

DRESS STYLE RECOMMENDATIONS BASED ON FEMALE BODY SHAPES

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ABSTRACT

Fashion is an important part of life. According to Kant (1892), fashion and style are the fundamental expressions of aesthetic tastes in the societal format. Clothing styles and apparel fit are the two key factors when consumers make purchase decisions. People have different body shapes and fit preferences; likewise, people have different aesthetic tastes in clothing design and styles. Many designer clothes are based on standard size systems, i.e., measurements, grading, pattern making, or common hourglass dress form. However, body shape is a complex physical attribute that can be gauged to help consumers achieve better aesthetic fitting styles for their needs. Therefore, this study aimed to develop a body shape-based style recommendation system, which could provide desirable apparel silhouettes and styles to consumers based on the relationships between dress attributes and body shape attributes. The recommended dress styles were collected from online channels and interviews with professional stylists. The Female Figure Identification Technique (FFIT) was adopted for the body shape categorization and validated with body measurement from SizeUSA. A style-by-body shape recommendation system was implemented on an interactive website with 3D dress rendered dresses and body shapes. The proposed recommendation system was examined by 171 fashion consumers to validate whether the recommendation would satisfy their needs for personal styles as well as body shapes and have an impact on their purchase intentions. A dress style recommendation system was developed based on surveys from the printed and online media, and stylists' interviews. Although no significant differences were found between the experimental (i.e., recommended styles) and control (i.e., all styles) conditions, the findings indicated that people with different body shapes had distinctive dress style preferences on waistlines and silhouettes.

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CHAPTER 1

INTRODUCTION

“What should I wear today?”. This is a daily question for many people. Clothing is an important aspect of life. People constantly seek a look that can make them feel confident and comfortable. How people define good fashion varies depending on the occasion, personality, preference, culture, and so forth. However, one component remains the same: body shape. Some people are curvy, some are lean, and some draw toward being skinny. Previously, young women considered the hourglass figure the ideal shape fit (Alexander et al., 2005) and preferred to have a 0.7 waist-to-hip ratio (Connolly et al., 2004). A recent study found that body shape acceptance and self-images have more diverse perceptions than before with the influence of social media (Aniulis et al., 2021). Mainstream and social media have a major influence on consumers’ self-images by presenting celebrity styles, and influencer looks. As a result, consumers think they do not fit in certain sizes, or worse, their bodies are not perfect (Levine & Murnen, 2009). Consumers tend to self-blame for ill-fitted clothing, which leads to feeling ashamed of their body measurements (Norman, 1988). As a result, it can be inferred that clothing fit is directly associated with body cathexis, i.e., the feeling towards one’s body (LaBat & DeLong, 1990).

Since 2010, there have been many established size recommendation websites, such as True Fit and Stitch Fix, offering their services to customers to find brands with the right sizes by collecting garment sizes and pre-screening consumers’ sizes. However, body shape is another important factor that can warrant the right fit physically and psychologically. For example, an earlier study showed that 64% of the respondents reported fit issues with ready-to-wear products; all body shapes except the inverted triangle body shape had fit problems during apparel shopping (Alexander et al., 2005). With the growth of e-commerce, consumers have been making purchase

decisions solely based on the sizes rather than trying on. According to Narvar report (2019), 34% Amazon and 46% of other online retailers' fashion product purchases were returned due to size and fit, which is the number one cause of returns. With the impact of the COVID-19 pandemic, the need for virtual fitting is even more pressing. Therefore, many new start-ups, such as Savitude (Savitude, n.d.), have been emerging to offer the use of artificial intelligence (AI) to create patterns based on nine different body shapes to provide better fitting garments for the individual body shapes of the consumers.

For each body shape, certain silhouettes are more desirable than others to provide both visual balance and comfort. Outfit silhouettes were found to be the determining variable when making purchase decisions (Zhou & Xu, 2019). For this reason, garment sizes and silhouettes should be considered as a part of style recommendation systems. Several studies in computer engineering have explored body shape-based styling frameworks by analyzing celebrities' styling data and body shape categories, identifying the correlation between body shapes and dress preferences, and constructing a data pattern of matching clothing styles to body measurements (Hidayati et al., 2018, Hidayati et al., 2021). Some of the research focuses on style recommendation-based clothing attribute data by using celebrity photos (Hsiao & Grauman, 2020), aesthetic features (Yu et al., 2018), and real-time intelligent vision technology (Chao et al., 2009). However, few research studies have focused on recommending silhouettes based on body shapes (Hsiao & Grauman, 2020).

Research purpose

This research aimed to develop a body shape-based style recommendation system, which can provide consumers with garments to achieve their desirable overall silhouette based on the relationships between dress attributes and body shape attributes. The goals of this research were

to (a) develop, and (b) evaluate a female body shape-based style recommendation system, particularly by matching apparel attributes to body shape data. The research questions (RQs) were as follows:

Research questions

RQ1: What types of garment silhouettes are suggested, for each female body type by designers, styling books, online resources, and stylists?

RQ2: What types of dress attributes are preferred by the female consumers based on (a) individual body shapes, (b) fit preferences, and (c) body cathexis?

RQ3: How likely the body shape-based style recommendation system will be accepted and adopted by the consumers?

CHAPTER 2

LITERATURE REVIEW

2.1 Overview

Fast fashion occupied the mass market with cheaper and trendier clothes in the past ten years. Due to the increasing trend cycles, clothing longevity shortened from a few years to a few months. Especially with social media and the “fab” trend, consumers tend to purchase garments based on their impression and likability. Most consumers only wear 20-30% of their closets, and are tempted to buy clothes because of discounts, influencer trends, color/season, occasion, etc. (Cachon & Swinney, 2011, Gabrielli et al., 2013, Joung, 2014). With the advantages of the internet and smartphones, e-commerce made shopping more accessible. Although the purchasing power is positive, sizing determination has become a challenge as buyers can only predict the fit based on photos and brief descriptions. According to a recent e-commerce return survey, about 26% of clothing purchases were returned from online purchases (Statista, 2022). The size and fit errors caused more than 70% of returns or styles in 2021 (State of Returns: Finding What Fits, 2021). In addition, the unlimited business hour online and social media influence encouraged impulse shopping behavior (Aragoncillo & Orus, 2018). As a result, the apparel industry accounts for the number one polluter in the world (Sweeny, 2015).

Focusing on data analysis and predictable recommendations in the shopping process is one of the solutions to reduce returns. With the increase in online shopping, several companies have started offering services to recommend sizes and garments for their customers. StitchFix, as an example, created a style recommender algorithm based on stylist suggestions and the shopper’s preferences, which can not only filter the clothing styles for personalization but also suggest the right size by understanding the multidimensional fit (Stitch Fix Algorithms Tour,

2021). Recently, Amazon opened their Omni store, i.e., Amazon Style, with personal style and fit machine learning algorithms to provide digital-driven personalized shopping experiences (Dastin, 2022). Building the right recommendation system benefits businesses and shoppers in today's data-driven world. To better predict the style and size may help to reduce returns, and satisfaction of shopping, minimize the wrong production, and maximize revenue returns

2.2 Definition of body shapes

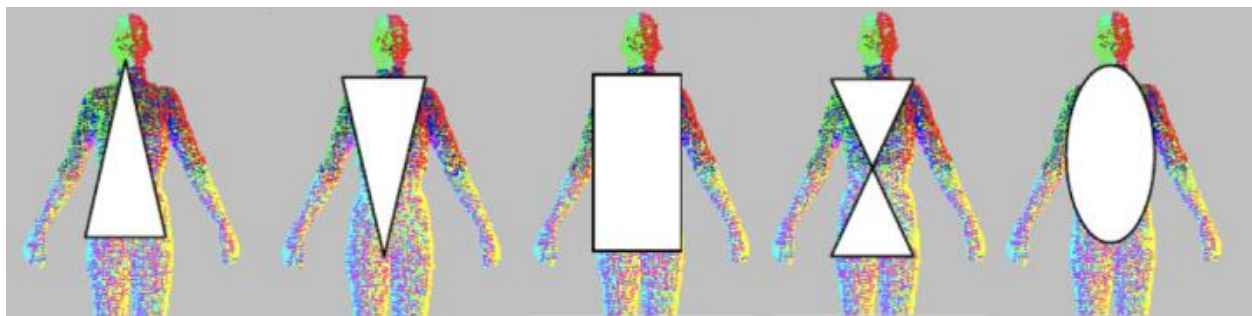
2.2.1. Body shapes as a physiological factor in the style selection

The body shape concept was firstly introduced in the 1940s by a psychologist, William Herbert Sheldon, to study male personalities in relationship with body shapes by using anthropometric indices based on three somatotypes: the ectomorph, the endomorph, and the mesomorph. (Sheldon et al., 1940). Then many other body shape coding systems were created and have started focusing more on women's body shapes rather than men's. The Body I.D. Scale collected the front and side width and length, then categorized the body proportion into five alphabet shapes (A, H, X, V, and T) (August, 1981). In the obesity and health area, researchers developed the Figure Rating Scales (FRS) with nine schematic female outlines to define thin and obese (Stunkard, 1983). The Female Figure Identification Technique (FFIT) is a body figure sorting system based on the front and side 3D body scan (Simmons et al., 2004). The FFIT introduced five body figures (Figure 1), triangle, inverted triangle, rectangle, oval, and hourglass (Simmons et al., 2004). The Body Shape Assessment Scale evaluated female body shapes with body scans and categorized four main shapes (slender, average, full, and heavy) based on the measurement of body build, body shape, posture, torso shape, hip shape, shoulder slope, bust shape, buttocks shape, and back curvature (Connell et al., 2006). The BSAS was constructed based on the previous studies and programmed into software, the Body Measurement Software (BMS©)

(Connell et al., 2006). A newer study developed the Body Shape Scale (BOSHAS) for the African population to explore body shape perception and satisfaction (Cohen et al., 2020). Although the body shapes may be classified based on the standard measurement, another study found the body shapes with different postures and found that the classified body shape may vary from standing to sitting posture (Surville & Herichi, 2010).

Figure 1.

Common female body shapes (Simmons, K., Istook, C., & Devarajan, P., 2004)



Among all the body shapes, the hourglass shape was considered the most idealized and preferred figure by women (Makhanya & Mabuza, 2020). Historically, psychologically, sexually, and culturally, there are many reasons to explain this preference. In the early years, artists refer to the Birth of Venus figure as the ideal goddess of beauty. Some explained that female hourglass beauty visually symbolized reproductivity and fertility (Singh, 2006). Extensively, one research suggested that Venus' body shape may not represent the majority of females, yet her figure symbolized the positivity of survival and continuity (Dixson & Dixson, 2011). Throughout history and regions, the definition of female beauty varies. An earlier study found that women with body mass indexes (BMIs) between 18.5-24.9 and the waist hip ratio (WHR) under 1.0 showed a positive relationship with health and longevity (Price et al., 2006).

Cross-culturally, the WHR of around 0.7 indicated the balance of hormones and was a reliable hint of fertility ability (Butovskaya et al., 2017).

A female attractiveness study also found that both Playboy and Miss America winners are within the 0.68 – 0.72 WHR range (Singh, 2006). The same study by Singh explored the preferences of female body figures among the African, Hispanic, Caucasian, and Asian groups, and the findings suggested that although the preferred WHR may vary, most of the preferences toward the hourglass figures remained the same due to the sexual attractiveness (Singh, 2006). It was suggested that body shapes with normal fat distribution and 0.7-0.8 WHR were the most desirable (Singh, 1994). However, another study compared the public perception of different BMIs and WHRs and argued that BMI was a significant factor in female body attractiveness (Swami & Tovee, 2005).

The clothing fit among female consumers is closely related to the preference for body shapes. Good clothing fit is complex as it is expected to enhance physical features, increase body confidence, and cover body flaws (Grogan et al., 2013). Grogan et al. (2013) found that the perception of the female ideal body shape was the slim hourglass, which indicated that the preferred clothing fit by females should define the waistline, balance physical silhouette, emphasize the slender shape, and present proper fit. Moreover, an individual's posture, occupation, proportion, and aesthetics should also be considered during the design and fitting sessions to achieve the ideal look (Kwong, 2004). Many studies have explored and validated the clothing fit problems in ready-to-wear. It was found that senior female consumers were dissatisfied with the current commercial patterns, and the fit problems were mostly in the bust, waist, and hip (Alexander et al., 2005; Goldsberry et al., 1996), which are the essential attributes to achieve the balanced slim hourglass look.

2.2.2. Body shapes as a psychological factor in the style selection

Social context is one factor that impacts the ideal body shape and the preferences of clothing fit, especially among young consumers. The factors that cause the decision to make a fashion purchase are complicated. With the development of social media and the influencer effect, creative outfits and positive feedback from peers can influence the preference of clothing fit (Shin, 2013). According to a recent Statista (2020) report, about two-thirds of adults in the U.S. use social media daily. Some studies found that social media content from admired influencers could positively motivate audiences' purchase intention (Martín-Consuegra et al., 2018; Nash, 2019). It was also noted that social media channels periodically lead the trend of ideal body shapes (Rashid, 2019). With the growing fitness social media influencers, more women are leaning towards the hourglass athletic buttock look rather than the health-based 0.7 WHR (Rosique & Rosique, 2019). As a result, the consumers' definition of clothing fit may also vary over time.

Many women have desired to achieve a slim hourglass shape through garments that can help define the waistline, balance physical silhouette, emphasize the slender shape, and present proper fit (Grogan et al., 2013). Although the preferred body shape seems consistent, the preferred silhouette is a trend that changes throughout time, culture, generations, and country (Alabama Chanin, 2017). For example, the trend for white-collar women in the 1970s and '80s was power dressing to make the shoulders look broader to create an inverted triangle silhouette (Avignon, 2018). However, in the early 20th century, under the influence of pop music and celebrity supermodels, trending preferred styles were more casual with semi-loose-fitting tops, high waist denim, and a feminine grunge appearance (Cerini, 2020). The previous study, which explored the relationship between the clothing aesthetic attribute preferences and body sizes,

indicated body shapes' effects on clothing style selections; however, body sizes showed significant fit perception (Chattaraman & Rudd, 2006). Large sizes in all body shapes are preferred to have greater body coverage and loose fitting cloth (Chattaraman & Rudd, 2006). In addition, body shapes and psychological fit preferences were highly correlated (Manuel et al., 2010). Due to the physical differences among each body shape, outfits may drape differently on the figures and create different feelings and perceptions for the wearer. Social feedback, comfort, and peer appropriation can also significantly impact an individual's fit perception (Shin, 2017).

2.3 Silhouette of clothing

From the design perspective, deciding on the silhouette is the initial process of achieving a certain apparel look. Silhouette refers to the outline of the cloth and the wearer, the final look of the completed style. The preferred silhouette is a trend that changes throughout time, culture, and countries (The History of Silhouettes, 2016). In ancient Greece (750-30 BC), chiton was the iconic style, a piece of fabric draped off the shoulder to form a tunic silhouette (Cleland, 2012). Around the same era, during ancient China in Qin and Han dynasties, the clothing style was layered and draped with waist wraps and embroideries to form an empire silhouette, which was emphasized under the bust (Hu, 2014). In Europe, during the Middle Ages, clothing silhouette was predominately influenced by religion and the aristocracy to symbolize faith in God and social status, which were presented as long loose gowns with decorative garments (Scott, 2018). Until the Renaissance, more fitted and waist-emphasized outfit styles were introduced, and different silhouettes indicated different social classes (Liechty et al., 2016, Naranjo, 2020). Before the 1840s industry revolution, the creation of apparel silhouettes was limited to the techniques and social conditions, in which patterns and designs were not mass produced. With the increasing production capability, consumers started to purchase for trend and style rather than

a necessity for warmth and cover (Perkins, 2013). The trend of creating the curve by emphasizing the waist and hip ratio continued until the Art Deco era. Designers like Coco Chanel, Paul Poiret, and Jean Patou influenced the avant-garde movement to simplify the layered curve silhouette and neutral gender silhouette (Reddy, 2020). The silhouette trend moved from corset-shaped hourglass to natural female body shapes after World War II. With the global power shifting, more subcultures and non-mainstream trends, such as Punk and Gothic styles, appeared under the inspiration from music, art, literature, film, and globalization. In more recent days, various avant-garde silhouettes have been generated by fashion designers, such as versatile designer Issey Miyake, subverted designer Rei Kawakubo, and innovative technology designer Iris Van Herpen.

There is yet an industry-standardized apparel silhouette classification; however, the six types of dress silhouettes, which include A-line, ball gown, empire waist, sheath, shift, and mermaid, are broadly used in the designing and styling process (France, 2020). A recent study proposed a numerical silhouette classification method based on image reading by measuring 11 points of the model dressed outline (Tsuru et al., 2019), and any studies focused on clothing classification and style attributes (Bossard et al., 2013). Figure 2 shows an earlier example of style recommendation based on different body shapes (Duffy, 1987). The styles and silhouettes had not varied from the current retail selection.

Figure 2.

Dress design details (Duffy, M. (1987). Dresses [Illustrations]. In HOAX Fashion Formula (pp. 74 & 77).



Silhouette is a fundamental factor in apparel styling. It was suggested by Liechty et al. (2016, p. 91) that in fashion and style, the silhouette is the “dominant” and the body is the “subordinate.” The silhouette is the creative manipulation to outline the visually pleasing balance of body figures (Sorger & Udale, 2017). In the book *Fashion Formula*, Duff (1987) suggested various styling techniques based on the H-O-A-X shape system. The *Body Shape Bible* described 12 body shapes identified based on the proportion of length and width measurements (including neck, shoulder, chest, waist, hip, thigh, and calve) and suggested appealing outfits and styling recommendations for each shape (Constantine & Woodall, 2007). Fashion designer Pucchi also suggested style enhancement to the five main body shapes: flatter curves for hourglass, inverted triangle, widened shoulders for the triangle, create curves for the broadened hip for rectangle, and illustrated waistline for apple (Pucchi, 2016). Several other studies also

suggested a silhouette styling system based on body shapes, such as the user profile-based apparel recommendation (Guan et al., 2016) and the celebrity styling data-driven style recommendation (Hidayati et al., 2018). Most of the styling suggestions are based on creating the ideal shape, i.e., hourglass. Due to the indistinct definition of the fashion silhouette in academic research, only a few studies have explored the relationship between body shapes and apparel silhouettes.

2.4 Clothing fit

2.4.1. Overview of clothing fit

Fit is one of the most fundamental factors in making clothing purchase decisions (Eckman et al., 1990). It has been validated in several studies that well-fitted clothes positively impact self-confidence, conceal body imperfections, and enhance body shape (Grogan et al., 2013).

However, fit satisfaction is subjective for each wearer, so there is no industry standard for it. In a recent study, five qualitative themes, including physical fit, aesthetic fit, functional fit, social context, and social comfort, were suggested to determine fit satisfaction (Shin & Damhorst, 2018). Past research suggested that physical and psychological attributes should be examined to define fit satisfaction (Ashdown & O'Connell, 2006). Erwin (1974) suggested five clues of a good fit for physical fit: grain, set, line, balance, and ease. For psychological aspects of clothing fit and comfort, Sontag (1985) and Pontrelli (1977) suggested measuring three main personal attributes: environmental effects, an individual's state of being, and past experiential memories.

Finding the right garment sizes have been falsely associated with ensuring that the garments that would fit individual bodies. In the early seventeen century, apparel size tables were introduced by clothing manufacturers to produce military uniforms and have not changed too much since then (Elliott, 2013). Early sizing systems were created to have scalable patterns for

reproduction uses; then, the scaled sizes were developed into a numerical or letter-based symbol with extending grading points (Ashdown, 2007), which simplified the purchase decision of consumers. The current mass production process has adopted the same sizing creation since 1951 (Ashdown, 2007). Although emerging technologies, such as 3D printing and laser cutting, might lead the next round of production revolution, the complexity of the sizing system has not yet changed much. The U.S. population structure and lifestyle have recast; as a result, current women's measurements could not be represented by the standard size tables. This situation calls for attention to other variables, such as body shapes, associated with body measurements' proportions.

