had to change. It became clear that in this illusion the use of color and contrast had a greater impact on perception than in some of the other optical illusions being investigated. This demonstrates the importance of a thorough examination of any design to be used in a

research study. Additionally, investigation of line placement and weight should fully be investigated before implementing a design.

The Helmholtz Illusion was also problematic for several reasons. First, the participants had many preconceived ideas about wearing stripes which affected the way in which they evaluated the effect of the Helmholtz illusion. Although these preconceived notions were expected, they created complications when analyzing the data. The participants were extremely conflicted between their pre-established beliefs about how stripes affect the perception of body shape and what they were seeing when viewing their avatar. Many of the participants defaulted to those preconceived ideas about stripes until they were faced with viewing the two illusions side-by-side. The unexpected issue that occurred as the participants viewed the avatars side-by-side was that the stripes on each garment were of a different scale. This change in scale occurred because the design was meant to reflect the original illusion which included the use of seven lines. Each of the optical illusion garments presented contained seven evenly sized and spaced lines, but as a result the scale of the lines changed (see figure 17).

Figure 27. Helmholtz Illusion Garments Scale of Stripes. This figure depicts the horizontal striped (left) and the vertical striped (right) garments, it is obvious that the scale of the stripes used in each garment are dramatically different.

This meant that the horizontal striped garment which had larger blocks of color was more susceptible to impact of other color theory principles such as spatial effects. This was evident as many of the participants noted that the placement and size of the black and white stripes in the horizontal garment drew their attention to or camouflaged certain areas of the body. The vertical stripe garment contained stripes of a smaller scale which seemed to be less affected by the use and placement of color, although a black stripe as the outline may have had an impact. Future research should evaluate this optical illusion further by creating garments that have the same scale stripes. Additional research should examine other types and variations of stripes in order to gain a better understanding of the affect that horizontal and vertical stripes have on the body. Also, since many women have preconceived ideas about wearing stripes their beliefs should be thoroughly investigated and research should evaluate the effect of these preconceived

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ideas on the evaluation of a striped garment. The difference in scale of the stripes led to one of the larger unexpected issues that occurred throughout the study, the perception of the use of color vs. the overall impact of the optical illusion.

Although it was obvious that the optical illusions used in this study were created from a combination of color theory principles, it was not the intention that these principles would be the dominant factor affecting the perception of the participants' body shapes. The intention was that these principles would come together in order to create overall designs that the participants would evaluate, however that was not always the case. Specifically, the perception of Muller-Lyer illusion and the Helmholtz Illusions (horizontal garment) were greatly impacted by the amount and placement of color. Therefore, sometimes the participant's reactions to these illusions were based on the color choice and placement and not the overall effect of the illusion. Additionally, in some cases, the use of color became more influential in how the participants perceived their body shape than the original illusion intent. For the Muller-Lyer illusion, the use of a large amount of white in the center of the body resulted in the participants' perception of a lack of a defined waist. It should be noted that if the color selection had been reversed a very different resulted would have occurred. Thus, if the colors were reversed, and the center of the body was depicted in black instead of white, the participants would possibly have had a different perception about waist shape and even overall effect of the illusion. Future research could examine this illusion by showing the participants both color options and observe the differences in perception. This again supports the critical importance that future research designs must be extensively analyzed prior to

implementation, taking into account the wide range of possible variables that participants will experience.

Additionally, some unexpected distractions occurred which also affected the way in which the participants evaluated the optical illusion garment and as a result their body shape. The first distraction was the overall appearance of the test garment. Since many of the participants were in their late twenties and early thirties many of them expressed that they would never wear a sheath dress as pictured. They preferred something more modern, strapless, and shorter. These statements about personal preference frequently distracted the participants from objectively evaluating their body shape and the optical illusion garment. An additional distraction was the participant's concern with other areas of the body, this prevented them from focusing on just their overall silhouette shape. For many of the participants, their concern with their height and facial features distracted them while viewing the optical illusion garments. In order to diminish some of these distractions questions that focus on personal preferences and other body satisfaction issues should be asked prior to the participant's viewing the avatar and should be included in the screening process. Additionally, when participants are asked to analyze their own body shape, they should be asked to analyze it from a more holistic view point. Their evaluations should factor in not just their bust, waist, and hips, but participants should be encouraged to include things like shoulder width, leg length and height.

Furthermore, although participants were given full control to move their avatar around all of the participants spun the avatar around once and then evaluated the garment from the front view. This meant that the participants were mostly evaluating a 2D image of themselves. In future research, participants should be encouraged to evaluate their

avatars from all angles and if 3D evaluation is to occur other 3D technologies such as 3D glasses would need to be implemented.

These unexpected outcomes are typical of an exploratory study and were aimed to aid researchers in the exploration of optical illusion garments in the future. This information helped to further establish this line of research and added to its contributions.

Contributions

As an exploratory study, the main contribution of the current study was twofold. First, the study helped to establish the examination of optical illusion garments as a feasible research topic for exploring women's self-perceptions of their own body shapes. Second, the current study helped to further establish a methodology that can be used in future research.

While the research that explores color theory (Zelanksi & Fisher, 2010; Itten 1961) is vast, no other research within the field of the textiles and apparel has explored optical illusion garment's effect on the perception of body shape. The current study, along with the pilot study, resulted in findings that contribute to the support of this area of research as a feasible topic for further exploration. It also lends support for the use of self-discrepancy theory to be used to help understand how optical illusion garments can aid a woman from moving from her actual self towards a more ideal self through the use of clothing.

Furthermore, the current research contributes to the field with the establishment of a methodological approach that can be used and expanded upon in the future research. The use of technology in the current study allowed for many traditional practices to happen in a digital environment. Additionally, it provides support for the use of avatars as

a representation of self for the purpose of trying on and evaluating clothing. This method of using technology to create digital garments and allow participants digitally to try on garments is relatively new to the field when it comes to design research. The current study opens the doors for future research to be conducted on the creation and implementation of the digital garments to be viewed on virtual bodies.

Implications

The implications for the current study are discussed in three parts: theory, research, and practice. Theoretical implications are discussed in terms of how the self-discrepancy theory was used and applied. Research implications focused on how the current study impacts scholarship and advances research methodologies. Additionally, practical implications focused on how the findings from this study can be applied by those working in the apparel industry. It is important to understand how the research conducted affects all of these areas, however as an exploratory study the results are preliminary and cannot be easily generalized.

Theory. The current study was guided by the self-discrepancy theory which was used to gain a better understanding of how women perceived their own body shapes and the effect that clothing, specifically optical illusions, can have on body satisfaction. While this study did not specifically test propositions predicted by the self-discrepancy theory, it did however lend guidance to exploring the impact that optical illusions had on women's self-perceptions. The current study was consistent in its use of the theory with other research (Kim & Damhorst, 2010; Jung, Lennon, & Rudd, 2001) in the field of Textiles and Apparel, and further expanded the use of the theory by examining a new topic, optical illusions. Additionally, new lines of research using the self-discrepancy

theory to elevate the use and interaction of people with avatars (Shim & Baytar, 2014) is emerging in the field of Textiles and Apparel. Although the current study is exploratory in nature, it does add to this new line of research by exploring the use of the self-discrepancy theory as a means to understanding the sense of connection between humans and a digital version of themselves.

Research. This study has several implications for scholarship. As previously mentioned, as an exploratory study, one of the main implications for academia is the advancement of research methodologies used to study a relatively new topic in the field of Textiles and Apparel. This study helped to establish a guide for the implementation of technologies to be used to examine digitally designed garments. The framework of this study can be used to explore other types of digital garments along with the effect that technology has on the design process.