Multiple organizations and institutions attempted to conduct national size surveys to guide the human-centered design and establish better-fitted clothes. One of the most adopted clothing sizing system guidelines by the International Organization for Standardization, ISO/TC 133, was created in 1969 and updated every five years (ISO, 2022). Alvanon, as an example, is a company that provides consulting services about body size and shapes to fashion brands and manufacturers (Alvanon, 2022). These types of services enabled accessibility of reference for brands and designers. However, constructing and updating the sizing survey is time-consuming and costly; the fast-changing population and lifestyle change put the guideline outdated. Limited access and resource added challenges to maintaining a suitable sizing system.

The perception of clothing size and fit are the rudimentary factors in building brand trust. Since the 1950s, the industry standard of the same size has been shifting to support business goals, which also changed the consumer's perception of size. In 1958, a size 8 referred to the bust size 31", waist size 23.5", and the hip size 32.5"; however, in 2012, a size 8 indicated the bust size 36.5", waist size 28", and the hip size 39.5" (Dockterman, 2016). In addition, each

brand maintains independent size standards; for example, Zara uses 27.6” as waist size for size 8, and Calvin Klein uses 29.5” as size 8 (Dockterman, 2016). Societal impression worsened such a movement; there is an industry trend of lowering size numbers, i.e., vanity sizing. Therefore, consumers may psychologically feel better about themselves by associating a smaller number with their bodies (Longhurst, 2011). As a result, consumers can hardly find consistent sizes in fashion retail. According to a Trunk Club survey, 57% of consumers could not find clothes that fit their body types, and 46% of consumers expressed that their outfit selections are affected by the size and fit issues (Market Researchers OnePoll, 2017). Under the condition of the COVID-19 pandemic and the work-from-home trend, Deloitte Digital Research suggested that developing a variety of sizing and individual fit may advance the fashion industry and consumers’ purchase intention in the next ten years (Biondl et al., 2020).

2.4.2. Fit preferences

Clothes are the worn environment (Watkins, 1995) that provide physiological, psychological, and physical support to the human body when it physically contacts the exterior environment (Choudhury et al., 2011). Proper fit of clothing can not only provide the wearer with comfort but also confidence. Several studies suggested that misfit was caused by the pattern block design misaligned with the wearer’s body shape and proportion (Belleau & Hebert, 1997, Mengna & Kuzmichev, 2013, Surikova et al., 2017). Individual fit preferences are influenced by body cathexis, body shapes, fabric, emotion, personality, culture, and more (Alexander et al., 2005, Manuel et al., 2010, Moody et al., 2010, Safdar et al., 2020). Mass-produced dresses were traced and modified to fit mature female figures, which were evaluated as lacking fit satisfaction for certain body types (Belleau & Hebert, 1997). Globally, the rapidly aging population will only expect more aging consumers with diverse body shapes than the current consumer segments

(Department of Economic and Social Affairs Population Division, 2019). In addition, different ethnicities prefer different fits; for example, young Africans prefer the hourglass as the ideal body shape and close fit on mid-lower hip areas, whereas Caucasians tend to like semi-fit around the waist (Makhanya & Mabuza, 2020).

2.4.4. Body cathexis' effect on the perception of clothing fit

Body cathexis is defined as the degree of psychological satisfaction with one's body parts. Individuals' body satisfaction is highly correlated to self-esteem and influenced by their body shapes (Fan et al., 2004). Previous studies found that body cathexis and fit preferences are influenced by age, income, and ethnicity (Manuel et al., 2010, Plutt, 2011). According to Shin and Baytar (2013), if consumers are satisfied with their bodies, they will have fewer concerns about size and fit. Properly fitted outfits provide comfort and positive feelings to the wearer. Previous research found that individuals with different body sizes prefer different aesthetics and fit of clothing (Chattaraman & Rudd, 2006). Satisfaction with clothing fit has positive psychological effects on one's body cathexis, especially towards smaller sizes (Kinley, 2010).

In an early body cathexis study, the researchers found that female participants' actual body sizes were significantly larger than their ideal measurements for weight, waist, and hips, yet the ideal bust size was rated larger, reflecting that era's trends (Jourard & Secord, 1955). Positive feeling toward clothing fit was shown to be based on the person's body satisfaction. Aesthetic styling proclivity decreased when self-perceived body image and body cathexis were negatives (Chattaraman & Rudd, 2006). Women with a higher body cathexis scale were found to require better-fitted clothes (Pisut & Jo Connell, 2007). Another study identified that women generally had lower satisfaction toward body parts below the waist than above (LaBat & DeLong, 1990). Recently, it found that fit preferences were more related to body parts rather

than the overall body shapes, and the middle and lower body parts were reported as the areas with the lowest body satisfaction (Makhanya & Mabuza, 2020). According to Makhanya and Mabuza (2020), consumers understood the differences between their body shape and the brand-selected body shape. Moreover, body shapes, body cathexis, and fit preferences were found to be correlated, which means different body shapes have different fit preferences (Manuel et al., 2010). Lastly, mood and feeling can also significantly influence fit and style preferences (Moody et al., 2010).

2.5. Fashion recommendation systems

2.5.1. Overview of recommendation systems

The COVID-19 pandemic accelerated online shopping needs. Fashion brands are growing in e-commerce, presenting 23% of total online retails (Statista, 2022). With the massive amount of online clothing options, a recommendation system is needed to better filter selections for shoppers. Developing recommendation systems is a high-demanding and fast-growing field in both business and technology aspects. With the rise of the internet era, recommendation systems are adopted in a wide range of products and services. Recommendation systems are generally designed based on consumer, product, and market data. TikTok, as an example, attracts billions of users by proactively showing personalized content with algorithmic recommendations based on user interaction data (Smith, 2021). The generally acknowledged first recommendation system study was a librarian system named Grundy in the late 70s to suggest books (Rich, 1979). Since then, many studies and products have focused on building recommendation systems, such as Tapestry, Ringo for Music, MovieLens, etc. (Goldberg et al., 1992, Harper & Konstan, 2016, Shardanand & Maes, 1995). A recommendation system is developed to create a filter to improve the efficiency and quality of information seeking through a large number of selections (Vaidya &

Khachane, 2017). Collaborative filtering, content-based filtering, and hybrid models are the top three adopted techniques of recommendation systems (Oard & Marchionini, 1996). The world's largest e-commerce Amazon patented its collaborative filtering technique in 1998 and has been continuously making success by recommending items to shoppers based on other similar shoppers (Hardesty, 2022). During the early stage, Netflix adopted content-based filtering to recommend content based on the same user's previous preference (Reddy et al., 2018). Content-based recommendation system utilizes multiple data points of a single user and is arguably recognized to have more power of prediction (Pazzani & Billsus, 2007). For shoppers, an accurate recommendation system provides a more personalized shopping experience and prevents fatigue from endless decision-making interactions. For businesses, recommendation systems can sustain the target users' engagement and scale business size, which are implemented and widely used in different digital spaces. A few disadvantages of implementing a personalized recommendation system include but are not limited to privacy concerns, technology trustability, and the echo chamber effect, which may grant the right to unethical business activities (Chen & Jin, 2013, Ge et al., 2020, Victor et al., 2011).

2.5.2 Garment size recommendation systems

Many companies and studies are exploring and establishing size recommendation systems to articulate the sizing shopping challenges. True Fit, a data-driven size recommendation platform, uses a hybrid recommendation model to compare sizing differences between brands and predict the best fit size for online shoppers. It analyzes manufacturing data, brand standard sizes, and shoppers' past orders to suggest the best fit for the item. (The True Fit Data Science Team, 2019). Other similar companies, such as Fit Analytics, FIT: MATCH, and Virtusize, all investigated multiple data points to identify the fit size for each shopper. Fit Analytics explored

the shopper's profile and product data to increase online conversion and reduce post-purchase returns (Fit Analytics, 2018). FIT: MATCH utilized the 3D scan of an individual's body measurement to evaluate the likelihood of size matches of the actual garment (FIT: MATCH, 2018). From the retailer's perspective, tools such as True Fit help reduce returns stemming from inaccurate size prediction. From the consumer perspective, size prediction technology gives more confidence to shoppers when making decisions. Consumers preferred to take fewer risks when choosing sizes with these recommendations (Parr, 2017).

2.5.3 Garment style recommendations

Recommendation systems are also widely utilized in retail and e-commerce. With the tremendous growth of fast fashion, the number of garment styles listed daily on brand websites could overwhelm shoppers. Aiming for better shopping experiences and return on investment (ROI), fashion retailers started to implement style recommendations to analyze shoppers' profiles and clothing detail datasets in the early 2000s (Chakraborty et al., 2021). A combination of fashion retailers and social media, companies such as Amazon, Shein, Alibaba, Pinterest, TikTok, Instagram, and Facebook, have become the newest significant players in advising trends and styles to consumers (Chen et al., 2019, Park et al., 2015, Tolcheva, 2021, Tsujita et al., 2010). StitchFix, which filed several patents in 2016, cultivated one of the most advanced styles recommending algorithms with a combination of complex data (Stitch Fix Algorithms Tour, 2021). With unique consumer preferences and fitting data, StitchFix can develop forefront machine learning projects and create a data-driven supply process. Other competitors, such as Trunk Club, Gwynnie Bee, Le Tote, and more, are also competing in configuring successful recommendation systems to maximize their business value (CB Insights, 2022). Academically, including both computer science and fashion design perspective, many studies have explored

style recommendation systems from data analysis and computer algorithms to vision analysis approaches (Veit et al., 2015, Veit et al., 2017, Hidayati et al., 2018, Hidayati et al., 2020, Nair et al., 2022). Geo-Style, for example, developed a style trend prediction algorithm by analyzing keywords of the dressing condition and visual understanding of outfits (Mall et al., 2019). Styling recommendation frameworks were explored with visual compatibility in pairing different clothing categories to generate outfits utilizing a Siamese Convolutional Neural Network (CNN) architecture (Veit et al., 2015). Other machine learning algorithms also included personal aesthetic preferences, social media influences, and occasions to better predict the likable outfits for consumers (Jiang et al., 2021, Mameli et al., 2022, Stan & Mocanu, 2019).

2.6 Theoretical frameworks

The sense of aesthetics is not only important for artists or designers but also for individuals in their everyday life. Philosophers and scholars have tried to understand the matter of taste and beauty. According to Kant (1892), the judgment of aesthetics involved universal feeling, emotion, pleasure, and cognition, which included delightfulness and joy. Although Kant's idea arguably framed the aesthetic definition, many scholars believed it contained a limitation of common sense and a broader range of influences due to the historical timing (Gorodeisky, 2010, Matherne, 2019). Rather than material clothing, like painting, music, and literature, fashion is an identity format to express aesthetic taste during social adoption (Simmel, 1957). Thus, trickle-down, trickle-up, and trickle-across theories were raised to explain how styles were commonly endorsed during a specific period (Robinson, 1958, Sproles, 1974, Veblen, 1973). To visualize fashion, individual styles are generally referred to as self-expression, as Coco Chanel's quote: "Fashion changes, but style endures."

Clothing attractiveness was found to have a similar positive perception as overall physical attractiveness (Lennon, 2009). Although facial features and behavior impressions are significant to the overall attractive perception, clothing and style choices also impact social desirability (Miller, 1970, Nielsen & Kernaleguen, 1976). Clothing style is considered an indicator of social status, personality, sexual appeal, and professionalism (Edmonds & Cahoon, 1986, Frevert & Walker, 2014, Wei et al., 2017, Yan et al., 2011). Some individuals may have more commonly favored style choices than others. Therefore, a clothing recommendation from a personal stylist is needed to elaborate one's wardrobe to present the characteristics and lifestyle.

There are three main types of stylists: personal, fashion, and wardrobe (Elsmore, 2022). Fashion and wardrobe stylists are considered part of magazines or celebrities' creative teams. In general, personal stylists are often hired as working professionals to maintain a consistent positive appearance and embrace social confidence (Gaskin, 2021). Thus, this research focused on style recommendations from personal stylists for generic individuals. The present study aimed to construct a style recommendation system to share expert knowledge for visual balance and aesthetic composition. Therefore, the Gestalt theory (Wertheimer, 1938), which explains design illusions and the overall visual balance perception, was selected as one of the guiding theories in the present study.

As a prominent part of the social context, people are interested in building personal images not only for self-pleasure or self-esteem but also for the benefit of social impressions. Physical attractiveness is associated with body shape, outfit selection, and overall appearance (Perry, 1998). The perception of attractiveness is slightly different between women and men. While men's physical attractiveness is associated with muscle mass and body fat distribution (Brierley et al., 2016), women's perceived attractiveness is a combination of facial features,

BMI, WHR, and posture (Miyazaki et al., 2018). Although physical judgment is considered a stereotype, visually well-presented people are recognized as more respected, successful, trustworthy, and creditable, which multiple books and studies articulated the stereotype (Guinalú & Jordán, 2016, Hamermesh, 2011, Lorenzo et al., 2010, Yamagishi et al., 2013). Good-looking influencers, for example, are viewed as more sociable, happier, and more successful via social media channels (AlFarraj et al., 2021). Physically attractive people significantly influence social perception; as previous studies explained, they are perceived to be more dominant, socially healthier, sexually attractive, and even professionally preferred (Eagly et al., 1991, Jackson et al., 1995). Although the judgment of visually pleasing and physical attractiveness may vary, symmetry and balance are always preferred. The optimal presentation of balance has been shown to be aesthetically pleasing in previous studies (Osborne, 1986, Swami & Furnham, 2012). In Leonardo da Vinci's illustration, the "Vitruvian Man," visual symmetry and balance were created with the golden ratio rule and manifested as the mathematical proportion to the beauty of the human body (Mona Lisa Foundation, 2018).

With thousands of dress options in the retail world, identifying a dress style to enhance one's physical figure, present a satisfied look, and provide a proper fit is time-consuming. This research assumed that the recommended styles act as a filter to allow consumers to choose from expert-selected styles for different body shapes to focus on making a decision based on personal preferences. According to the Cognitive Authority Theory, expert styling opinions are associated with their experiences, learnings, passions, etc., which can be learned as second-hand knowledge (Wilson, 1983). This study attempted to explore the acceptance of the dress style recommendation system based on body shape, built upon the expert's second-hand knowledge. To investigate the factual opinions towards dress styles on their body shape, the participants

were unaware of the background of the stylists' interviews, books, or online resources. The social opinion might create additional variables and opinion bias in the results.

CHAPTER 3

METHODS

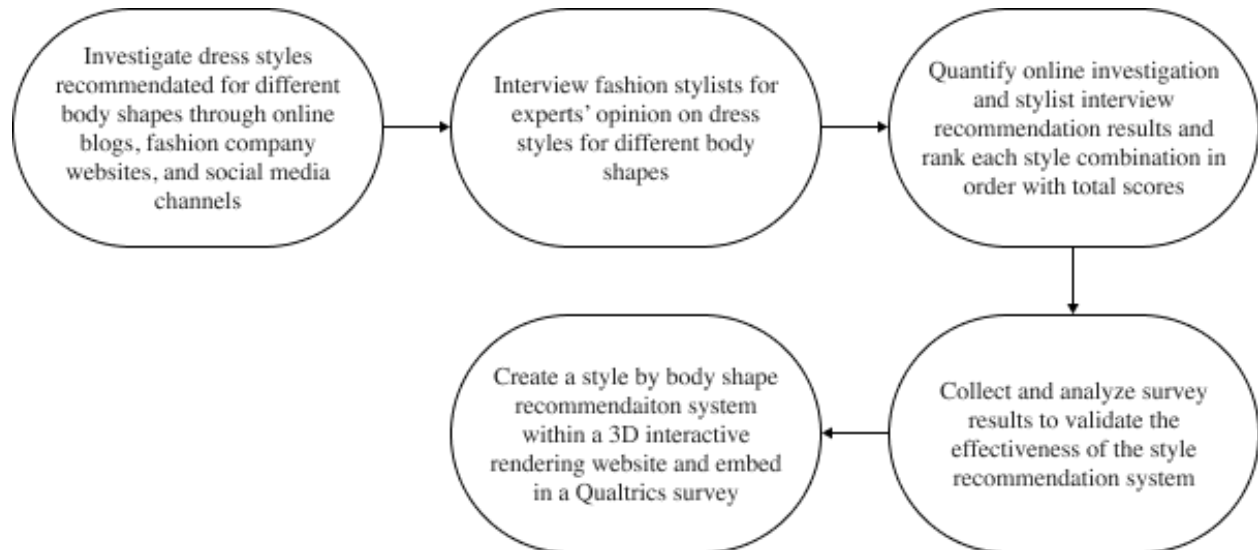
3.1. Overview

To develop a style by body shape recommendation system for different body shape shoppers and to examine the effectiveness of the system as well as better understand consumers' needs, a style recommending score-based website with 3D interactive dresses was developed and embedded within a Qualtrics survey. Prior to distributing the survey, the questions were organized based on the four main criteria: body shape measurements, personal body cathexis satisfaction, interactive 3D dress by body shape selection, and purchase intention. To build the recommendation system, firstly, clothing and styling recommendations were investigated through social media channels, blogs, and expert stylist interviews. The results were analyzed and calculated into a score ranking set. To develop a 3D interactive website, at first, five body shapes, as well as dress styles, were analyzed, identified, and generated digitally with CLO3D. The typology of body shapes identified by the FFIT (Simmons et al., 2004) was adopted in this study. With the development of the ranking system, eighteen dress styles were implemented on the website in the order of recommendation with two testing conditions created: the control with all styles and the experiment with recommended styles. Three styles of necklines, three types of waistlines, and two dress silhouettes were prototyped and rendered in 3D on five types of female body shapes. Upon the development of the system and receiving an Institutional Review Board (IRB) approval (Approval no. 2103010217), study participants were randomly assigned to experimental and control conditions in this between-subjects experimental study. Based on the bust, waist, waist, high hip, and hip measurements, each participant was categorized under one of the five main body shapes (i.e., hourglass, triangle, inverted triangle, rectangle, and oval) (Simmons, 2004;

Vuruşkan & Bulgun, 2011). Survey questions prepared in Qualtrics were answered by the participants. The flowchart (Figure 3) below outlines the approaches taken to design the study.

Figure 3.

Flowchart for recommendation system construction and data collection methods



3.2. Participant population

In the past 10 years, e-commerce has been growing and taking over 25% of total retail sales globally (Rajnerowicz, 2022). Online fashion shoppers are relatively younger than traditional brick and mortar consumers, which sometimes requires a technology learning curve. Gen Y and Gen X shop online half of the time (Smith & Anderson, 2020). According to JungleScout's consumer trend report (2021), although overall men spent more than women shopping online, women spent more time online comparing and deciding (Nelson, 2020). 71% of women purchase fashion items online, whereas 49% of men behave the same (Chevalier, 2017). Thus, in this study, the targeted participants were women aged 18-65 living in the U.S.

3.3. Stimulus development

3.3.1. Analysis of body shape attributes

The five body shapes, including hourglass, spoon/oval, triangle, inverted triangle, and rectangle, were adopted, and coded based on the FFIT (Table 1). To visually present the five body shapes, five 3D avatars were rendered with CLO3D. Skin colors were removed from all avatars.

Utilizing a 3D avatar eliminated the biased opinion toward real people’s photos. The measurements of five body shape avatars were generated by keeping the same height of 5’4” (What Is the Average Height for Women?, 2021) and bust size as 39.98” circumference. The bust size was determined based on the median chest circumferences among 6311 randomly drawn female body measurements from SizeUSA. Due to inconspicuous digital presentation, both bottom-hourglass and top-hourglass were categorized under hourglass in this research. Shoulder width was adjusted for the triangle body shape and the high-hip and hip circumferences were increased for the spoon/oval shape to enhance the visual difference from other shapes.

Table 1.