Furthermore, the findings of this study showed that digital garment creation and the use of avatars was a viable method to gain an understanding of the interaction between clothing, the body, and the wearer/viewer. This implies that design researchers may be able to conduct digital garment design as a more sustainable method of practice. Resources allocated to traditional design practices are often substantial; therefore creation in a digital environment may alleviate some of the financial and environmental burden associated with traditional design practices.

Additionally, this study of optical illusion garments adds to the body of literature as very limited research has been conducted on the application of optical illusions to dress. The current study not only helped to establish this as a feasible research topic it

also suggests that clothing can significantly impact how a consumer perceive their body shape.

Practice. The implications for the apparel industry were twofold. First, the results of this study provided meaningful support for target market mass customization. Second, as apparel companies continue to expand into more virtual shopping environments, this study provided viable information on how digital garment display and the use of avatars is perceived by consumers.

The current study provided support for target market mass customization as suggested by Ashdown and Loker (2010). This study demonstrated that there are trends in apparel preferences according to body shape. Therefore, if apparel companies further investigate their target market and identify the most prevalent body shapes of their consumers, apparel retailers will be able to provide a product that better meets the needs of their consumers. Apparel companies could use information provided by this study on apparel preferences, based on body shape, to design clothing for their target consumer. This could aid the consumer in acheiveing the perception of a more ideal body shape through the clothing a company designs. Furthermore, this could result in overall improved shopping experince for the consumer if they find that the clothing being offered is flattering and enhances their body shape satisfaction. Additionally, this study could assist companies in evaluating the variables needed to effectively test consumer preferences.

Currently, the apparel industry is expanding their online shopping websites into digital shopping enviroments. This study's use of avatars to understand women's self-perceptions provided valuable knowledge about how women respond and relate to

avatars that are created as representative of themselves. Many apparel retailers allow shoppers to input body measurements so that their avatar is a physical representation. The current study showed that women do view the avatar as being a good representative of the self, provided that the body measurements were collected by body scanners which creates a more complete and accurate physical representation. Therefore, allowing the consumer to simply input their measurements may not be enough to allow the consumer to feel as if they are actually viewing their own body shape. Apparel companies whose goal is to reach an online or digital audience may want to consider adding an online feature or cell phone app that allows consumers to upload their own avatar that was designed by a body scanner. Additionally, apparel companies may want to consider placing a body scanner within their store so that consumers can create a digital avatar to be used when shopping online.

Limitations and Future Research

Limitations of the current study are discussed in two parts. The first part examines the limitations that occurred as part of the study's design and the second part explores the limitations that occurred as part of the implementation of the study. Additionally, future research opportunities are addressed.

The limitations that occurred as part of the study's design consisted of issues surrounding the sampling method, procedure, and choice of research design. First, the sampling method that was used, advertisement through flyers and snowball sampling, meant that a limited number of women were exposed to the ad. Additionally, since the flyers were placed on campus, several of the respondents were graduate students which resulted in a limited range of ages for those who participated in the study. Future research

should explore a larger sample size that examines a more diverse population. Second, because the methodology of the study was exploratory there were some limitations both in the procedure and the choice of research design.

One limitation was that participants were asked to identify their own body shape from a list of body shapes as part of the questionnaire in stage one of the study. This could be viewed as problematic, by presenting the body shape options in a textual list, the researcher assumed that participants had knowledge of how these shapes were visually represented. Future research should provide participants with images and names of the body shapes so that participants are better informed of their selections. Researchers could also ask participants to verbally describe how they would define each of the body shapes on the list so that they can gain a better understanding of how the participants defined each shape.

An additional limitation was the way that the participants' body shapes were classified. Although mathematical equations were used to identify the participant's body shape category, too much closeness between some of the shapes occurred. Additionally, since this study examined hourglass, which contained two sub-categories, as one category there were many similarities between the bottom hourglass participants and the spoon shaped participants. Future research should explore other measures for classifying body shape or should obtain a copy of the FFIT software.