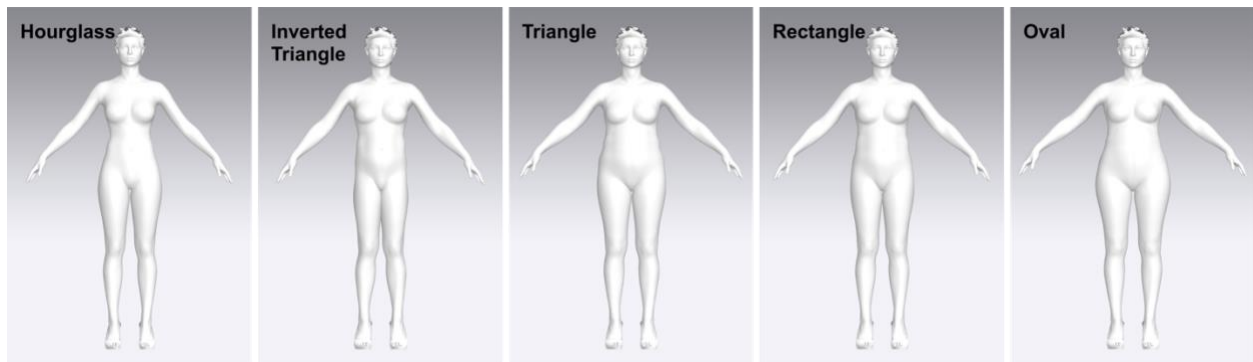
Calculation formula coded according to the FFIT

1	= concatenate (
2	if(and(hip-bust<3.6, bust-hip<= 1, or(bust-waist>=9, hip-waist>=10)), " hourglass", ""),
3	if(and(hip-bust>=3.6, hip-bust<10, hip-waist>=9, high hip/waist<1.193), " bottom-
4	hourglass", ""),
5	if(and(bust-hip>1, bust-hip<10, bust-waist>=9), " top-hourglass", ""),
6	if(and(hip-bust>2, hip-waist>=7, high hip/waist>=1.193), " spoon", ""),
7	if(and(hip-bust>=3.6, hip-waist<9), " triangle", ""),
8	if(and(bust-hip>=3.6, bust-waist<9), " inverted-triangle", ""),
9	if(and(hip-bust<3.6, bust-hip<3.6, bust-waist<9, hip-waist<10), " rectangle", "")))

The avatar renderings were recolored in light grey to avoid skin color bias. Avatars were taking a standard A-pose, to give a better view of the body shape. These body shape avatars (Figure 4) were shown to the stylists during the interview, as well as used for creating the 18 dress prototypes.

Figure 4.

Five body shape avatars created in CLO3D based on the FFIT



3.3.2 Dress style attributes analysis

Dress, as a clothing category, is mainly worn by women. In 2021, dress sales took about 14.4% of the total apparel industry revenue, which declined market need during the pandemic (O'Connor, 2021). According to McKinney Returns Management Survey in 2020, although apparel e-commerce has grown 35% during COVID-19, clothing return rates have gone up to 25% (*Returning to Order: Improving Returns Management for Apparel Companies*, 2021).

Unlike the top or bottom garments, a dress covers both top and bottom body parts, thus presenting more fitting challenges, especially for certain body shapes that deviate from the industry-standard hourglass shape. Designing and patternmaking for dresses require more effort to understand the upper and bottom body proportions. Proper dress fit involves accurate placement of cutting lines and curves, such as the waistline, armholes, or darts. Even though

multiple sizing systems are deployed in industry, it was found multiple body areas were unsuitable with the pattern grading methods in mass production (Bye et al., 2008).

Therefore, in the present research, dress was selected as the focus category. Shapes and lines were considered throughout the study; yet color and texture were excluded to eliminate excessive variables (Elements and Principles of Fashion Design, 2015). By following the Gestalt theory, the dress style defining process started with the overall review of each body shape and the proportion of the visual balance. Then the preferred outline and silhouette were identified. Lastly, the design details were reviewed and taken apart to rank with suggestions from the styling books and online resources.

The dress attributes were separated from design components, and three fundamental attributes, necklines, waistlines, and silhouette, were selected because they closely interact with the main torso of the body shape and can change how body shape is perceived when wearing certain styles. Other components, such as sleeve, skirt length, and back openings, were excluded from this research. The three basic necklines, waistlines, and silhouettes were identified and categorized through multiple blogs and fashion design books (Koester & Bryant, 1991, Stitch Fix 2017, Tariq, 2022). Neckline styles included V-neck, scoop neck, and strapless (Shoukat, 2016). The waistline contains a natural, drop waist, and no waistline (Stitch Fix, 2017), and the empire waist was replaced with a no-waist to create clear visual differences in 3D renderings. Dress silhouettes had A-line and H-line styles, which included the outline shape for the commonly seen styles such as a sheath, flare, and shift dresses (Stitch Fix, 2017).

3.3.2.1. Dress styles from the Internet and printed media

The most recommended dress style attributes for each body shape were observed and identified from fashion books, blogs, leading fashion brands, and magazines, including Trunkclub, Stitch

Fix, WhoWhatWear, Vogue, Tan France, The Body Shape Bible 2007, etc. The dress style recommended attributes were constructed from contemporary brands (Stitch Fix and Trunk Club), fashion blogs (The Concept Wardrobe, and Reader's Digest), trend reports (WhoWhatWear), and literature (The Body Shape Bible 2007, The Complete Bonnie August's Dress Thin System, and H-O-A-X Fashion Formula). The findings were then validated and enhanced with 10 professional stylist surveys and interviews.

3.3.2.2 Fashion styling expert evaluation

Upon receiving the IRB approval (Approval no. 2103010217), fashion style experts were interviewed in a semi-structural manner via Zoom. Style experts were recruited via social media posts, referrals, and stylist seminars. Pre-interview survey and consent forms were sent via email along with the zoom invitation. Figure 4 was presented to visually guide the reference of different body shapes.

Stylist Participants: A total of 10 fashion professionals with apparel styling expertise in the United States, including nine females and one male, participated in the remote interview session. All stylist participants completed the consent form for this study with an allowance of video and audio recording. To better understand the process in terms of body shape analysis in the styling session, stylists with different backgrounds were recruited.

Procedures: After receiving the consent agreement (Appendix VII), each stylist participant was requested to complete the pre-interview question to report demographic information, occupation background, and body shape styling preferences via a Google form on the cloud. Each stylist participant was then scheduled for an hour-long Zoom interview session with video and audio recordings. The interviewer had a positive attitude toward fashion styling but strived to remain neutral during the conversations to minimize the experimenter effect. Each stylist participant

received a \$15 gift card from convenience stores based on the individual’s preferences as an incentive after the interview.

An interview guideline was developed to ensure each stylist participant was asked the same questions, which supported the RQs 1 and 2 (Table 2). During the interview session, the interviewer initiated the conversation with an overview of the research purpose and the values of the outcome. Then, the interviewee was asked two sets of questions for each body shape, including three questions focusing on the body shape by silhouette recommendation and three questions focusing on the body shape by style attribute recommendation. The stylist participants also explained the rationales behind their silhouette and style attribute recommendations. Lastly, the stylist participants were requested to suggest an “avoid-list” of silhouette and style attributes for each body shape and provided reasons for not recommending it.

Table 2.

Stylist interview question protocol matrix

	Demographic and background information	Research Question 1	Research Question 2
Interview Question 1	X		
Interview Question 2		X	
Interview Question 3		X	
Interview Question 4		X	
Interview Question 5			X
Interview Question 6			X
Interview Question 7			X

Data analysis: All recordings were then transcribed verbatim via Otter.ai with minor corrections due to stylist participants’ grammar mistakes or transcribing errors. Randomly selected transcripts were coded in Microsoft Excel by two coders (i.e., the researcher and her thesis

advisor) to identify the desired relationships between body shape attributes and dress style attributes. Frequent themes were identified through coding and Cohen's kappa inter-coder reliability was calculated. When strong inter-rater reliability (0.87) was reached and consistency among the agreements was established, the main researcher coded the remaining transcripts by using the qualitative software ATLAS.ti. The data was coded with the framework method applied by Gale et al. (2013).

Each transcript was coded independently with five body shape labels (H - hourglass, I – inverted triangle, T - triangle, R - rectangle, and O - oval) and 2 sub-labels (D – definition, P – positive, and N - negative) to indicate the positive or negative opinions. Three additional labels (OP – opinion, FS – fact sharing, ST – styling techniques) were created for comprehensive suggestions and opinions. Then all 18 coded transcriptions were reviewed and reorganized based on the codes to capture the key opinions for each body shape. In addition, each stylist participant was given a memo based on their background; for instance, stylist or designer referred to the occupation, and M or F referred to their gender. Lastly, the raw data were refined by adding, removing, merging, and quoting to quantify the conclusion. To ensure the reliability and consistency of the data, the coded contexts were analyzed based on Rabiee's recommended guideline (Rabiee, 2004). Both visualized network graphics and quantified framework matrices were presented in the discussion section.

When analyzing the data, Rabiee's (2004) recommendation on the qualitative interpretation of the interview data was adopted. The words used as indicators of recommendation included women's dress silhouette, pattern and seam terms, body shape terms, style definitions, colors, embellishment, and design terms. Each question was asked based on the 3D avatar images. Each stylist participant was encouraged to share their past styling experiences,

client stories, and expert opinions to support the answers. Due to the topic being on the stylist participants' expertise, the responses tended to be positive and proactive. The frequency of similar terms and pattern of style recommendations were identified during the interviews and coding. In the given order of discussing the body shapes, minimal opinion changes were found in individual stylist participants' recommendations. Each stylist participant provided extensive opinions on overall apparel styling in the relationship between sizing and body shapes, which were coded and concluded in the discussion section. Each positive code for style attributes was counted as (+1) in the recommendation system, and each negative code was counted as zero. Printed and online media research and stylists' interviews were weighted equally in the system algorithm.

3.3.3. Recommendation score ranking

Fashion style contents and expert interview transcripts were coded based on the recommended and not recommended dress styles for each body shape. All recommendation opinions were weighted equally. Each code for style details was scored based on recommended as +1 and not recommended as (-1). Two total scores were calculated: one sum for each style detail (body shape by style detail sum = total recommended scores + total non-recommended scores), and one sum for dress style details combination (body shape by style combination score sum = neckline style scores + waistline scores + silhouette shape scores). The total scores were ranked for each dress style combination based on the body shape.

The control group participants were able to select three liked and three disliked from all eighteen dresses. The experimental group participants selected the top three liked and disliked dresses from the ranked selections based on media and stylists' recommendation scores. Based on the total scores for style combination, the top 30% of styles were considered as recommended

and the bottom 30% were not recommended (score ≥ 21 , unrecommended score ≤ 16), which were rendered in CLO3D on their FFIT-calculated body shapes.

3.4. Recommendation website development

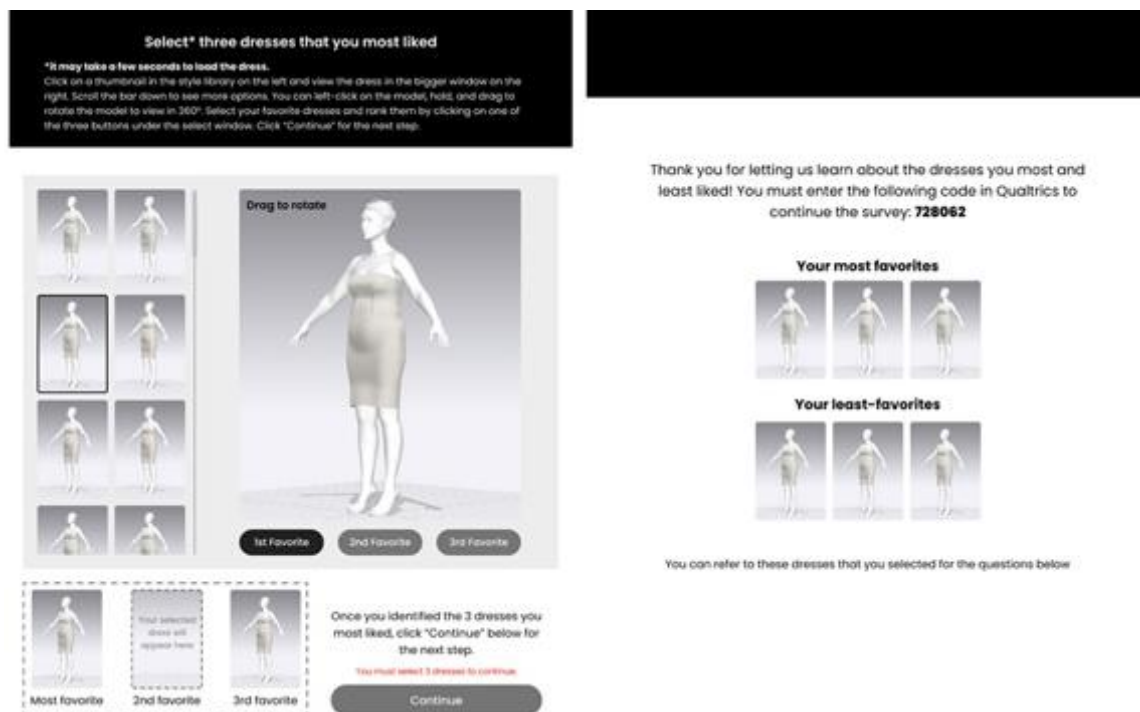
The patterns of the 18 dress styles were drafted with Adobe Illustrator and imported to CLO3D based on the three variables: neckline, waistline, and dress silhouette. The design options were selected based on their popularity and were commonly used in current fashion. Then the patterns were adjusted and rendered on the 3D female avatar in five body shapes as the stimuli. The ivory cotton poplin, as a versatile woven fabric, was selected as the fabric for all dresses to create visual contrast to the white avatars. Stretch, and jersey fabrics were eliminated for this study to avoid design and draping complications. Due to the invisible seamlines on the drop waist designs, a bone-white strip pattern was added to the top of the drop waistline to enhance the visual separation. The neckline styles included V-neck, scoop neck, and strapless (Shoukat, 2016). The waistline contains a natural drop waist and no waistline (Stitch Fix, 2017), and the empire waist was replaced with a no-waist dress to create apparent visual differences in 3D renderings. Dress silhouettes had A-line and H-line styles, which included the outline shape for the commonly seen styles such as sheath, flare, and shift dresses (Stitch Fix, 2017).

All style combinations were customized for each body shape (Appendix IX). All 3D renderings were implemented in an interactive website with three.js and hosted on cPanel under the GoDaddy domain www.fashionstylestudy.com (Appendix VII). The three sections' website flow and user interface were designed in Figma, including participant validation, body measurement input, and dress style preference selections. PHP, CSS, and Three.js were used to implement the website. Three.js was coded to present the drag-to-rotate 3D avatar and dress options. The validation section collected the participants' emails or MTurk IDs to verify their

information with Qualtrics data. The FFIT body measurements, including bust, waist, high hip, and hip, were collected to identify body shape and website avatar. Two subdomains were created for control and experimental conditions. The control link presented all 18 styles for participants to choose from; the experimental link only presented the top 30% scored recommending styles based on the analysis result from the recommendation from media and stylist interviews. Participants' input data from the website were stored under cPanel, then migrated to the Qualtrics result for analysis.

Figure 5.

Interactive recommendation website



The first section collected participants' emails or MTurk IDs to verify the participant information with Qualtrics data. Participants were guided to measure and enter their bust, high waist, low waist, and hip circumferences in the second step. These data points were calculated following the FFIT formula (Simmons et al., 2004), and each participant was assigned the

corresponding body shape category without front-end indication. Then the participants were presented with the 3D interactive dress styles of the body shape and asked to select the top three liked and disliked styles. Participants' input data from the website were stored under cPanel.

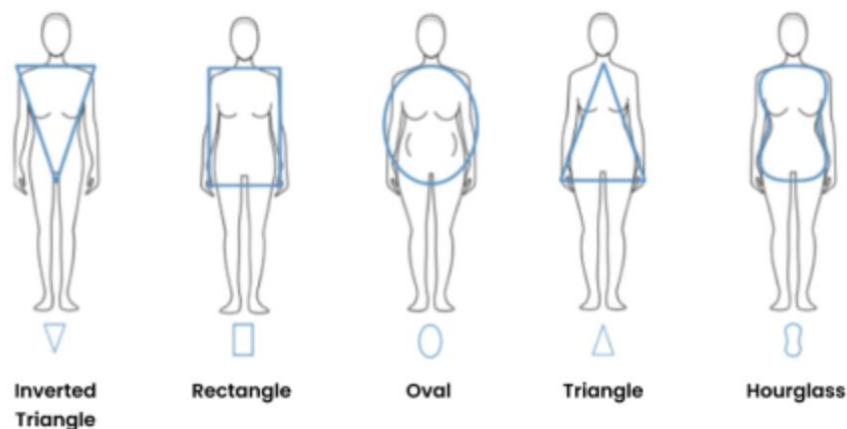
3.5. Participant survey

3.5.1. Procedure

A survey with 36 questions was constructed in Qualtrics, in which the 3D interactive recommendation website was embedded (Appendix VII). Participants were required to sign the consent (Appendix III) and confirm their gender as women and their ages as 18 or older to proceed. Before interacting with the 3D website, participants were asked about their self-identified body shape, ideal body shape, body satisfaction, purchase intention, trend preferences, self-estimated body measurements, and fit preferences. Figure 6 was shown to the participants to better inform them when selecting their self-identified body shape and commenting on their ideal body shape in the pre-test survey.

Figure 6.

Women's body shape chart



Note. Women's Body Shape Chart. (2014, September 5). [Illustration]. Golden Rules of Dressing for All Body Shapes. <https://vanessanicoleg.files.wordpress.com/2014/09/women-body-shape-e1409921815636.png>

In addition, brief body measurements and shoulder types (including regular, narrow, and broad), were also collected prior to the style recommendation website interaction.

The 36 items were categorized into six main sets: participant demographics, body cathexis, body shape identification, dress shopping preferences, the 3D dress style by body shape selection, and qualitative feedback.

3.5.2. Instrument

Dress style recommendations, shopping preferences, including frequency, budget (by item and annually), purchase intention, and trend preferences, were measured by 5-point Likert type scales and multiple selections. In the end, participants' demographic data were also collected to better understand the difference between age and income.

Body Cathexis Scale. The 11 items for body appearance satisfaction were originally modified and adopted by Sidberry (2011) from a combination of Bonnie August's Body I.D. scale (1981) and the body landmarks defined by Fiore and Kimle (1996). The personal body cathexis satisfaction measurable items were adopted from the Body Areas Satisfaction Subscale (BASS) developed by Thomas Cash (1995). With the acceptable Cronbach's alpha, which was higher than .70, the same items were introduced in this research to identify the correlation between body satisfaction and dress style preferences. In the Qualtrics survey, the participants were instructed to select the level of satisfaction toward body parts with a 5-point Likert type scale (Extremely Dissatisfied = 1, Extremely Satisfied = 5).

Body feature satisfaction scale. The body shape satisfaction scale was partially adopted from the Body Satisfaction Scale by Slade et al. (1990). The altered items were adopted from Petrie et al. (2002) with a revised 5-point-Likert type scale (1 = Extremely Dissatisfied, 5 = Extremely Satisfied). Both studies resulted in a Cronbach's alpha higher than .80. Eleven items, including

face, hair, lower torso, mid-torso, upper torso, muscle tone, bust, hip, shoulders, waist, and overall appearance, were presented for the participant to select scale level. Facial features, arms, and legs were removed from the scale to focus on the body shape related.

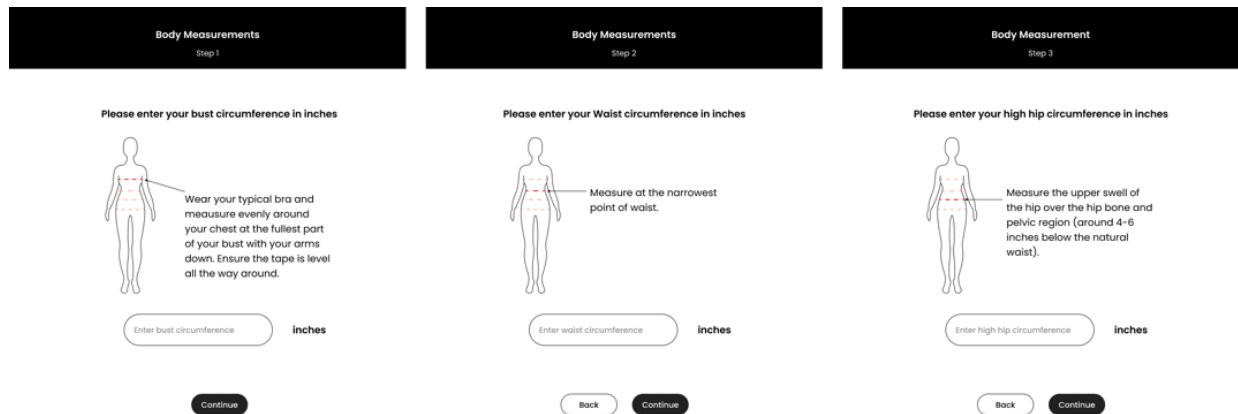
Shopping preference. Shopping preference was assessed with 11 items within three main constructs: garment features, design features, and fit preferences. Durability, care instruction, price, color, and fabrics were introduced to assess garment purchase decisions, which were adapted from Fiore and Kimle (1996). Six items of fashion trend preferences, fashion adoptability, and happiness were introduced from Beaudoin's apparel attribute (1998).