Additionally, although the researcher required that participants had a normal BMI in hopes to reduce overall body dissatisfaction future research should take into account other body issues that participants might be faced with such as height, weight, and body build. Several participants in this study had issues with their height and it did affect how

they viewed the optical illusion garments. Future research should fully investigate body issues of the participants in order to gain a more holistic perspective of the participants' perceptions. Furthermore, future research should also examine those women outside the normal BMI range to gain a more holistic view point of the affect that optical illusions can have on body shape perception.

Another limitation of this study was that the optical illusion garments were designed by the researcher and were not pretested in the original focus group. Although the researcher did show the designs to several fellow researchers for feedback, a focus group would be helpful in identifying whether the researcher's design intention was clear, and/or what other variables have an impact on viewers. Future research that uses designs developed by the researcher should be pretested extensively so that the researcher has greater knowledge about the perception of their designs. This could insure that the designer/researcher's intentions are clearly communicated through their design or that all the variables are taken into consideration.

Additionally, the textile prints that were used in this study were rather simple, were limited in number, and limited in the use of color. While for an exploratory study these designs met the objective of the study, the designs of the garments in future research should be more complex and create a greater interaction between the body and the garment. Also, only one garment in this study was created using color instead of black and white, thus future research should aim to examine optical illusions created using additional color combinations.

Other limitations that occurred as part of the study's implementation consisted of issues specifically related to the implementation of the technology used. The avatars that

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were used in this study were depicted as colorless, meaning that they appeared as a light

gray color. Currently, it takes two different software programs, one to create the avatars

(TC2 Image Twin) and another to digitally drape or dress the avatar (Optitex).

Unfortunately, the software programs did not communicate with each other thus the

avatars could not be pictured in skin tones that matched the participants. This is identified

as a limitation as it could have impacted the way the participants were able to connect

with their avatars. It could be argued that an avatar depicted in full color would have been

easier for the participant to relate too. However, the current study did attempt to

maximize the use of the software and was able to produce an avatar that had the facial

features of each participant.

Another limitation of the study was the use of Optitex PDS to digitally fit the

garments. Several times the researcher made dramatic changes to the pattern and when

the garment was digitally draped very limited or no change occurred. This made the

digital fit process very difficult and not always accurate. Future research should

investigate the accuracy and ease of digitally fitting garments and should pretest the fit of

the garments by having an additional interview in which the participants critiqued the fit

of the garment. This would allow the researcher time to make adjustments based on the

perceived fit and fit preferences of each participant. This could potentially eliminate fit

and personal preferences as a distraction to viewing the optical illusion garments.

Furthermore, an additional limitation of the study was the same print placement

on each of the participant's bodies. For consistency, the researcher placed the textile

prints, for each optical illusion, at the same position on the body. Future research should

consider adjusting the print placement so that it properly sits on the body taking into

account different body sizes and shapes. Each participant, even though some shared body shape categories, had very different bodies so some of the prints that were meant to hit at the smallest part of the waist, hit above or below that depending on the body of the individual participant. Future research should explore making custom designs that specifically take into account not only body shape, but also size and posture of the participant.

Some additional areas of future research have also been identified. First, this research should be extended to other populations and examine specific cultural or ethnic groups which may have shared ideals. Additionally, the application of optical illusions to men's apparel has yet to be explored and could result in some valuable findings and implications. Future researcher might also explore how others perceive a woman's body shapes while wearing optical illusion garments.

Future research could also explore additional illusions, color theory principles, or more extensively exam those illusions used in the current study. This might include perception of spatial effects used on current runway designs to explore whether the designer's perceived intentions are being effectively communicated. Additionally, future research should explore the design process of creating optical illusion garments as research through practice and also examine how the use of multiple technologies affect the design process.

Furthermore, examining the perception of overall body size while wearing optical illusion garments would provide insight into how optical illusion garment affect the visual perception of the body. While this study investigated the topic using digital stimuli, future research could involve the actual construction of optical illusion garments

and explore how women's perceptions changed when physically wearing the garments. With the physical construction of the garments, the research can be expanded to investigate the relationship between actual garment fit and optical illusion designs. Garments that fit more closely to the body may have a greater impact on the effect of visual perception.

In conclusion, the exploratory nature of this study opens up numerous avenues of additional research. This study was guided by the self-discrepancy theory to examine women's self-perception of body shape while wearing optical illusion garments. Results from this study showed that optical illusion garments do affect the visual perception of body shape and can result in the perception of a more ideal body shape.

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APPENDIX A: RECRUITMENT FLYER

3D Body Scanning Research Study on Woman's Self-Perceptions & Optical Illusion Garments

Want to you know your actual body shape?

Interested in understanding how to dress for your body shape?

Purpose of the Research Study :
To examine the effect of optical illusion garments
on a woman's perception of body shape
using 3D body scanning technology

Eligibility Criteria:
Female
Age 18-65
Available Feb 2014-May 2014

Study Procedure and Requirement:
Stage 1:
Questionnaire and Pre-Body Scan Interview (20 mins)
3D Body Scanning Process (10 mins)
Stage 2 (2 weeks after stage 1):
Post Body Scan Interview
and Viewing of Your Avatar (approximately 45 mins)

Participants will earn a $10 Target gift card
for each stage of the project completed.
Complete Stage 2 and receive a copy of your 3D body scan
with your body measurements and body shape information!

To learn more and reserve your spot please contact the researchers!
Jessica Ridgway, M.S., jlrrzf@mail.missouri.edu, (8473382159)
Dr. MyungHee Sohn, sohn@mail.missouri.edu (5738827317)

APPENDIX B: CONSENT FORM

Women's self-perceptions: A case study of optical illusion garments

You are invited to be a part of the research conducted at the Apparel Technology Lab. You were selected as a possible participant because you are interested in participating in the body scanning process. We ask that you read this form and ask any questions you may have before agreeing to be a part of this continuing research.

This study is being conducted by:
Jessica Ridgway, M.S., Principal Investigator
Researcher from the Department of Textile & Apparel Management, University of Missouri-Columbia

Background Information
The purpose of this study is to explore women's self-perceptions and will involve collecting body measurements resulting in data that will be used to determine body shape. The researcher's intention is to create a digital avatar from the body measurements collected and will digital construct clothing for the avatar. Optical Illusions will be used in the print development of the garment.

Procedures
All consenting participants will be asked to complete Phase 1. Participants will then be selected to participate in Phase 2 if they meet the criteria specified by the researcher.

If you agree to be in this study, we would ask you to do the following things:
    Phase 1:
        a. Fill out a brief questionnaire and participate in a short interview lasting about 15 minutes prior to being body scanned.
        b. Participate in being body scanned in which measurements of your body will be collected. You will be scanned wearing your own undergarments in 3D body scanner. This procedure will take approximately 15 – 20 minutes.
    Phase 2:
        c. If you are selected to continue onto the second phase of the study, you will be asked to participate in an additional interview, which could last up to an hour, in which you will view your own avatar wearing clothing.
        *All interviews will be audio recorded.

Compensation
Participants will receive a $10 Target gift card for each stage of the project. There are 2 stages so participants could earn up to $20. Participants who complete phase 2 of the study will be presented a copy of their 3D body scan which includes collected body measurements, BMI score, and body shape category. Participants will receive a hard copy of this information.

Risks and Benefits of being in the Database

Inclusion in this study does have some risk: First, should there be any loss of confidentiality of the project information; the personal data collected would identify you as a participant. Secondly, the body scans stored could conceivably be recognized as your image, should there be a loss of confidentiality of the project information.

The benefits to society that this study will provide include the follow: a better understanding of body shape and classification, greater knowledge on how consumers perceive design details, and examples of how optical illusions affect the perception of the body.

Confidentiality

The records of this study will be kept private. In any sort of report we might publish, we will not include any information that will make it possible to identify a subject. Research records including your body scan data and your personal information will be stored securely and only researchers will have access to the records. The body scan data will be saved as a cloud point format (.rbd); thus, your face will not be recognizable.