Purchase intention. The purchase intention scales were collected and modified by eliminating "television shopping" from the items (Kim & Lennon, 2000, p. 315). Five items of the self-reported questionnaire were adopted from previous studies (Kim & Lennon, 2000, p. 315), which obtained a .90 Cronbach's alpha. Respondents were instructed to select the most appropriate options by using a 5-point Likert type scale (1 = Extremely Unlikely, 5 = Extremely Likely).

Body shape identification. The body shape measurements were collected twice: self-assessed and self-measured. The guided body measurements were collected under the interactive 3D website. Bust, waist, high-hip, and hip measurements were guided with both graphic and written descriptions (Figure 7). Each participant was then assigned body shape based on the FFIT. Their body shapes were calculated with the FFIT's definition based on self-measured body measurements. The participants were asked to select three top liked and disliked dresses based on the identified avatar from the FFIT-calculated body shape. The assigned body shape was not given as a text, instead, it was only presented as a 3D rendered avatar.

Figure 7

Guided body measurement process



The participants were randomly assigned to either the control or the experimental of the 3D interactive website. The control group interacted with the 3D interactive website with all the available styles on the avatar with their FFIT-calculated body shapes. The experimental group only viewed the recommended dress options based on the previous interview and data collection from the stylists. Participants were asked about their shopping behavior prior to the 3D interaction experience.

After interacting with the recommendation website, participants continued to answer their satisfaction with the recommended dress and impression of the categorized body shapes. A 5-point Likert type scale was utilized to measure four aspects of the favorite dresses' satisfaction: fit, comfort, attractiveness, and fashionable impress (1 = Strongly Disagree, 5 = Strongly Agree); as well as the likelihood of purchasing and wearing (1 = Extremely Unlikely, 5 = Extremely Likely). Participants could select their most and least favorite dress details from the following: neckline, waistline, sleeve, shape, silhouette, color, fabric, fit, and length. Validation questions included the likelihood of wearing the selected dresses, the frequency of wearing, and the

possibility of recommending to others. Lastly, demographic data were collected at the end in regard of ethnicity, age, and income.

Open-ended Questions. Four additional open-ended questions were asked before redirecting participants to the 3D style selection website. Participants were asked to provide short answers about their feelings when selecting a dress style and size for their body shape. The questions included:

- How do you feel when selecting a dress for your body shape during shopping?
- How do you feel when selecting a dress size for your body shape? Do certain dress styles make you feel more confident to wear? Please explain.
- How would you change a dress design to suit your body shape better?
- How did you feel about the recommended dress styles for your body shape?

These questions were used to compare and analyze post-engagement answers to identify their attitudes towards style selection based on body shapes.

3.6. Data analysis

For the stylist interviews, Zoom was used for the stylist interview and the recordings were transcribed with Otter.ai. The interview transcripts were imported into Atlas.ti for analyzing. Qualtrics were used to design surveys. Survey questions were adopted and adapted from validated scales and include open-ended questions. The collected survey data were analyzed with JMP Pro 16 and interpreted consumers' style recommendation satisfaction and purchase intentions. All descriptive statistics (e.g., frequency, percentage, mean, standard deviation, visual tests for normality) were computed for all scale and numerical sets. Scale questions were recoded into numbers, then the reliability and validities were obtained with Cronbach's alpha. To avoid agreement bias and bot participants, validation questions, such as number selection, and

negative items were included throughout the questions. Control and experimental groups were the two comparable groups in the style selection data, for which t-tests were calculated.

Respondents who had partially completed the survey were excluded from the analysis of the data set; however, the responses for other sections were included in the sets with full answers. T-tests, Chi-squared analysis, Cronbach's alpha, and p -values were calculated to identify comparison significance, validity, and reliability.

CHAPTER 4

RESULTS

4.1. Results from the stylists' interviews

4.1.1. Participants

A total of 10 fashion experts, nine women, and one man, from the U.S., were interviewed via Zoom and phone calls. Six participants were working professional stylists; three participants were women's wear fashion designers; one participant was a fashion model. Sixty percent of the participants had more than ten years of experience in the fashion industry, and the rest had less than five years of experience. In general, all participants were paid or commissioned for styling services. A letter was used to replace the stylist's names for confidentiality.

Table 3.

Participant demographics and styling background

Gender	
Female	n=9 (90%)
Males	n=1 (10%)
Age	
25-50 years old	n=8 (80%)
Over 50 years old	n=2 (20%)
Occupation	
Fashion Stylist	n=7 (70%)
Fashion Designers	n=3 (30%)
Year of Experiences	
1-5 years	n=4 (40%)
5-10 years	n=0 (0%)
10+ years	n=6 (60%)

4.1.2. Body shape and styling perception

The results showed that 80% of the stylists perceived the hourglass as a more balanced body shape. Seven stylists described rectangle and inverted triangle shapes presented a more athletic

and fit look. Four stylists mentioned that oval and triangle shapes were more likely to indicate maturity and were perceived as mother-like. It was suggested that an individual's body shape changes over time and might have mixed body shapes based on postures.

“You may have somebody 6ft tall and somebody 5ft tall (...) [although they are the same shape] (...) they're not gonna be able to wear the same thing [although] they can, in theory(...) But how it fits on the body may look different. They may have a longer torso...”
(Stylist A)

“Plus size women are shaped so differently because some of them are top heavy bottom heavy(...)plus size women are more challenging when they're shopping for the right outfit” (Stylist J)

All stylists agreed that building self-confidence and style exploration are more important than trend adaptation in styling sessions. Based on the interview analysis, stylists' style recommendations were not only based on the body shapes but also the height, facial shape, torso length, and preferences. The five body shape categories were also criticized for lacking consideration of "different torso, height, and curves" (Stylists C, E, and H). Occasionally, women with the same body shape may select the opposite styles as explained by Stylists A and B as follows:

“I get two types of clients. The one is ‘I'm heavy on the top.’ So, I want to hide (conceal) that. And the other same, “I'm heavy on the top, and I want to celebrate it” (Stylist A).

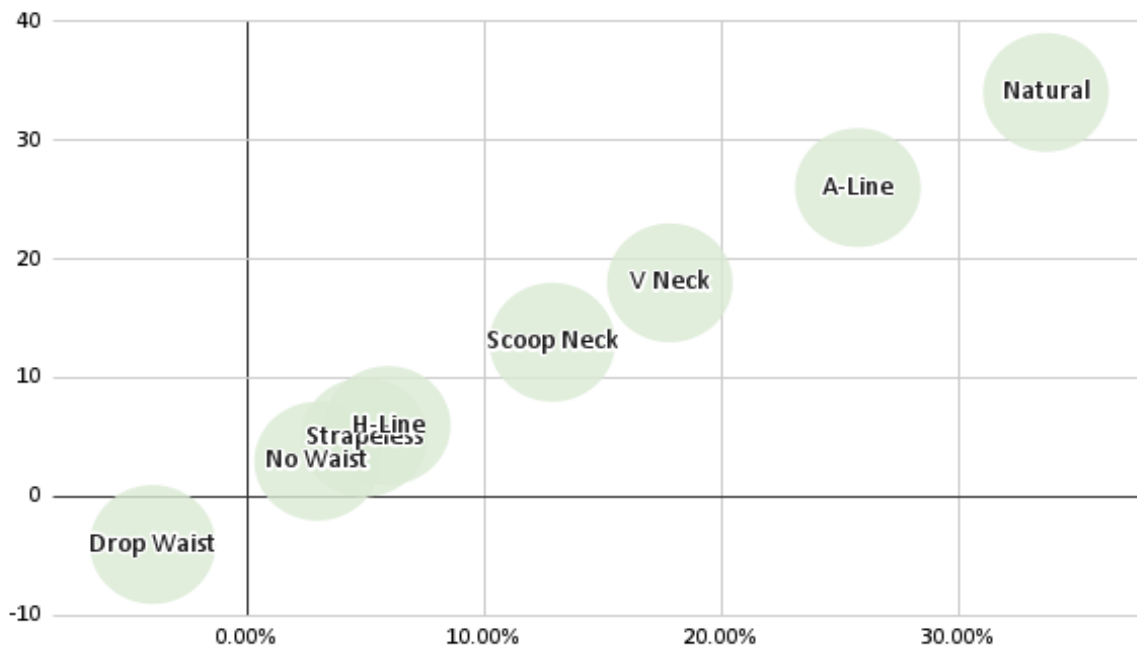
“It is a personal selection if there are preferences, some to hide imperfection... personal aesthetic will need to base on the inner understand and psychological perspective (Stylist G)”

4.1.3. Dress details recommendation

The dress detail of neckline (total score = 36, score percentage = 35.64%), waistline (total score = 33, score percentage = 32.67%), and silhouette (total score = 32, score percentage = 31.68%) was counted independently from the interview script. The transcripts were coded with two coders among 45 lines of code with 87% agreement. By separating each garment detail attribute, a total of 1718 recommended/non-recommended style scripts were coded, which included aesthetic dress style opinions from printed and online media research, and stylists' interviews. Natural waistline (33.66%), A-line silhouette (25.74%), and V-neck neckline (17.82%) were the most recommended regardless of style. On the other hand, drop waistline (3.96%), no waistline (2.97%), and strapless (4.95%) were the least recommended details by the stylists (Figure 8). The negative score was calculated as more not recommended scripts than recommended. Among the stylists' scripts, strapless was mentioned the least, whereas the H-line silhouette had the most mention.

Figure 8.

Total score rank of recommended styles



The garment style combinations were ranked differently for five body shapes. The triangle body shape had the most recommended codes (n=1718, 23.40%), and the inverted triangle had the least recommended codes (n=1718, 16.24%). The garment details were suggested for a triangle body shape that showed the highest observed agreement between stylists; however, the stylists disagreed mostly on garment details suggested for the oval body shape. Each code counted as either recommended (+1) or not recommended (-1), so each garment style for each body shape was summed with a total score from the script code. The combination of V-neck (score=18), natural waistline (score=34), and A-line dress silhouette (score = 26) had the top scores for all body shapes, which was summed as “the most recommended dress style” (Figure 9). However, the style combination with scoop neck was the top-recommended for rectangle (total score = 37) and triangle (total score = 43), whereas the style combination with V-neck was the top-recommended for hourglass (total score = 37), inverted triangle (total score = 33), and oval (total score = 32).

Figure 9.

Recommendation scores based on fashion media and stylist interview

Combination Hourglass	Total Score	Combination Rectangle	Total Score	Combination Inverted Triangle	Total Score
V Neck + Natrual + H-Line	37	Scoop Neck + Natrual + A-Line	37	V Neck + Natrual + A-Line	33
Scoop Neck + Natrual + H-Line	35	Strapeless + Natrual + A-Line	31	Scoop Neck + Natrual + H-Line	29
V Neck + Natrual + A-Line	32	V Neck + Natrual + A-Line	31	Scoop Neck + Natrual + A-Line	28
Strapeless + Natrual + A-Line	31	Scoop Neck + Natrual + H-Line	29	Strapeless + Natrual + A-Line	26
Scoop Neck + Natrual + A-Line	30	Strapeless + Natrual + H-Line	23	V Neck + Drop Waist + A-Line	23
V Neck + Drop Waist + H-Line	24	V Neck + Natrual + H-Line	23	V Neck + No Waist + A-Line	21
Strapeless + Natrual + H-Line	23	Scoop Neck + No Waist + A-Line	21	V Neck + Natrual + H-Line	19
Scoop Neck + Drop Waist + H-Line	22	Scoop Neck + Drop Waist + A-Line	19	Scoop Neck + Drop Waist + A-Line	18
V Neck + No Waist + H-Line	21	Strapeless + No Waist + A-Line	15	Scoop Neck + No Waist + A-Line	16
Scoop Neck + No Waist + H-Line	19	V Neck + No Waist + A-Line	15	Strapeless + Drop Waist + A-Line	16
V Neck + Drop Waist + A-Line	19	Scoop Neck + No Waist + H-Line	13	Strapeless + No Waist + A-Line	14
Scoop Neck + Drop Waist + A-Line	17	Strapeless + Drop Waist + A-Line	13	Strapeless + Natrual + H-Line	12
V Neck + No Waist + A-Line	16	V Neck + Drop Waist + A-Line	13	V Neck + Drop Waist + H-Line	9
Strapeless + No Waist + A-Line	15	Scoop Neck + Drop Waist + H-Line	11	V Neck + No Waist + H-Line	7
Scoop Neck + No Waist + A-Line	14	Strapeless + No Waist + H-Line	7	Scoop Neck + Drop Waist + H-Line	4
Strapeless + Drop Waist + A-Line	13	V Neck + No Waist + H-Line	7	Scoop Neck + No Waist + H-Line	2
Strapeless + No Waist + H-Line	7	Strapeless + Drop Waist + H-Line	5	Strapeless + Drop Waist + H-Line	2
Strapeless + Drop Waist + H-Line	5	V Neck + Drop Waist + H-Line	5	Strapeless + No Waist + H-Line	0
	380		318	IT least recommendation	279
Total Recommendation Coded	1718	Total Recommendation Coded	1718	Total Recommendation Coded	1718
	22.12%		18.51%		16.24%

Combination Triangle	Total Score	Combination Oval	Total Score
Scoop Neck + Natrual + A-Line	43	V Neck + Natrual + A-Line	32
V Neck + Natrual + A-Line	42	V Neck + No Waist + A-Line	28
Strapeless + Natrual + A-Line	37	Scoop Neck + Natrual + A-Line	27
Scoop Neck + Natrual + H-Line	29	Strapeless + Natrual + A-Line	24
Scoop Neck + No Waist + A-Line	28	Scoop Neck + No Waist + A-Line	23
V Neck + Natrual + H-Line	28	V Neck + Drop Waist + A-Line	23
V Neck + No Waist + A-Line	27	V Neck + Natrual + H-Line	23
Scoop Neck + Drop Waist + A-Line	24	Strapeless + No Waist + A-Line	20
Strapeless + Natrual + H-Line	23	V Neck + No Waist + H-Line	19
V Neck + Drop Waist + A-Line	23	Scoop Neck + Drop Waist + A-Line	18
Strapeless + No Waist + A-Line	22	Scoop Neck + Natrual + H-Line	18
Strapeless + Drop Waist + A-Line	18	Strapeless + Drop Waist + A-Line	15
Scoop Neck + No Waist + H-Line	14	Strapeless + Natrual + H-Line	15
V Neck + No Waist + H-Line	13	Scoop Neck + No Waist + H-Line	14
Scoop Neck + Drop Waist + H-Line	10	V Neck + Drop Waist + H-Line	14
V Neck + Drop Waist + H-Line	9	Strapeless + No Waist + H-Line	11
Strapeless + No Waist + H-Line	8	Scoop Neck + Drop Waist + H-Line	9
Strapeless + Drop Waist + H-Line	4	Strapeless + Drop Waist + H-Line	6
Triangle most recommendation	402		339
Total Recommendation Coded	1718	Total Recommendation Coded	1718
	23.40%		19.73%

4.1.4. Additional expert stylist interview findings

The importance of the waistline was emphasized throughout the interviews by all interviewees, which was mentioned 151 times in the script because it was perceived as defining proportion and balance. As described by one of the stylists: “...it’s a matter of the proportion...most often I see women they either wear something too long or too big. Not proportion right for their body, just

for they're not wearing it correctly." (Stylist G). Another stylist emphasized the importance of height and how a balanced look would depend on the height":

" Define their height first I define their pretty part of first then I figure out what the balance...manipulate the part of that's not balanced. When the height is short...if the curve is too large, it breaks the balance in proportion... Visually, the goal is to create a balance between the upper body and the bottom. " (Stylist F)

Most of the stylists (n = 7) described the styling process similarly, which can be put in steps as follows:

- Identify the unique part and the proportion between each part of the body
- Define waistline
- Balance body proportion with various designs of accessories and garments
- Emphasize the positive aspects of the body and disposition
- Make the individual comfortable and confident
- Utilize design and techniques to create certain silhouette illusions

These steps were practiced in styling sessions with clients to identify the outfits and style options, which might not need to follow specific orders.

4.2 Results from the recommendation website study

4.2.1. Participants

The survey was collected from March to May 2022 via the automated recruiting platform MTurk (n = 77), a convenience sample of college students (n = 63), and other (n = 33) online social media recruitment who were female shoppers from the U.S. Both control and experimental conditions were set with equal participating allowance in the MTurk distributions. The college student participant recruitments were distributed by the college administrators, and the two

conditions were distributed to two colleges. A total of 173 responses were collected. Twelve participants did not completely fill out the survey and were excluded from data analysis. For all 161 who completed the survey, there were 102 participants in the control group and 59 participants ($M_{Turk} = 44$) in the experimental group. The participants aged from 18 to 65 with a mean age of 34.74 ($SD = 12.17$) years old. There was significant age difference between the control ($M = 30.64$, $SD = 11.34$) and experimental group ($M = 41.76$, $SD = 10.13$), $t = 6.39$, $p < .0001$. Participants were from diverse background; 64% ($n = 103$) are Caucasian, 21% are Asian ($n = 33$), and the rest includes Native Americans ($n=1$, 1%), Hispanic ($n=12$, 8%), African Americans ($n = 9$, 6%), and others ($n = 2$, 2%). Although each group had a different number of participants, the 102 participants in the control group demonstrated no significant difference in ethnicity from the experimental group, $t(4) = -0.13$, $p = 0.89$. As for the income bracket, there was no significant difference between the control and experimental group, $t(7) = -0.85$, $p = 0.398$.

Table 4.*Participants demographic statistics (n = 161)*

		Control	Experiment
Age	Mean	30.64	41.76
	SD	11.34	10.13
Ethnicity	Caucasian	60%	71%
	Asian	39%	17%
	Native American	1%	0%
	Hispanic or Latino	8%	7%
	African American	6%	5%
	Other	2%	0%
Income	Under \$15000	12%	3%
	\$15000 - \$24,999	10%	14%
	\$25,000 to \$34,999	7%	7%
	\$35,000 - \$49,999	11%	7%
	\$50,000 to \$74,999	17%	31%
	\$75,000 to \$99,999	7%	15%
	\$100,000 - \$149,999	18%	15%
	\$150,000 to \$199,999	12%	3%
\$200,000 and over	10%	14%	

4.2.2. Body shape identification

Based on self-reported data from 171 participants, the body weight ranged from 90 lb. to 320 lb and the average was 152.61 lb ($SD = 45.41$). The height ranged from 4'9" to 6'4" ($M=5'5"$, $SD = 2.76"$). On average, the participants' BMI was 25.53 ($SD = 7.23$). Based on the participant's self-identified shoulder type, 53% ($n= 90$) selected regular. Thirty six percent ($n = 62$) identified as broad shoulder and 11% ($n = 19$) selected as narrow.

The body measurements were recorded twice: one with self-estimated measurements including weight, height, shoulder type, shoulder width, bust, waist, and hip sizes in inches. Another one with body measure guidelines including bust, shoulder, high hip, and hip. The shoulder was excluded from the guided measure as it was not required by the FFIT; instead, the

high hip was measured. The mean values of self-estimated and guided bust, waist, and hip measurements were found to have no significant differences, $t(2) = -0.018, p = .493$.

Table 5.

Estimated bust, waist, hip, and shoulder and guided measured bust, waist, hip, and high hip

	Est. Bust	Est. Waist	Est. Hip	Est. Shoulder
Mean	37.13	31.69	38.98	22.46
SD	7.35	7.39	7.70	10.50
	Measured Bust	Measured Waist	Measured Hip	Measured High Hip
Mean	37.11	31.36	39.51	36.46
SD	5.53	7.07	5.87	6.77

Participants selected self-identified and ideal body shapes by referring to Table 6. As a result, 30.41% of participants self-identified as an hourglass shape, yet 27.27% were categorized as an hourglass shape based on the FFIT. 18.13% of the participants self-identified as a rectangle; comparably, 38.79% were considered as a rectangle based on the FFIT. Based on statistical analysis in Figure 7, the degree of agreement between the self-identified and the FFIT-calculated shapes was significantly low (Kappa = -0.019). The ideal body shape was also collected to explore whether participants' self-identified body shapes were their ideal ones. Among all participants, 74.85% agreed that an hourglass is the ideal body shape to have. One-tenth selected inverted triangle and 7.6% selected rectangle as their ideal body shapes. There was a significant relationship between the self-identified and ideal body shapes. Ideal body shape was more likely to be hourglass, $\chi^2(1, N = 171) = 49.39, p < .001$. The result is consistent with previous literature review that indicates the hourglass body shape to be the most preferred.

Table 6.*Self-identified body shape, ideal body shapes, and the FFIT-calculated body shapes*

Self-identified	Count	Proportion in %
Hourglass	52	30.41%
Oval	39	22.81%
Triangle	30	17.54%
Inverted Triangle	19	11.11%
Rectangle	31	18.13%
Ideal body shape		
Hourglass	128	74.85%
Oval	5	2.92%
Triangle	8	4.68%
Inverted Triangle	17	9.94%
Rectangle	13	7.60%
FFIT body shape		
Hourglass	45	27.27%
Oval	35	21.21%
Triangle	19	11.52%
Inverted Triangle	2	1.21%
Rectangle	64	38.79%

In Table 7, the Kappa Coefficient test was performed to evaluate the agreement between self-identified body shapes and the FFIT-calculated body shapes. A comparison of the self-identified and FFIT-calculated body shapes produced a Kappa value of -0.019, which suggested no agreement between the two body shape identifications. Thus, in this study, the self-identified body shapes were utilized to conduct an analysis of the results to record participants' style preferences.

Table 7.*Self-identified vs. FFIT-calculated body shapes agreement statistic*

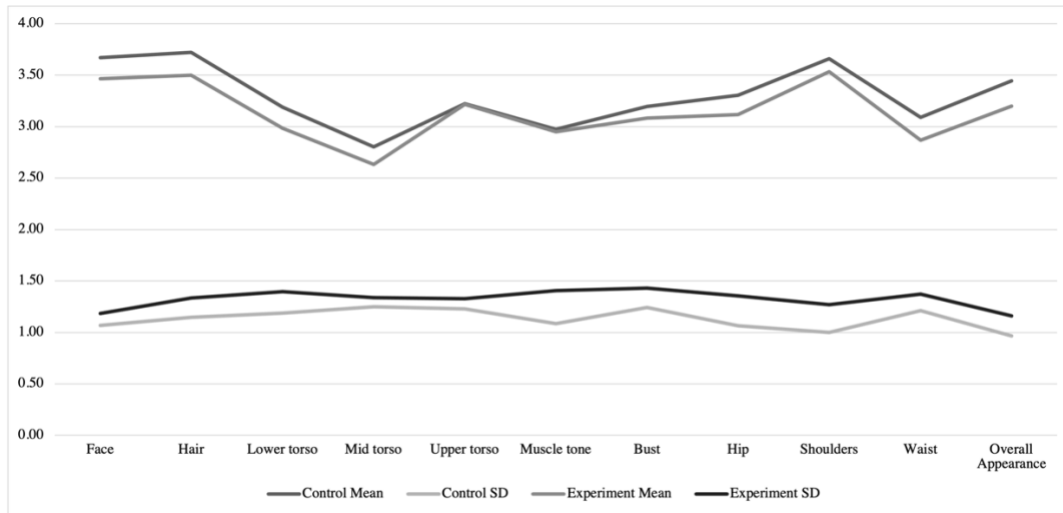
Degree of Agreement	Kappa	Std Err
	-0.01852	0.037294
Asymptotic Test	Prob > z	Prob> Z
	0.3188	0.6376

4.2.3. Body appearance satisfaction

All participants scaled higher satisfaction on face (M=3.60, SD = 1.10), hair (M=3.60, SD = 1.10), and shoulder (M=3.60, SD = 1.10) respectively, but they had lower satisfaction on mid-torso (M=2.80, SD = 1.30), lower torso (M=3.60, SD = 1.30), waist, and muscle tone. Between the mean scale value of control and experiment respondents, Cronbach's alpha was obtained as 0.89, which exceeded the threshold value of 0.70. Thus, the body satisfaction scale presented high internal consistency. The control and experiment group results indicated the same satisfaction pattern across all body parts; however, in Figure 10, both the mean and standard deviation of the experimental group were lower than the control group, except for the upper torso (M=3.20) and muscle tone (M=3.00). Statistically, no significant difference of body satisfaction was found between the control (M = 1.46; SD = 0.21) and the experimental group (M = 5.54; SD = 0.57), $t(20) = 6.436, p = 3.739$. The null hypothesis was accepted to confirm no significant difference in the means of the two conditions.

Figure 10.

Body appearance satisfaction comparison between the control and experiment groups



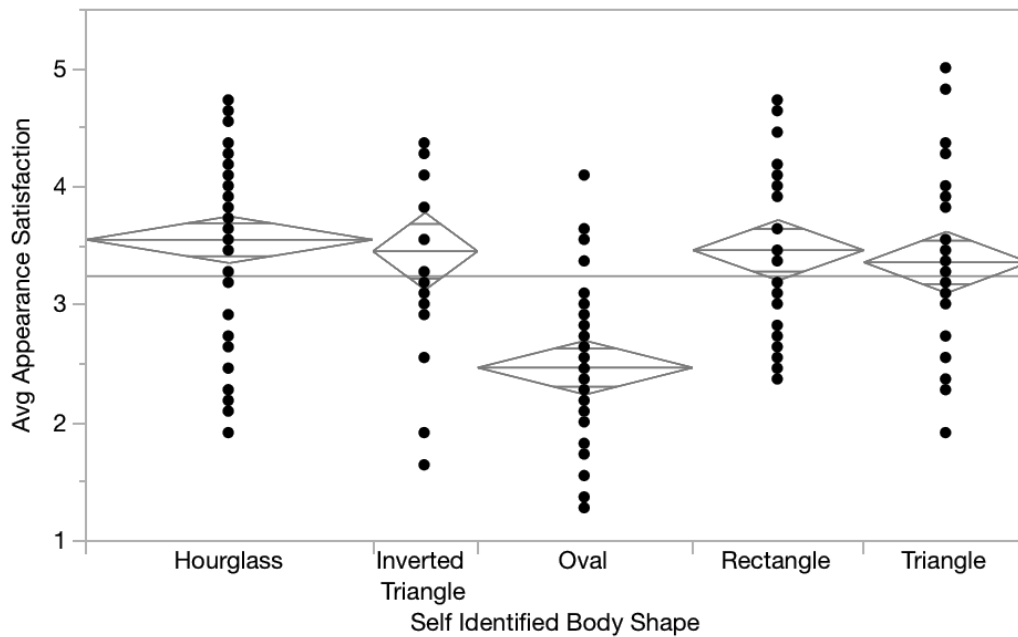
The participants selected a body shape as a self-identified body shape after entering their weight and height. Based on the average appearance satisfaction by self-identified body shapes in Figure 11, oval shape ($M=2.47$, $SD = 0.66$) expressed to have the average lowest body satisfaction (Figure 11). Hourglass ($M = 3.55$, $SD = 0.75$) was rated as the most satisfied body shape. Rectangle ($M = 3.46$, $SD = 0.64$) showed the smallest standard deviation, which indicated the likelihood of agreement between the participants. The inverted triangle ($M = 3.45$, $SD = 0.84$), on the other hand, had the largest standard deviation, which indicated the satisfaction difference might vary between participants.

Ninety-two percent of the self-identified hourglass and 72% of the self-identified oval body shapes preferred to have hourglass as their ideal body shape. Self-identified triangle (63%) and inverted triangle (63%) were less likely to select hourglass as their ideal body shape. On average, 60% of participants selected a different body shape than their self-identified body shape as the ideal body shape. Hourglass (92%) and inverted triangles (32%) were more likely to be

satisfied with their self-identified body shape. Only 10% of oval shape identified oval as their ideal body shape.

Figure 11.

One-way analysis of avg appearance satisfaction by self-identified body shape



4.2.4. Dress fit preferences

The first statement result showed that hourglass ($M = 3.94$, $SD = 0.88$) and inverted triangle ($M = 3.78$, $SD = 0.54$) shapes exhibited more satisfaction towards the fit based on their past purchases. Triangle body shape participants tended to agree with the statement, whereas oval-body shape participants ($M = 3.36$, $SD = 1.04$) rated the lowest among all other body shapes and were more likely to disagree on fit based on their past purchase experience. Different body shapes had diverse opinions on dress fitting ($p < .050$). The second statement measured the intention of purchasing garments that fit well. Triangle ($M = 4.72$, $SD = 0.46$) and inverted triangle ($M = 4.73$, $SD = 0.46$) body shaped expressed more positive intention to purchase well-fitting dresses. On the other hand, rectangle ($M = 4.40$, $SD = 0.67$) and oval ($M = 4.41$, $SD =$

0.72) body shapes indicated less intention to shop for a well-fitting dress. Both questions showed no significant differences between the control and the experimental groups ($p > .500$).

4.2.5. Dress shopping preferences and purchase intentions

More than half of the participants (54.76%) indicated that they shop a few times a year. The control and experiment groups did not show a significant difference in these questions ($p > 0.50$).

Hourglass (A few times a year = 64.71%) and oval (A few times a year = 61.54%) tended to shop more often than other body shapes. On average, most of the respondents spent less than \$100 on dresses (80%). Most of the participants spent \$100-\$500 per year on dress purchases.

Oval (61.5%) and hourglass (56.86%) respondents expressed that their body shape always affected on how they select dresses. In general, hourglass body shape-respondents thought they were happy about the fit (Always = 27.45%, Most of the time = 47.06%) and style (Always = 33.33%, Most of the time = 54.90%) about the dresses they bought. However, oval rated the fit (Always = 12.82%, most of the time = 35.90%) and style (Always = 15.38%, Most of the time = 41.03%) comparably low in their dress shopping (Table 8).

Table 8.*Shopping preferences by self-identified body shapes (%)*

	Hourglass	Inverted Triangle	Oval	Rectangle	Triangle
How often do you shop for dress?	%	%	%	%	%
A few times a year	64.71%	33.33%	61.54%	43.33%	53.33%
Never	9.80%	0.00%	7.69%	6.67%	0.00%
Once a month	13.73%	33.33%	10.26%	16.67%	13.33%
Once a week	0.00%	11.11%	2.56%	6.67%	3.33%
Once a year	11.76%	22.22%	17.95%	26.67%	30.00%
How much do you spend on one dress average?					
\$50-\$100	45.10%	27.78%	43.59%	40.00%	36.67%
\$100-\$500	15.69%	27.78%	23.08%	13.33%	23.33%
\$500- \$1,000	0.00%	0.00%	0.00%	3.33%	0.00%
Under \$50	39.22%	44.44%	33.33%	43.33%	40.00%
How much do you spend on dress purchase per year?					
\$1,000 - \$5,000	5.88%	16.67%	7.69%	6.67%	3.45%
\$5,000- \$10,000	1.96%	5.56%	0.00%	6.67%	0.00%
\$100-\$500	41.18%	33.33%	56.41%	43.33%	48.28%
\$500 - \$1,000	15.69%	22.22%	15.38%	10.00%	20.69%
Under \$100	35.29%	22.22%	20.51%	33.33%	27.59%
My body shape affects how I select dress styles					
About half the time	3.92%	5.56%	12.82%	13.33%	10.00%
Always	56.86%	44.44%	61.54%	33.33%	30.00%
Most of the time	33.33%	44.44%	25.64%	43.33%	43.33%
Never	0.00%	0.00%	0.00%	3.33%	3.33%
Sometimes	5.88%	5.56%	0.00%	6.67%	13.33%
I am happy about the fit of the dresses I purchase					
About half the time	17.65%	11.11%	28.21%	36.67%	30.00%
Always	27.45%	0.00%	12.82%	16.67%	10.00%
Most of the time	47.06%	83.33%	35.90%	36.67%	56.67%
Never	0.00%	0.00%	2.56%	0.00%	0.00%
Sometimes	7.84%	5.56%	20.51%	10.00%	3.33%
I am happy about the styles of the dresses I purchase					
About half the time	9.80%	27.78%	25.64%	23.33%	13.33%
Always	33.33%	5.56%	15.38%	20.00%	10.00%
Most of the time	54.90%	66.67%	41.03%	50.00%	70.00%
Never	0.00%	0.00%	2.56%	0.00%	0.00%

The reliability of the 11 questions was acceptable with Cronbach's alpha of 0.71. On average, respondents agreed that price ($M = 4.57$, $SD = 0.65$), color ($M = 4.50$, $SD = 0.68$), and fit ($M = 4.58$) were more important when making a dress purchase decision. On other is trendy ($M = 3.21$, $SD = 1.11$) and fashionable ($M = 3.92$, $SD = 0.94$) were scaled as the lowest to the shopping factors. Although the experimental group ($M = 4.27$, $SD = 0.88$) rated overall mean higher than the control group ($M = 4.07$, $SD = 0.98$), there was a not a significant difference between the two groups, $t(9) = 1.31$, $p = 0.193$.

4.2.6. Participants' thoughts on body shape and commercial dress design styles

Selecting the body shape. Fifty-seven percent of the participants reported that they had negative feelings about shopping for their individual body shapes. Only 33% of the respondents indicated confidence when selecting a dress for their body shape. Fifty-five participants described some body shapes were limited by style choices. When the preferred dress did not fit the body, eight participants felt self-conscious and concerned about body image. Only 17 respondents specified that they felt confident to select a dress for their figures.

"I get frustrated that a lot of dresses are designed for only one body type" (Participant E9304)

"It's difficult for me to select a dress because I have an hour-glass shape figure and my hips are very prominent. I try to look for styles that draw attention away from the lower portion of my body." (Participant C6503)

"Shopping itself is not a great experience because most designers do not cut for my body shape, and the dresses that are cut for my body shape are generally low-quality ultrafast fashion." (Participant C2653)

Selecting dress size. The majority of the participants agreed that dress sizes were inconsistent from brand to brand and confusing to shop. Nine respondents shared that they cared more of the actual fit and less about the size labels.

“As I have gone through prom dress shopping, I have seen lots of dress sizes and with the body size that I have, sometimes, due to clothing brand bigger size than what I normally wear fits very nicely and sometimes smaller size than what I normally wear also fits nicely...” (Participant C1691)

“The size is unimportant because the brands are often sized differently.” (Participant C9400)

“The size is usually a gamble for me. In one brand I can wear a 14, but in another brand have to squeeze into an 18. Every line is really inconsistent with their sizing, which makes it hard to shop. Sometimes I get discouraged when I have to get bigger sizes, but I really try not to let the number define how I feel about myself.” (Participant C5648)

Dress fit. One-fifth of the qualitative comments mentioned, “fit”. Inverted triangle (26%), triangle (23.6%), and hourglass (23.5%) emphasized fit in their responses. However, participants with oval body shapes were likely to have fewer concerns regarding dress fit (20%), yet more concerns in style selection (19%). Each body shape shared different concerns about dress fit.

“... a dress may fit me in the bust and hips but is too large in the waist. This makes it challenging as I can sometimes be an "in-between" size and must purchase a dress that does not fit me perfectly.” (Hourglass participant C8424)

“There are only certain types of dresses that fit me correctly.” (Inverted triangle participant C4305)

“I feel it doesn't fit my body shape properly since I am really small up top and way too big on the bottom.” (Triangle participant C1998)

*“It's hard to find dresses that fit my hips and waist without being huge on my bust. I usually end up sizing for my bust and buying dresses that flare out at the waist.”
(Triangle participant C3980)*

“...it can be hard to find dresses which fit my hips and look nice with my curves.” (Oval participant C3254)

“I sometimes take inside seams to better fit my waist and emulate an hourglass shape. I try to avoid emphasizing my shoulders and will utilize ruffles or body-hugging materials to try to appear curvier.” (Rectangle participant C4259)

Dress styles. Ninety-two percent of the respondents agreed that they felt more confident dressing in certain dress styles. A-line was called out multiple times as the “easy” and “look good” style. A few participants expected to select the dress styles to make them “hide the body flaws” and “look slimmer”. Half of the participants preferred to have a well-fitted and curve-emphasizing look, yet some also mentioned preferring the loose and flowy look.

“...ones that drape and hide my stomach but accentuate my hips. Usually, one with a belt that draws attention to the smallest part of my waist and accentuates my bust.”

(Participant C3667)

“I would say that tighter dresses around the waist and bust make me feel more confident, but they have to be more flowy on the bottom half so that it hides the thickness of my thighs and bottom.” (Participant C8047)

“I like things that fit well and emphasize the parts of my body that I feel confident in. The last dress I wore was strapless because I like my shoulders, but it wasn't tight around my

lower torso or hips. I also like a little extra padding in the bust because it makes me feel more like a woman.” (Participant C8159)

4.2.7. The most and least liked dress styles

Overall, the dress with a scoop neck, natural waist, and A-line was the most favored among all the respondents (n = 165, 55%). The preference comparison was found not significant ($p = 0.33$) between the control (n= 106, 50%) and the experimental groups (n = 57, 53%). The control group respondents selected V-neck natural waist A-line (29%) and H-line dresses (20%) as the most preferred styles. The experimental group had fewer style choices for their body shapes; thus 38 out of 59 experimental participants (67%) selected the V-neck natural waist A-line, more than half (58%) participants selected scoop neck no waistline A-line dress, and 53% selected the scoop neck natural waist A-line dress. V-neck, natural waist, with A-line or H-line styles were both showing significant differences between the control and experiment groups ($p < .001$). Strapless, natural waist, with A-line or H-line also showed significant difference ($p < .001$) between the groups.

The participants were asked about their intention of wearing the recommended dresses (Yes = 3, Maybe = 2, No = 1). As compared to the control group, more participants in the experimental group indicated higher intent to wear the recommended styles for their body shapes. However, 106 control participants who had all dress style options (M = 2.31, SD = 0.48) as compared to the 59 experimental participants (M = 2.41, SD = 0.42) showed not significantly difference, $t(164) = -0.88, p = .19$. A chi-square test of independence was performed to examine the relation between body shapes and intention to wear the recommended styles. The relation between these variables was significant, $\chi^2(2, N = 165) = 8.73, p = .027$. Inverted triangle shapes

were more likely than other body shapes to wear the recommended styles. Triangle body shapes were the least likely to wear the recommended styles.

For the least liked selections, the control group disfavored strapless, no waistline, and A-line dress style (n=106, 40%); whereas the experiment group disliked the V-neck, no waistline, and A-line dress (n=57, 70%). Both groups selected V-neck / scoop neck, no waistline, and A-line as the top disliked styles, which were slightly different from the overall experts' style recommendations. The experts' interview results as well as literature findings suggested strapless, no waist, with H-line (n₁), and strapless, drop waist, with H-line (n₂) were not recommended for all body shapes. Only a few participants selected these two styles (n₁ = 8, n₂ = 5) as liked (Table 9).

Table 9.