Voluntary Nature of the Study

Participation in this study is voluntary. Your decision whether to participate will not affect your current or future relations with the University of Missouri. If you decide to participate, you are free to not answer any question or withdraw at any time without affecting those relationships.

Contacts and Questions

The researcher conducting this study is Jessica Ridgway. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact me or my advisor:

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If you have any questions regarding your rights as a human subject participant and would like to talk to someone other than the researcher(s), **you are encouraged** to contact the Campus Institutional Review Board, 483 McReynolds Hall, University of Missouri, Columbia, MO 65211; (573) 882-9585.

Statement of Consent:

I have read the above information. I have asked questions and have received answers. I consent to participate in the study.

Signature: _____

Date: _____

Signature of Investigator: _____

Date: _____

APPENDIX C: QUESTIONAIRE

Please answer the following questions:

1. What is your age? _____

2. Identify the racial/ethnic group which you most closely identify

   A. White

   B. Hispanic

   C. Black

   D. Native American

   E. Asian

   F. Other: _____

3. What is your body shape?

   a. Hourglass

   b. Rectangle

   c. Spoon

   d. Triangle

   e. Inverted Triangle

   f. Oval

   g. Diamond

4. Have you ever been body scanned before? _____

APPENDIX D: STAGE ONE INTERVIEW PROTOCOL

Questions of be asked to each Participant prior to being body scanned.

1. Can you please describe to me your ideal body shape?
2. Can you also describe to me how you think society currently defines ideal body shape?
3. Tell me a little bit about your clothing selection process? Is body shape something you consider when getting dressed?

APPENDIX E: STAGE TWO INTERVIEW PROTOCOL

These questions will be asked prior to the participant viewing their avatar.

1. Please describe your ideal body shape

   a. If classified, what shape would it be identified as?

2. How do you think society currently defines ideal body shape?

3. What role do you feel clothing plays in the way in which your body is perceived?

4. When you get dressed what are some of the things you consider in the process of selecting a garment?

   a. Do you usually dress in clothing that makes you feel good about yourself? Or are you more concerned with the way others might perceive you?

Participants will now view their avatar for the first time…

1. What are your initial reactions to your avatar?

   a. Do you feel it is a good representation of yourself? Please explain.

2. Please describe what you see on the screen? Be specific with regard to describing your body and the clothing you are pictured wearing.

3. How closely does this image represent your idea of the ideal body?

Questions to be asked when participants are viewing optical illusion garments.

1. Please describe what you see on the screen? Try to be specific describing your body shape and the garment you see on screen.

2. How do you feel this garment makes your body shape look?

   a. Talk about proportions that you see, height/width

   b. Does it change the way you feel about any parts of your body? Please describe.

      c.   How does this garment effect your overall shape?

3. How closely does this image represent your idea of your ideal body shape?

4. How do you feel about the design of this garment?

5. Overall, how content are you with the way your body looks in this garment?

Follow up questions.

What are your general impression about wearing optical illusions?

Do you think optical illusion garments can help you achieve a more ideal shape?

Please explain.

How do you think your personal style effects how you feel about these garments?

VITA

Jessica Ridgway was born in Barrington, Illinois and grew up in Lake Zurich, Illinois. She started her undergraduate work at the University of Missouri in the fall of 2005. She received a Bachelor of Science in Textile and Apparel Management with emphasis in Apparel Product Development. She also earned a minor in Business. Jessica continued her education at the University of Missouri and received her Master of Science degree also in Textile and Apparel Management with a focus on branding and color theory. During the work on her master's degree, Jessica also earned a minor in Information Sciences and Learning Technology. Additionally, Jessica also received her Ph.D. in Human Environmental Sciences from the University of Missouri. Her Ph.D. research focused on Apparel Design and the incorporation of the technology into the design process. She specialized in the creation and study of optical illusion garments which will continue to be the focus of her research as she continues her career in academia.