Selected dress style combination by the testing condition (control & experiment)

	Control		Experiment		Control		Experiment	
	Liked	%	Liked	%	Disliked	%	Disliked	%
ScoopNeck_Drop_A-line	6	6%			15	14%		
ScoopNeck_Drop_H-line	7	7%			10	9%	13	31%
ScoopNeck_NaturalWaist_A-line	53	50%	30	53%	3	3%		
ScoopNeck_NaturalWaist_H-line	20	19%	15	38%	13	12%		
ScoopNeck_NoWaistline_A-line	16	15%	14	58%	37	35%	7	41%
ScoopNeck_NoWaistline_H-line	8	7%			12	11%	14	33%
Strapless_Drop_A-line	5	5%			28	26%	19	37%
Strapless_Drop_H-line	5	5%			25	23%	23	40%
Strapless_NaturalWaist_A-line	19	18%	25	44%	8	7%		
Strapless_NaturalWaist_H-line	7	7%	14	50%	16	15%	4	22%
Strapless_NoWaistline_A-line	7	7%			43	40%	8	29%
Strapless_NoWaistline_H-line	4	4%			12	11%	33	58%
V-neck_Drop_A-line	8	7%	1	4%	17	16%	6	55%
V-neck_Drop_H-line	3	3%	4	24%	10	9%	14	33%
V-neck_NaturalWaist_A-line	31	29%	38	67%	2	2%		
V-neck_NaturalWaist_H-line	21	20%	25	48%	6	6%		
V-neck_NoWaistline_A-line	14	13%	5	16%	40	37%	12	71%
V-neck_NoWaistline_H-line	12	11%			9	8%	14	58%

4.2.8. Selected dress styles by body shapes

Although preference rankings varied (Table 10), all body shapes shared top interests in scoop neck, natural waist, A-line dress, and the V-neck, natural waist, A-line dress (hourglass 18%, inverted triangle 24%, oval 18%, rectangle 21%, and triangle 20%). Hourglass body shape respondents indicated high interest in natural waist and H-line regardless of neckline types. Comparably, triangle and rectangle body shapes preferred the combination of natural waist and A-line regardless of neckline types. Oval body shapes preferred A-line silhouette with all combinations except drop waist (2%) and strapless (3%). Inverted triangle body shape participants favored a natural waist for both V-neck and scoop neck. However, eighteen participants considered themselves as an inverted triangle, but only two were identified as such based on the FFIT calculation. Thus, the dress style preferences for the inverted triangle body shape could not be concluded.

Generally, the selected dress style results from each body shape were consistent with a few exceptions. The top suggestion of printed and online media research, and stylists' interviews was natural waistline and H-line silhouette for hourglass, whereas the top selected styles by hourglass participants was natural waist with A-line. The second suggested styles for oval shape were V-neck, and no-waist with A-line, but oval participants preferred the combination of the scoop neck, no waistline, and A-line.

Table 10.*The most liked dress styles by the self-identified body shapes*

Liked Styles	Hourglass	Inverted Triangle	Oval	Rectangle	Triangle
	n = 153	n= 54	n= 114	n = 81	n= 87
ScoopNeck_NaturalWaist_A-line	18%	24%	18%	20%	20%
V-neck_NaturalWaist_A-line	16%	15%	19%	21%	13%
ScoopNeck_NaturalWaist_H-line	13%	7%	4%	4%	7%
V-neck_NaturalWaist_H-line	12%	11%	7%	11%	9%
Strapless_NaturalWaist_A-line	8%	6%	11%	16%	11%
Strapless_NaturalWaist_H-line	7%	6%	4%	0%	5%
V-neck_NoWaistline_A-line	5%	0%	5%	1%	10%
ScoopNeck_NoWaistline_A-line	4%	9%	11%	6%	6%
ScoopNeck_NoWaistline_H-line	3%	6%	2%	2%	2%
Strapless_Drop_H-line	3%	0%	2%	1%	1%
V-neck_NoWaistline_H-line	3%	0%	3%	6%	6%
ScoopNeck_Drop_H-line	2%	0%	3%	1%	2%
Strapless_NoWaistline_A-line	2%	2%	3%	0%	1%
ScoopNeck_Drop_A-line	1%	2%	2%	1%	1%
Strapless_Drop_A-line	1%	4%	1%	1%	1%
V-neck_Drop_H-line	1%	2%	2%	2%	2%
V-neck_Drop_A-line	1%	4%	4%	2%	1%
Strapless NoWaistline H-line	0%	4%	1%	2%	1%

Each body shape group had different preferences for the least liked dress styles. Strapless, drop waist, and A-line dress was the top pick by the hourglass (14%) and inverted triangle (17%) body shapes. Oval (15%) selected strapless, no waist, and H-line as the least liked. Strapless, no waist, and A-line was ranked top as disliked by triangle (15%) body shape. Rectangle body shape (14%) selected V-neck, no waist, and A-line as the least liked. Mostly the participants' disliked styles were consistent with the not-recommended styles by the stylists as well as by the online and printed resources. Rectangle body shape, on the other hand, disliked no waistline the most, whereas the drop waist was the least recommended.

Table 11.*The least liked dress styles by self-identified body shapes*

Disliked Styles	Hourglass n= 153	Inverted Triangle n = 54	Oval n = 114	Rectangle n= 78	Triangle n = 87
Strapless_Drop_A-line	14%	17%	7%	5%	8%
Strapless_NoWaistline_A-line	12%	9%	5%	13%	15%
V-neck_NoWaistline_A-line	10%	13%	5%	14%	14%
ScoopNeck_NoWaistline_A-line	9%	6%	10%	10%	9%
V-neck_Drop_A-line	8%	6%	3%	3%	3%
Strapless_Drop_H-line	7%	9%	12%	10%	11%
Strapless_NoWaistline_H-line	7%	9%	15%	13%	2%
V-neck_NoWaistline_H-line	6%	2%	7%	5%	2%
ScoopNeck_Drop_H-line	5%	4%	4%	8%	5%
V-neck_Drop_H-line	5%	7%	5%	3%	7%
ScoopNeck_Drop_A-line	4%	4%	2%	4%	5%
Strapless_NaturalWaist_H-line	4%	4%	7%	1%	3%
ScoopNeck_NoWaistline_H-line	3%	6%	10%	6%	5%
ScoopNeck_NaturalWaist_H-line	2%	2%	4%	3%	2%
Strapless_NaturalWaist_A-line	1%	2%	2%	0%	3%
V-neck_NaturalWaist_H-line	1%	2%	1%	1%	2%
ScoopNeck_NaturalWaist_A-line	0%	0%	1%	1%	1%
V-neck_NaturalWaist_A-line	0%	0%	1%	0%	1%

4.2.9. Selected dress details by the body shapes

The comparisons of the liked garment details by each body shape were given in Figure 12. The x-axis represented the percentage of participants' selection within that body shape category.

Regardless of testing conditions, all body shape selected natural waist and A-line as the top preferred garment details. V-neck was highly preferred by rectangle body shapes, whereas scoop neck was favored by inverted triangle shapes. Drop waist, no waistline, and strapless were least preferred among all body shapes. Opinions towards strapless were consistent for all body shapes.

Figure 12.

The most liked dress details by self-identified body shapes

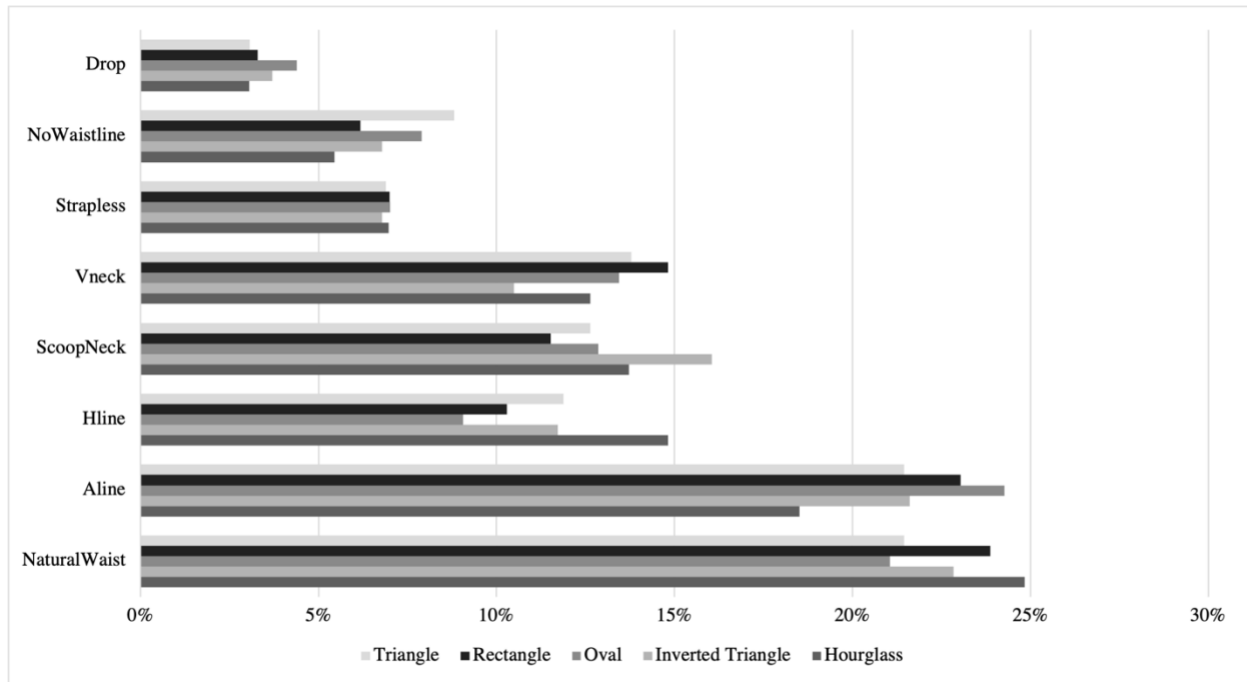
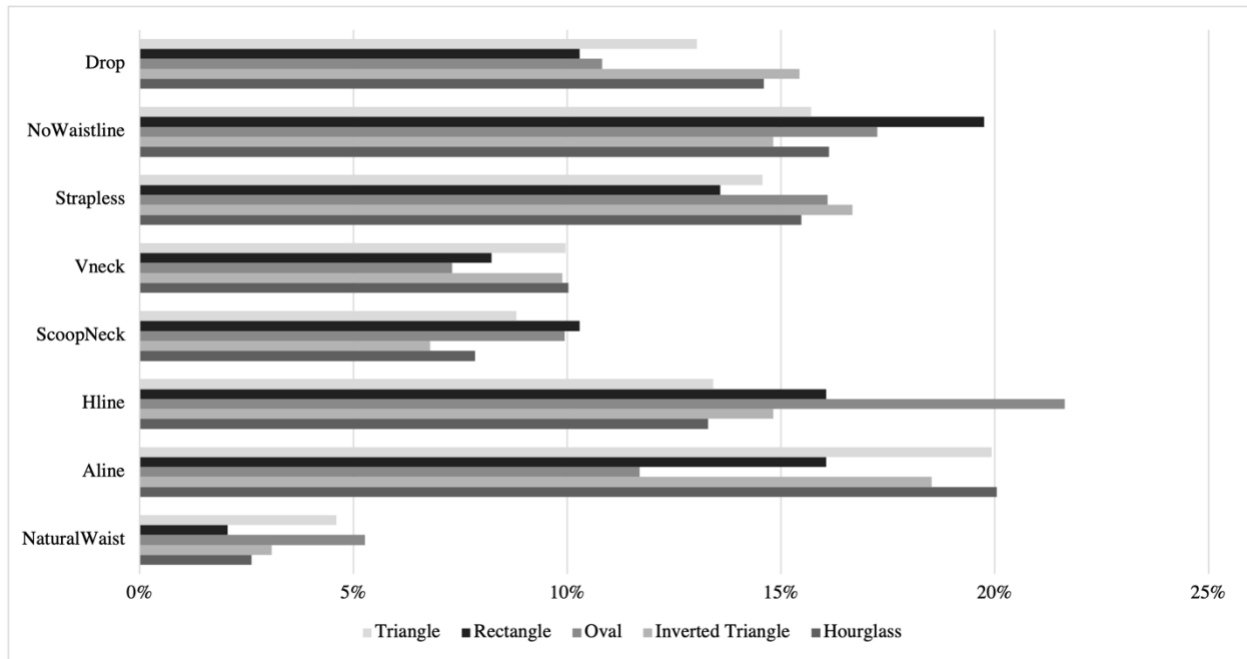


Figure 13 compares the disliked garment details by each body shape. The x-axis represented the percentage of the disliked styles that the participants selected. Drop waist and no waist were unfavored among all the body shapes. Oval shape participants had notable negative preferences towards the H-line silhouette. Triangle and hourglass body shapes selected the A-line silhouette as a disliked style. Likewise, participants with rectangular body shape disapproved of the no waistline designs. These findings were consistent with Arnheim's (1938) Gestalt theory of visual balance, emphasizing the balance of composition and visually pleasing symmetry. The rectangle body shapes with no waistline emphasized the rectangle outline, which was the opposite intent of creating body curves. Inverted triangle body shapes in H-line enhanced the narrow hip shape that disrupted the body shape balance between the upper torso and lower torso.

Figure 13.

The least liked dress details by self-identified body shapes

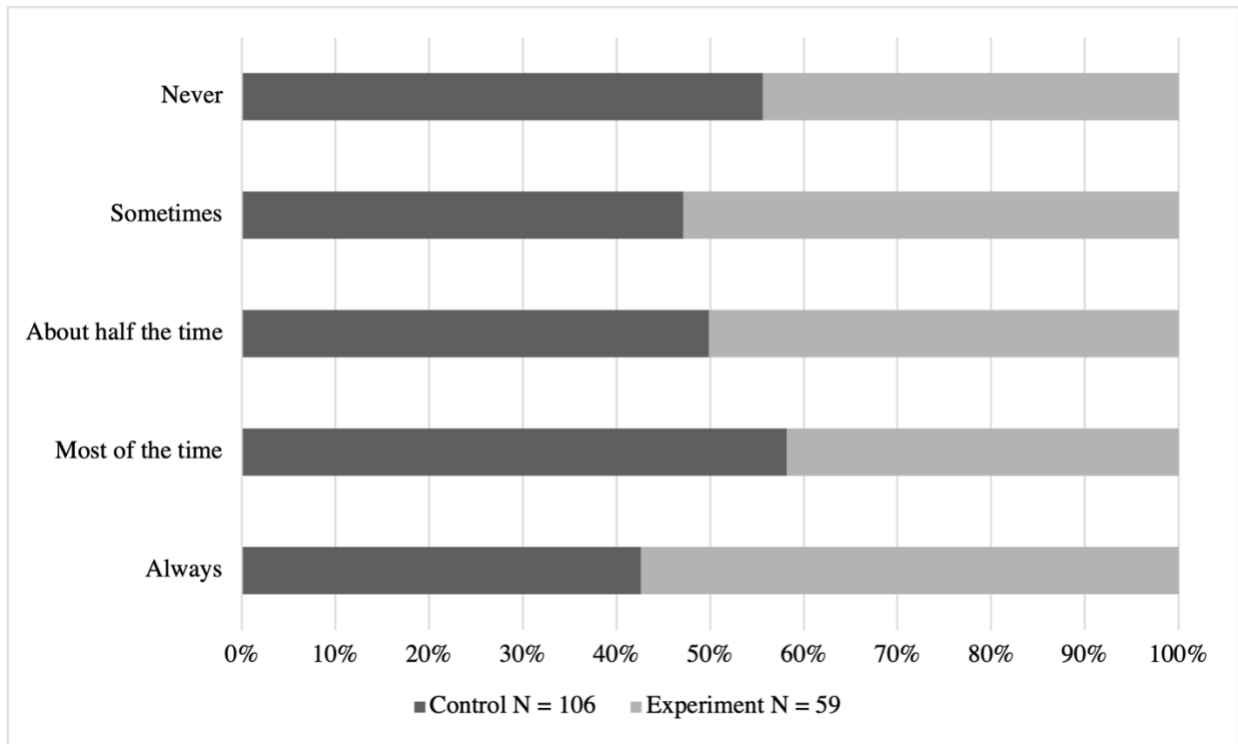


4.2.10. Intention toward wearing the selected dresses

Based on the result of the survey after 3D dress selection engagement, 49% of the experimental and 42% of the control group participants responded positively towards the intention to wear the recommended dresses. According to Figure 14, the experimental group would wear the recommended dresses more frequently than the control group. However, there was no statistical difference found between the control and experimental groups ($p > .050$). Control group ($M = 2.64$, $SD = 1.00$) and the experimental group ($M = 2.59$, $SD = 0.98$) would wear the dress between “About half the time” and “Sometimes.” The intention towards wearing the selected/recommended dresses between the control and experimental groups was not conclusive.

Figure 14.

How often would you wear the selected/recommended dresses?



4.3. Responses to the open-ended survey questions

4.3.1. Design suggestions

Participants were asked to provide design suggestions for dresses made for their body shapes. One participant mentioned that body shapes different from the hourglass shape were more likely to have fit issues. Two participants expressed the design should make their physical look slimmer. Waist-emphasizing or hourglass-shape mimicking designs were also demonstrated. Besides adjusting length for different heights of women, providing options of torso length was also suggested as different bodies had different placement of waistlines.

“... a dress may fit me in the bust and hips but is too large in the waist. This makes it challenging as I can sometimes be an "in-between" size and must purchase a dress that does not fit me perfectly.” (Participant C8424)

“... dresses meant to be mid-thigh end up being short-short because of my longer torso and curvature of my butt. It is especially problematic (and near impossible) for me to find a romper or playsuit that actually fits because of these issues.” (Participant C9108)

“Too often I find cute dresses that I can't get over my hips or fit my hips/waist and are huge on my bust and shoulders.” (Participant E1370)

4.3.2. Feelings when shopping for body shapes

Only 20% of all participants expressed positive feelings toward shopping for their body shapes. Two types of negative feelings were expressed throughout the comments self-blaming and disappointment with the limited options. Multiple participants felt unconfident and stressed during shopping because they could not find items that they liked to fit their body shape. Several other comments expressed frustration as dresses seemed to design for only one figure and not flattering on their body shape.

“I get frustrated that a lot of dresses are designed for only one body type.” (Participant E9304)

*“I wish there were things that are more modest and flattering for my figure.”
(Participant E4428)*

“It's stressful and difficult to find the right dress, especially when many of the fashionable and trendy options just don't look good with my body type.” (Participant E9356)

4.3.3. Feelings when selecting sizes for body shapes

Only five participants expressed positive and confident feelings when selecting sizes for their body shapes. The most frequently mentioned emotion-signaling words among the responses were overwhelmed, confusing, difficult, and frustrated. Two main challenges of the sizing selection were explained in the comments. The first challenge was the difference between fabrics. The same size could have different fit on their body shape with different fabrics. The other challenge was that each brand had a different size and fit with the same letter or number.

“Usually, women with my size bust and ribcage fit into a size 0-2 dress, but depending on the style and fabric, I usually don't fit because my butt and hips are too big for a size 0-2.” (Participant E4513)

“This can be a complicated process because my dress size can vary depending on the brand, so I almost always wear a different size in each brand.” (Participant E9598)

*“I am frustrated that the sizing for different brands is all over the place, and I get really frustrated when stores mix their teen clothing in with adult clothing because the sizing is different between the two. It makes shopping very difficult and time-consuming.”
(Participant E9356)*

4.3.4. Effect of dress styles on individual's confidence

Participants were asked whether they felt more confident when wearing certain dress styles. Except for ten comments that had no strong feelings towards styles, 94% of participants expressed feeling confident about certain dress styles and suggested the styles for their body shapes. Hourglass body shape participants preferred well-fitted dresses with a defined waistline, such as fit and flare and bodycon dresses. Inverted triangle preferred to wear dresses that created a curvy illusion, such as A-line and flowy dresses. Oval body shape participants emphasized the proper fit as the most important condition. They felt more confident if the design could visually

make the oval body shape slimmer. Rectangle body shape participants shared two different style preferences: trend sporty or loose fitted. These comments were consistent with the stylist's interview suggestions, which also suggested rectangle body shapes tended to be more athletic looking. Triangle body shape participants felt confident when dresses were comfortable, especially not too tight or body hugging.

"I love styles that feel flirty and special as it gives me confidence, yet not flashy."

(Participant C4259)

"Dresses that accentuate my upper body by being fitted definitely make me feel more confident because I am proud of my shape." (Participant C6757)

"... dresses that accentuate certain body parts make me feel confident. I like dresses which give the illusion that I am curvier." (Participant C1462)

4.3.5. Other comments

A few suggestions were identified by the participants in the last survey comments. Half of the comments thought the website was fun and interactive. A few comments highlighted the 3D interactive renderings were engaging; however, they also felt limited with style, color, and fabric choices. As the presented avatar was generated based on the FFIT calculation of their body measurements, several participants commented that they could not reflect their body shape to the rendered avatar. Other suggestions towards the quality of the rendered dress styles and the testing website were interpreted under the discussion section.

"There are doing to be people who are extra short and extra tall. I know there is more of a push to be inclusive with sizes but most of that is about weight and not height. ... rarely do brands do petite and even if they do, they are still not perfect or there is a very, very limited supply." (Participant C7129)

“Maybe include a weight portion to the 3d rendering because I think the height and weight of a person would influence how the rendering comes out and therefore our dress decisions...” (Participant C9104)

*“The texture and color are limited - and the model is not similar to my body shapes.”
(Participant C5896)*

“The 3-D models are not very accurately rendered. Like the pattern for the fabric is so-so and it feels very rudimentary.” (Participant C1643)

“Survey was fine but the options in the dress recommendation website seemed limited in styles.” (Participant C9442)

CHAPTER 5

DISCUSSION

The purpose of this research was to develop and evaluate a body shape-based style recommendation system by matching with preferred apparel style. To understand the preferred styles for each body shape, suggestions and opinions were collected from printed and online media research, and stylists' interviews. Previous studies have suggested that clothes that were made based on individual body shapes resulted in providing higher fit satisfaction (Song & Ashdown, 2012, Hidayati et al., 2018), market acceptance (Ashdown & Loker, 2015), and style preferences (Sattar et al., 2019). The research objectives were to discover the relationship between the following:

- 1) Garment silhouettes and designs suggested by experts for each body shape to develop a style-by-body shape recommendation system.
- 2) Garment styles and fit preferences based on body cathexis and body shapes
- 3) Intention to adopt the style recommendation system

Although many advanced machines learning algorithms were explored and constructed in the fashion recommendation sector (Hardesty, 2022, Pazzani & Billsus, 2007, Reddy et al., 2018), this study experimented with a framework to collect an unweighted opinion dataset and build it into a score ranking system, where the higher score indicated the scale of recommendation. To understand the preference of styles for different body shapes, this study investigated six fashion blogs and interviewed ten stylists to define the expert opinions. A score-based ranking system was adopted to build the style recommendation. Although the collected data was limited to a small sample, it revealed the potential for expansion and potential adoptability in business usage. This study investigated research objectives 2 and 3 with 161

participants: 102 participants experimented with the dress selection without the recommendation system, and 59 participants experienced the dress selection with the recommendation system.

Many studies explored the relationship between body shape and body cathexis (Alexander et al., 2005), body satisfaction (Sidberry, 2011), and attractiveness (Singh, 1993). Few findings have been identified to investigate the aesthetic relationship between body shapes and garment design styles.

5.1. Research objective 1: The garment silhouette and designs suggested and preferred for each body type

With the continued growth of digital shopping, fashion retailers and consumers had shown increasing demand for style recommendation systems. Due to the physical feature differences between each body shape, different style details were expected for each body shape. In the first part of the research, the recommended style details collected from fashion blogs, books, and stylist interviews were observed to contain both similarities and differences. The qualitative interview questions with stylists suggested that creating visual balance and proportion for each body shape to achieve a visually aesthetically pleasing appearance were the goals through the styling sessions. The findings supported a previous study by (Anyan & Clarke, 2012) that stylists held a creative position in manifesting the visual presentation of the model or the client. In this research, all resources of style recommendation by body shape opinions were weighted equally by constructing the +1/-1 score system.

5.1.1. Printed and online media research, and stylists' interviews

The present study findings indicated that professional fashion stylists' dress style recommendations were different for each body shape. A natural waistline with an A-line silhouette combination was the most recommended style among all five body shapes, whereas

drop waist and strapless shoulder were the least recommended style details. Defining the waistline was essential to start a styling session for all body shapes. Although different dress styles were suggested by the printed and online resources, and the stylists, it was emphasized that creating psychological confidence and physical comfort were the main goals while identifying the style of appearance and outfits.

5.1.2. Participants' preferred dress styles

The commonly preferred dress style was scoop neck, natural waist, and A-line silhouette, yet the preference was ranked differently for different body shapes. No waistline and natural waistline were preferred by the oval body shape participants; in contrast, hourglass participants showed little interest in no waistline designs. Drop waist was the least preferred style regardless of the combination, which was consistent with the previous result from the printed and online media research, and stylists' interviews. Strapless was preferred by the rectangle, oval, and triangle body shape participants only when paired with a natural waistline. This was slightly different from the stylists' suggestions. Overall, an A-line shape was liked more than an H-line shape.

Hourglass was more likely to be the ideal body shape and indicator for the young as the fashion industry, internet influences, and the manufacturer used dress form. Rectangle and inverted triangle shapes presented a more athletic and fit look. Oval and triangle shapes were more likely to indicate maturity and are mother-like. A natural waistline with an A-line silhouette combination was the most recommended style among all five body shapes. Drop waist and strapless shoulder were the least recommended style details.

Natural waistline and A-line were consistently preferred the most throughout the investigation. V-neck was suggested to associate with face features and shoulder types during the interviews. The ideal body shape remained as an hourglass, which was suggested to have a

broader range of styles to wear with fewer fit concerns. The survey results indicated high preferences in emphasizing the waistline and low interest in drop and no waist. The oval body shape was considered the most challenging to style during the stylist interviews with two dress goals: to flatten the belly area, and to visually look smaller. A-line was highly preferred by the participants regardless of the combination. Although fewer participants were inverted triangles in this research, the H-line design was preferred only when it was paired with no waistline, which was opposite to the results of the expert investigation. All five body shapes had different recommended style combinations, which indicated that body shapes were an essential element in style selection. The preference may vary based on an individual's opinion. Based on the interview analysis, stylists' style recommendations are not only based on the body shapes but also the height, facial shape, torso length, and individual preferences. It was emphasized among the interviewees that defining the waistline was one of the first steps in selecting styles.

5.2 Research objective 2: Garment styles preferences based on body cathexis and body shapes

5.2.1. Body shape categorization

Based on the interview results, it was highlighted that each women's body shape was all different. Younger generations were more likely to recognize themselves as an hourglass shape. Middle to older generations were more likely to identify themselves as the triangle and oval shapes, which also indicated lower confidence in selecting dress style and fit in the open-ended questions. Although the hourglass was suggested to be the ideal female body shape, women may also think of their own body shape as the ideal body shape. This could be influenced by the body positivity trend, as well as confidence in self-image. The findings also revealed that people disagreed with the FFIT-calculated body shape as not reflecting the actual body proportion and

fat distribution. Participants were more confident to select dress styles for their self-identified body shape rather than the assigned one. In addition, the participants advocated for more options to be included in the body shape categorization, such as torso length, height, or bust sizes. Both the stylists' interviews and the qualitative answers revealed the possibility of body shape changing in individuals due to giving birth, working out, or lifestyle changes. As a result, an individual's body shape might be categorized as a temporary reference.

5.2.2. Body cathexis and the dress fit

The respondents indicated higher satisfaction towards face, hair, and shoulder. All body shapes rated lower satisfaction on the mid-torso and waist, which was the key identifiers for body shape categorization. Hourglass and rectangle body shapes indicated higher overall appearance satisfaction than inverted triangle and triangle. Oval body shape had lower overall satisfaction with their look. These results were consistent with the previous findings from the literature reviews. The oval body shape was identified as correlated with fatness and causing health conditions, which might also lead to social pressures and negative self-images (Bailey et al., 1990, Singh, 1994, Shih 2005). The qualitative answers also suggested that all body shapes, except the hourglass, faced the limited option of styles that could conceal the body imperfections and enhance the positive body parts. Although participants disagreed with the FFIT-calculated body shape, they shared a positive attitude towards more style variations. Expanding style selections encouraged different body shapes to seek for options to create visual curves with designs.

The findings also suggested that different body shapes had different clothing fit preferences. Hourglass, triangle, and inverted triangle body shapes tended to prefer more fitted dresses, whereas rectangle and oval preferred less fitted clothes. Body shapes and fit preferences

were correlated. However, the qualitative analysis of the open-ended questions revealed that specific fitting preferences could vary for individuals. Even though hourglass shapes generally indicated less concern about fit during dress shopping, some participants shared negative fit perceptions towards the loose waist, tight bust, or tight hip from the mass-produced garments. Regardless of the body shape, getting the dress customized or tailored based on the individual's preference of shape and fit was suggested to solve the fit issue.

5.3 Research objective 3: Acceptance and intention to adopt the style recommendation system

In the present study, unlike other studies, the experimental group participants were not informed that they were given recommendations by the experts. Therefore, it was intended to see if people would resonate more with the given expert suggestions even though they did not perceive the dresses as curated by the experts. The intention to adopt the style recommendation was not significantly different between the control and experimental groups. Although the experimental group selected similar liked and disliked styles as the control group, the experiment group showed negative impressions with the limited style options. Based on the style selection result, the drop waist and no waistline were found to be the lowest agreement between the control and experiment groups, which indicated that style details might be favored as personal preferences. Additional variables, such as personal aesthetics, physical comfort, or geographic locations, should be considered to improve the recommended style accuracy.

The initial creation of the recommended system was to reduce the overburden of information and options for the participants. From the algorithm perspective, the style recommendation system acted as a filter for consumers to focus on fewer selections and more efficient decision-making. Rather than filtering styles, in this research, participants felt limited

by the recommendation system. A recent machine learning study suggested improving the recommendation system with ranking-sensitive optimization of top-k precision (Muramoto & Yu, 2020), which identified improved engagement when the recommended and partial non-recommended contents were presented. The conditions, including but not limited to creating random sorting of the recommended and not recommended styles, the pattern of displaying the two conditions, or adding the rank-sensitive algorithm, would be worthy to investigate within the style recommendation system to understand the effect of including the non-recommended style on the acceptance of the recommendation system.

Based on the qualitative analysis, both groups indicated positive feelings towards the style recommendation system with 3D engagement by enabling avatar and dress rotation. Unlike 2D photos, 3D interaction enabled the participant to control visibility at all angles, where the participants could better assess the overall style look and fit accuracy of the body. This finding might guide further exploration of the 3D shopping experience in retail settings. If the 3D avatar could simulate individual body shapes more accurately, the 3D dress rendering could lead to a more interesting online shopping experience, as well as fitting judgment. A few virtual fashion companies, such as DressX and The Fabricant, investigated the digital creativities and fashion designs in the Metaverse and NFT areas. Digital apparel designs or recommendations for various body shapes have not yet been explored in the fashion business.

CHAPTER 6

CONCLUSION

The present study developed and tested a body shape-based style recommendation system through a 3D interactive website with potential consumers. Body part satisfaction, body shape identification, purchase intention, and dress style selections were investigated to understand how women with different body shapes made the decision on dress styles. Both quantitative and qualitative answers were collected to analyze the style preferences and recommendation effectiveness for each body shape. Each body shape type indicated different overall dress styles and design details. However, the results suggested no significant differences in wear and purchase intentions between the control (without the style recommendation system) and the experimental (with the style recommendation system) groups. With their answers, the participants with different body shapes validated the recommended dress styles and design details given by the printed and online media research, and stylists' interviews.

This research was the first study investigating style recommendations for different body shapes based on printed and online media research, and stylists' interviews. The results may inspire an in-depth investigation of body shapes and fashion style recommendations to enhance individual apparel selection. The recommended dress styles and design details on different body shapes could be referred to during designing, patternmaking, and fitting sessions. For instance, designers may consider the preferred design details for their focused body shape groups. The style preferences for different body shapes could be employed during sample making and fitting, as well as marketing aspects. For example, online retailers may offer expert opinions to guide shoppers on proper dress fit and style.

The research also attempted to clarify the concept of styling balance and aesthetics. Styling was found to achieve several aims: psychological confidence, ideal body shape emphasis, sizing fit, physical comfort, and clothing functions. All stylists recognized dressing for psychological confidence within body cathexis and social context. No matter which body shape the person is, enhancing positive feelings toward their body shape enabled their chance to find extensive outfit style options. As a physical attribute, wearers may change outfits easily but are less likely to change their body shape. Although people may have distinctive visual preferences, emphasizing the visual balance between the dress and body shape was discovered with two primary purposes: "to conceal" and "to embrace" certain body parts. Identifying the correct clothing size was found to be challenging during shopping. The oval and the plus sizes are more likely to be limited with available sizes in the market and have a higher risk of misfit. When shopping for clothes online, fit can only be assessed based on the visual presentation, such as model photos or virtual prototypes. Different brands vary in size and models, which causes challenges for consumers. Physical comfort also contributes to the aesthetic fit. Styling for comfort includes clothing fit to the body and designs to flatten undesired curves of the shape. Lastly, clothing is a foundational need to cover and protect body parts, which affects consumers' assessment of styling aesthetics.

Additionally, all dress styles were designed in 3D format and enabled with rotating features on the website. Positive perception towards 3D dress style engagement was discovered as fun, engaging, and valuable. However, negative feelings toward the limited styles were discovered within this research's capacity. The prototyping and website development process involved advanced software and coding language skills. As new versions of the 3D render tool, interactive clothing websites could emerge to meet such a need. Similar 3D virtual online

engagement could contribute to expanding consumers' digital experience and reducing design sample-making production.

Limitations and future research

In this study, the adopted FFIT system was validated with one of the most significant numbers of anthropometric datasets to ensure all types of combinations can be categorized; however, the qualitative findings indicate the categorized body shape does not align individual's self-identified body shape. Although self-identified body shapes may not be factual, FFIT-calculated body shapes introduced an uncertain attitude towards the recommendation system. A few participants questioned the 3D avatar not matching their body type, which led to selecting dress styles for the avatar rather than their own body shape. Future studies could explore 3D avatars with self-identified body shapes so that participants feel more confident in style selection.

Dress style option limitation was also advocated throughout the qualitative comments, especially for the experimental group with the recommendation system. Besides their body shapes, multiple effects, such as season, location, lifestyle, and religion, might impact a person's outfit choices. Trends, which represent the societal influence on style choice, should also be taken into the recommendation system. As trends passed through the internet and social media quickly, some dress styles, colors, or fabrics, were more preferred by consumers than others. Events like celebrities, social occasions, or brand runway shows could all influence consumers' choice of their outfits.

Although various style combinations were presented in this research, the study was limited to stylists and participants recruitment. All stylists were from the U.S., with only one male, which might limit the diversity of opinions. Each stylist showed a different interest in outfit styling. Some stylists focused on photoshoots and performance styling, whereas some

focused on professional look styling. Including more diverse stylists, styling books, and online resources in future research could increase the accuracy of the style recommendation system. As for the control and experimental participants, due to the significant age difference, the result might be affected due to generational opinions and age-related aesthetic preferences.

Additionally, both groups were not informed of the background of the expert recommendation. Future experiments might investigate the effect of the influencer's, expert's, or stylist's opinions on consumers' adoption of the recommendation system. For people who did not know how to style themselves, knowing the background of the style recommendation system might enhance the trustability and positive attitudes towards the styles suggested.

Within the 3D avatar and dress style options, expanding the garment detail options and alternative body shapes would be necessary for in-depth learning. In this study, silhouette and style preferences were found to vary based on individuals' opinions. The preferred garment styles might vary based on physical fit, psychology, occupation, and body proportion for the same body shape. Even though the 3D dress was prototyped on the avatar, participants could only make the visual judgment based on their preference. According to suggestions from the stylists, the future study may examine trust in recommendations and the preferences of styles, including facial shapes, height, torso length, and alternative body shape categories.

Moreover, this research was conducted during the COVID-19 pandemic, which introduced an exceptional setting to the perception. With the rising trend of working from home, causality impacted the preference for fit as fewer formal outfits were worn. Other aspirational art influences may impact the result during this period. It was found that art and music are also key

influencers of the taste of fashion (McRobbie, 1999). It is worth investigating the body shape in relation to the style preference under different art and music influences.

Future participant recruitment to have a border sample with more details of their religion, cultural background, and geographic location to better present the appropriate dress styles. As the results contained different participants between the control and experimental group, future studies should attempt to recruit equal numbers for each condition to enhance the internal validity. Very few inverted triangles body shapes were identified in this research. Nevertheless, a few expert stylists highly prefer them. Extensive learning of the same topic may investigate each body shape separately to identify aesthetic preferences in style and expand style options within the recommendation system.

Under a survey format, participants may not perceive the same experience as the natural shopping settings. Based on the qualitative comments, the main suggestion is to include more design details and options, such as more color, fabric, sleeve, and length choices. The current results may inspire an in-depth investigation of body shapes and fashion style recommendations to enhance individual apparel selection. Moreover, the findings may provide design, manufacture, and retail references for different body shape segments and encourage individuals to better understand body shapes and proportions. Providing an engaging shopping experience with multiple options could enable fashion brands, retailers, and manufacturers to collect multi-variable data from consumers, which may increase the accuracy of design-to-market strategy and reduce production waste.

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APPENDIX I: IRB APPROVAL



Cornell University
Office of
Research Integrity and Assurance

Institutional Review Board for Human Participants
Cornell University
395 Pine Tree Road, Suite 320
Ithaca, NY 14850
<https://researchservices.cornell.edu/offices/IRB>

Institutional Review Board for Human Participants

Concurrence of Exemption Notice

To: Wenjia Zong (wz74)
Protocol Number: IRB0010217 (2103010217)
Protocol Title: Dress Style Recommendations based on Female Body Shapes
Approval Date: 03/31/2022
Expiration Date: None

Your request for the following change(s) to the protocol referenced above has been approved:

- Addition of new recruitment sites.
- Change to incentives for participation-for participants being recruited from the new sites.

Your protocol continues to be eligible for exemption from IRB review according to Cornell IRB policy and under the Department of Health and Human Services Code of Federal Regulations 45CFR46.104(d).

Please note the following:

- Investigators are responsible for ensuring that the welfare of research subjects is protected and that methods used and information provided to gain participant consent are appropriate to the activity. Please familiarize yourself with and conduct the research in accordance with the ethical standards of the [Belmont Report](#).
- Investigators are responsible for notifying the IRB office of change or amendments to the protocol and acquiring approval or concurrence BEFORE their implementation.
- Progress reports, requests for personnel or other administrative changes, or requests for continuation of approval are not required for the study. However, upon conclusion of the study, please submit a Project Closure request through [RASS-IRB](#).

For questions related to this application or for IRB review procedures, please contact the IRB office at irbhp@cornell.edu or 607-255-6182. Visit the [IRB website](#) for policies, procedures, FAQs, forms, and other helpful information about Cornell's Human Participant Research Program.

APPENDIX II: CONSENT FORM

Research Consent Form (Stylist Interview)

I am asking you to participate in a research study titled “Dress Style Recommendations based on Female Body Shapes”. I will describe this study to you and answer any of your questions. This study is being led by Wenjia Zong, Department of Fiber Science and Apparel Design at Cornell University. The Faculty Advisor for this study is Professor Fatma Baytar, Department of Fiber Science and Apparel Design at Cornell University.

What the study is about

You are invited to participate in this study to explore body shapes and personal outfit styles as a part of my thesis. This study is being conducted by Wenjia Zong, graduate student, under the direction of Dr. Baytar, Assistant Professor at Cornell University Department of Fiber Science and Apparel Design. You were selected as a potential participant as you are a Fashion Stylist.

What we will ask you to do

Your participation is completely voluntary. If you decide to participate in this research study, you will be asked several questions in related to fashion dress styling and body shapes. Your total time commitment will be 45-60 minutes.

Risks and discomforts

We assure that the participation in this study would put you in no physical or psychological risks other than the minimal inconvenience of participating in the interview. Personal information collected through this questionnaire will be kept confidential and used only for the purpose of this study. No identifiers will be used to link your responses to your identity.

Benefits

This study may provide personalized clothing style and size recommendation to the general population. Product designers, clothing manufactures, fashion marketers may design, produce and promote products that can better style and fit the preference of the customers.

Compensation for participation

To thank you for your time of participation, a gift card (\$15.00) will be offered to 10 participants.

Audio/Video Recording

As part of this research project, we may audio and videotape recording of you while you participated in the interview. We would like you to give permission to record and use for the

study. We will only use the videotape in ways that you agree to. In any use of this videotape, your name would *not* be identified.

Indicate *Yes* or *No*:

I give consent to be audiotaped during this study.

Yes No

I give consent to be videotaped during this study:

Yes No

I give consent for drawings and illustrations during this study to be used for this study:

Yes No

I give consent for tapes resulting from this study to be used for used for scientific publications.

Yes No

Privacy/Confidentiality/Data Security

Your email and phone number will be only collected for sending you instructions of arranging interview. The emails and phone numbers will not be linked to the data, which will be de-identified for data analysis.

If you have questions

The main researcher conducting this study is Wenjia Zong at Cornell University. Please ask any questions you have now. If you have questions later, you may contact Wenjia Zong at wz74@cornell.edu or at 626-679-7796. If you have any questions or concerns regarding your rights as a subject in this study, you may contact the Institutional Review Board (IRB) for Human Participants at 607-255-5138 or access their website at <http://www.irb.cornell.edu>. You may also report your concerns or complaints anonymously through Ethicspoint online at www.hotline.cornell.edu or by calling toll free at 1-866-293-3077. Ethicspoint is an independent

organization that serves as a liaison between the University and the person bringing the complaint so that anonymity can be ensured.

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

Your Signature _____ Date _____

Your Name (printed) _____

Signature of person obtaining consent _____ Date _____

Printed name of person obtaining consent _____

This consent form will be kept by the researcher for five years beyond the end of the study.

APPENDIX III: CONSENT FORM

Research Consent Form (Participants)

I am asking you to participate in a research study titled “Dress Style Recommendations based on Female Body Shapes”. I will describe this study to you and answer any of your questions. This study is being led by Wenjia Zong, Department of Fiber Science and Apparel Design at Cornell University. The Faculty Advisor for this study is Professor Fatma Baytar, Department of Fiber Science and Apparel Design at Cornell University.

What the study is about

You are invited to participate in this study to explore body shapes and personal outfit styles as a part of my thesis. This study is being conducted by Wenjia Zong, graduate student, under the direction of Dr. Baytar, Assistant Professor at Cornell University Department of Fiber Science and Apparel Design. You were selected as a potential participant as you are a woman between ages 18-65.

What we will ask you to do

Your participation is completely voluntary. If you decide to participate in this research study, you will be asked to complete a questionnaire. Your total time commitment will be 10-15 minutes.

Risks and discomforts

We assure that the participation in this study would put you in no physical or psychological risks other than the minimal inconvenience of completing the questionnaire and body scan measurement. Personal information collected through this questionnaire will be kept confidential and used only for the purpose of this study. No identifiers will be used to link your responses to your identity.

Benefits

This study may provide personalized clothing style and size recommendation to the general population. Product designers, clothing manufactures, fashion marketers may design, manufacture, and promote products that can better style and fit the preference of the customers.

Compensation for participation

To thank you for your time of participation, a cash incentive (\$1.00) will be offered to 200 participants via MTurk.

Audio/Video Recording

No audio or video recording will be collected

Privacy/Confidentiality/Data Security

We will protect your privacy and the data you provide. Information collected through your participation may be published in a professional journal, and/or presented at a professional meeting. The emails will not be linked to the data, which will be de-identified for data analysis.

If you have questions

The main researcher conducting this study is Wenjia Zong at Cornell University. Please ask any questions you have now. If you have questions later, you may contact Wenjia Zong at wz74@cornell.edu or at 626-679-7796. If you have any questions or concerns regarding your rights as a subject in this study, you may contact the Institutional Review Board (IRB) for Human Participants at 607-255-5138 or access their website at <http://www.irb.cornell.edu>. You may also report your concerns or complaints anonymously through Ethicspoint online at www.hotline.cornell.edu or by calling toll free at 1-866-293-3077. Ethicspoint is an independent organization that serves as a liaison between the University and the person bringing the complaint so that anonymity can be ensured.

I have read the above information, and have received answers to any questions I asked. I consent to take part in the study.

Your Signature _____ Date _____

Your Name (printed) _____

Signature of person obtaining consent _____ Date _____

Printed name of person obtaining consent _____

This consent form will be kept by the researcher for five years beyond the end of the study.

APPENDIX IV: CONSENT FORM

Research Consent Form (Lottery Participants)

I am asking you to participate in a research study titled “Dress Style Recommendations based on Female Body Shapes”. I will describe this study to you and answer any of your questions. This study is being led by Wenjia Zong, Department of Fiber Science and Apparel Design at Cornell University. The Faculty Advisor for this study is Professor Fatma Baytar, Department of Fiber Science and Apparel Design at Cornell University.

What the study is about

You are invited to participate in this study to explore body shapes and personal outfit styles as a part of my thesis. This study is being conducted by Wenjia Zong, graduate student, under the direction of Dr. Baytar, Assistant Professor at Cornell University Department of Fiber Science and Apparel Design. You were selected as a potential participant as you are a woman between ages 18-65.

What we will ask you to do

Your participation is completely voluntary. If you decide to participate in this research study, you will be asked to complete a questionnaire. Your total time commitment will be 10-15 minutes.

Risks and discomforts

We assure that the participation in this study would put you in no physical or psychological risks other than the minimal inconvenience of completing the questionnaire and body scan measurement. Personal information collected through this questionnaire will be kept confidential and used only for the purpose of this study. No identifiers will be used to link your responses to your identity.

Benefits

This study may provide personalized clothing style and size recommendation to the general population. Product designers, clothing manufactures, fashion marketers may design, manufacture, and promote products that can better style and fit the preference of the customers.

Compensation for participation

To thank you for your time of participation, five \$20.00 e-gift cards will be given to randomly selected participants.

Audio/Video Recording

No audio or video recording will be collected

Privacy/Confidentiality/Data Security

We will protect your privacy and the data you provide. Information collected through your participation may be published in a professional journal, and/or presented at a professional meeting. The emails will not be linked to the data, which will be de-identified for data analysis.

If you have questions

The main researcher conducting this study is Wenjia Zong at Cornell University. Please ask any questions you have now. If you have questions later, you may contact Wenjia Zong at wz74@cornell.edu or at 626-679-7796. If you have any questions or concerns regarding your rights as a subject in this study, you may contact the Institutional Review Board (IRB) for Human Participants at 607-255-5138 or access their website at <http://www.irb.cornell.edu>. You may also report your concerns or complaints anonymously through Ethicspoint online at www.hotline.cornell.edu or by calling toll free at 1-866-293-3077. Ethicspoint is an independent organization that serves as a liaison between the University and the person bringing the complaint so that anonymity can be ensured.

I have read the above information, and have received answers to any questions I asked. I consent to take part in the study.

Your Signature _____ Date _____

Your Name (printed) _____

Signature of person obtaining consent _____ Date _____

Printed name of person obtaining consent _____

This consent form will be kept by the researcher for five years beyond the end of the study.

APPENDIX V: STYLIST INTERVIEW QUESTIONS

Study Title: Dress Style Recommendations based on Female Body Shapes

Stylist Expert Interview Questions

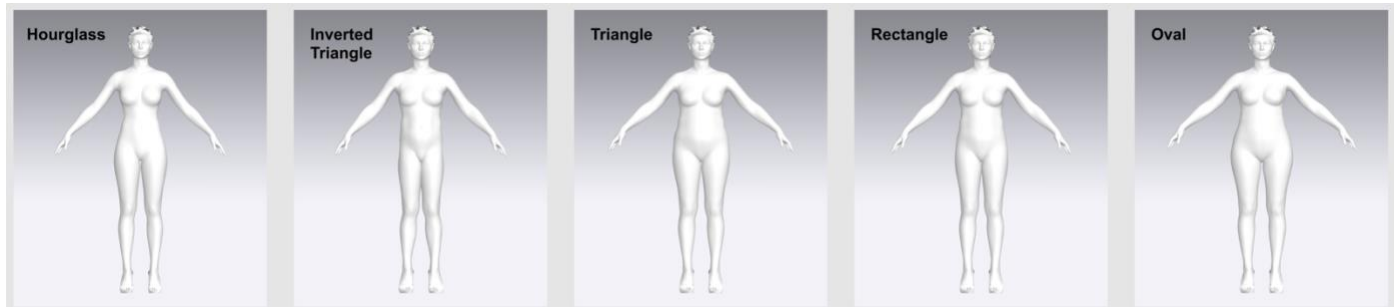
Demographic & Body Shape Satisfaction

Directions: Please answer the following demographic questions.

1. Gender at birth
2. Occupation
3. Which of the following represents your styling charge?
 - Under \$150
 - \$151 - \$499
 - \$500 to \$999
 - \$1000 to \$3000
 - \$3000 and above
4. Years of experience ()
5. Ideal body shape to style ()
6. What resource to get styling tips for different body shapes

Expert Stylist Interview Questions

“Hello! Thank you for accepting to help us better understand body shape- garment relationships. For the following questions, I will be showing you a group of body shape images and asking about your style recommendations – and why you would recommend them”



- 7- Describe your recommended dress styles for each body shape (different body shape images will be shown to probe conversations) & The rationale behind your recommendation

Body Shape	Dress Silhouette Recommendation	Dress Detail recommendation
Hourglass	What kind of silhouette would you style this body shape?	What kind of dress detail attributes would you style on this body shape?

	<p>How would you style to achieve this silhouette? Why would you style this body shape to achieve the silhouette?</p>	<p>How do you select the detail attributes during styling session? Why would you style this body shape with the suggested attributes?</p>
Triangle	<p>What kind of silhouette would you style this body shape? How would you style to achieve this silhouette? Why would you style this body shape to achieve the silhouette?</p>	<p>What kind of dress detail attributes would you style on this body shape? How do you select the detail attributes during styling session? Why would you style this body shape with the suggested attributes?</p>
Triangle Invert Triangle	<p>What kind of silhouette would you style this body shape? How would you style to achieve this silhouette? Why would you style this body shape to achieve the silhouette?</p>	<p>What kind of dress detail attributes would you style on this body shape? How do you select the detail attributes during styling session? Why would you style this body shape with the suggested attributes?</p>
Rectangle	<p>What kind of silhouette would you style this body shape? How would you style to achieve this silhouette? Why would you style this body shape to achieve the silhouette?</p>	<p>What kind of dress detail attributes would you style on this body shape? How do you select the detail attributes during styling session? Why would you style this body shape with the suggested attributes?</p>
Oval	<p>What kind of silhouette would you style this body shape? How would you style to achieve this silhouette? Why would you style this body shape to achieve the silhouette?</p>	<p>What kind of dress detail attributes would you style on this body shape? How do you select the detail attributes during styling session? Why would you style this body shape with the suggested attributes?</p>

- 8- Present top 3 recommended and not recommended dresses (show images rendered on the body shape) for each body shape based on the constructed algorithm. Rate the approval of the recommendation (5-point Likert scale)
- 9- Provide feedback and comments on the recommended and not recommended dress attributes for each body shape based on the constructed recommendation system

Body Shape	Comments on the top 3 recommended dress styles	Comments on the top 3 NOT recommended dress styles
Hourglass	Do you agree with the recommended dresses? What would you suggest on the silhouette of the recommended dress? What would you suggest on the dress details for this body shape?	Do you agree with the NOT recommended dresses? What other styles you may NOT recommend for this body shape? What kind of dress details would you suggest to avoid?
Triangle	Do you agree with the recommended dresses? What would you suggest on the silhouette of the recommended dress? What would you suggest on the dress details for this body shape?	Do you agree with the NOT recommended dresses? What other styles you may NOT recommend for this body shape? What kind of dress details would you suggest to avoid?
Triangle Invert Triangle	Do you agree with the recommended dresses? What would you suggest on the silhouette of the recommended dress? What would you suggest on the dress details for this body shape?	Do you agree with the NOT recommended dresses? What other styles you may NOT recommend for this body shape? What kind of dress details would you suggest to avoid?
Rectangle	Do you agree with the recommended dresses? What would you suggest on the silhouette of the recommended dress? What would you suggest on the dress details for this body shape?	Do you agree with the NOT recommended dresses? What other styles you may NOT recommend for this body shape? What kind of dress details would you suggest to avoid?
Oval	Do you agree with the recommended dresses? What would you suggest on the silhouette of the recommended dress? What would you suggest on the dress details for this body shape?	Do you agree with the NOT recommended dresses? What other styles you may NOT recommend for this body shape? What kind of dress details would you suggest to avoid?

APPENDIX VI: STYLIST INTERVIEW RECRUITMENT POSTER

Title: Stylists needed for research study on Dress Style Recommendation

Text: Do you dress clients by their body shapes? Do you select dresses for clients to hide imperfect and highlight certain areas? Share your thoughts and opinions with us by participating in this research.

What is in it for you?

- Monetary compensation
- Connect directly with Cornell Fashion Research team
- The ability to contribute to fashion style recommendation system

Are you eligible?

- Working stylists with portfolio
- Experienced with dressing different body figures

Stylists will be asked to

- Meet online for 60 min
- Answer questions about dress styling techniques
- Sketch/draw dress styles for different body figures
- Share opinion and thoughts on different body figures in different dresses

If you are interested:

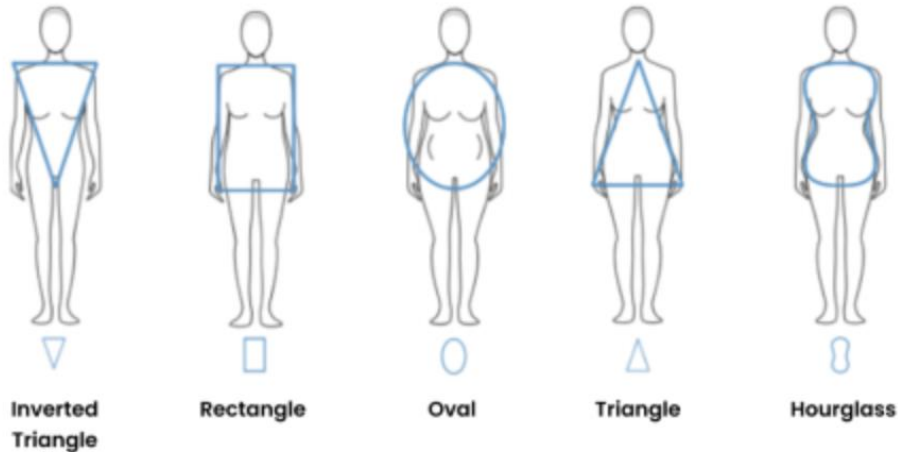
- Email: wz74@cornell.edu
- Call: 626-679-7796

APPENDIX VII: FASHION CONSUMER SURVEY

Study Title: Dress Style Recommendations based on Female Body Shapes

Survey questions

7. Weight in ()lb.
8. Height in ()ft.
9. Self-perceived body shape:



My current body shape is

- The inverted triangle
- The rectangle
- The oval
- The triangle
- The hourglass

My ideal body shape is

- The inverted triangle
- The rectangle
- The oval
- The triangle
- The hourglass

10. Body Shape Satisfaction (5-point Likert Scale: extremely unsatisfied, dissatisfied, neutral, satisfied, and extremely satisfied)

Directions: using the scale below indicate your level of satisfaction with each of your body areas below:

- Face (facial features, complexion)
- Hair (color, thickness, texture)
- Lower torso (buttocks, hips, thighs, legs)

- Mid torso (waist, stomach)
- Upper torso (chest, shoulders, arms)
- Muscle tone
- Overall Appearance
- Bust
- Hip
- Waist
- Shoulders

10. If you read this question, select 3 in the following 5-point Likert scale

11. Enter your Physical Body Measurements

- Shoulder ()
- Shoulder Type ()
- Bust ()
- Waist ()
- Hip ()

Dress Shopping Preferences

1. How often do you shop for dress?
 - Never
 - Once a year
 - A few times a year
 - Once a month
 - Once a week
 - Daily
2. How much do you spend on one dress average?
 - Under \$50
 - \$50-\$100
 - \$100-\$500
 - \$500- \$1,000
 - \$1,000 and above
3. How much do you spend on dress purchase per year?
 - Under \$100
 - \$100-\$500
 - \$500 - \$1,000
 - \$1,000 - \$5,000
 - \$5,000- \$10,000
 - \$10,000 and above

Select from the scale below (5-point Likert Scale: extremely unsatisfied, dissatisfied, neutral, satisfied, and extremely satisfied)

1. Durability is an important quality to be considered when selecting dresses
2. Care of the dress is a factor that influences my purchase decision
3. Price is important to my purchase decision
4. Color is important to my purchase decision
5. Fabric is important to my purchase decision
6. I buy dresses that is trendy
7. I buy dresses that fit me well
8. I buy dresses that is fashionable
9. Dress fashionable makes be happy
10. Dress highlights my body shape makes me happy

Dress Fit Preferences (5-point Likert Scale: extremely unsatisfied, dissatisfied, neutral, satisfied, and extremely satisfied)

1. Do your body shape effect how you select dress styles?
2. Are you happy with your selected dress fit?
3. Are you satisfied with your selected dress style?
4. How do you feel when shopping and selecting dress for your body shape? (Qualitative response)
5. How do you feel when selecting dress size for your body shape? (Qualitative response)
6. Do certain dress style make you feel more confident to wear? Please explain.
7. Would you change any dress design to better suit your body shape?

Interact with iframe embedded 3D engaging website and select 3 most liked and disliked dresses

Post Recommendation Satisfaction Questions

Recommend dress prototypes (5-point Likert Scale: extremely unsatisfied, dissatisfied, neutral, satisfied, and extremely satisfied)

Different consumers have different preferences for apparel design details, such as shape and silhouette. Using the visual stimuli provided, indicate the likelihood as relevant to the adjacent statement or question.

FOCUS ON DRESS SHAPE, NOT THE COLOR AND/OR STYLING DETAIL OF EACH DRESS.

- This dress shape will fit my body well.
 - This dress shape will be comfortable on my body.
 - This dress shape is attractive on my body.
 - This dress shape is fashionable.
1. How likely is it that you will buy the dress you viewed above in the next 12 months?

2. How likely is it that you will shop for this dress shape when you buy apparel in the next year?
3. How do you feel about the recommended dress styles for your body shape?

4. Would you wear the recommended dress? (Yes/No)
5. What is your most positive association with this dress? _____
6. What is your most negative association with this dress? _____
7. How often would you wear the dress?
8. How likely would you purchase this dress?
9. Would you recommend the dress matching to your friends? (Yes/No)
10. Other comments about this survey _____

Demographic & Body Shape Satisfaction

Directions: Please answer the following demographic questions.

11. Age ()
12. Ethnicity
 - a. Caucasian
 - b. African American
 - c. Native American
 - d. Asian
 - e. Native Hawaiian and other Pacific Islander
 - f. Hispanic or Latino
 - g. Other
13. Which of the following represents your annual household income?
 - Under \$15000
 - \$15000 - \$24,999
 - \$25,000 to \$34,999
 - \$35000 - \$49,999
 - \$50,000 to \$74,999
 - \$75,000 to \$99,999
 - \$100,000 to \$149,999
 - \$150,000 to \$199,999
 - \$200,000 and over

APPENDIX VII: 3D INTERACTIVE WEBSITE

Select* three dresses that you most liked

***it may take a few seconds to load the dress.**

Click on a thumbnail in the style library on the left and view the dress in the bigger window on the right. Scroll the bar down to see more options. You can left-click on the model, hold, and drag to rotate the model to view in 360°. Select your favorite dresses and rank them by clicking on one of the three buttons under the select window. Click "Continue" for the next step.

Drag to rotate

1st Favorite 2nd Favorite 3rd Favorite

Your selected dress will appear here Your selected dress will appear here Your selected dress will appear here

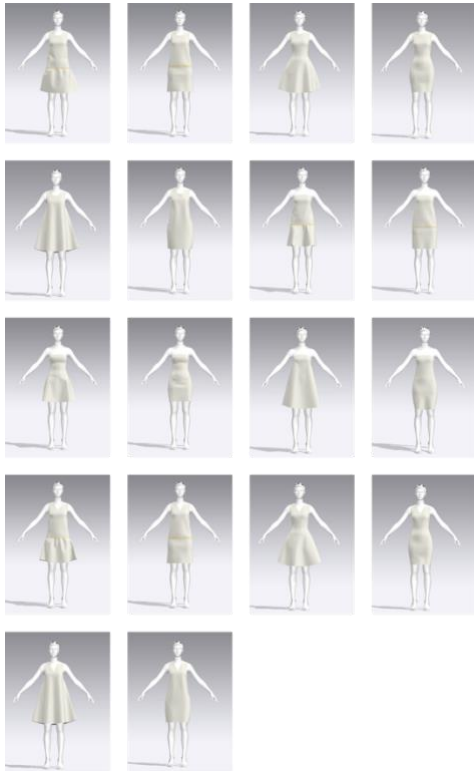
1st Favorite 2nd Favorite 3rd Favorite

Once you identified the 3 dresses you most liked, click "Continue" below to the next step.

You must select 3 dresses to continue.

Continue

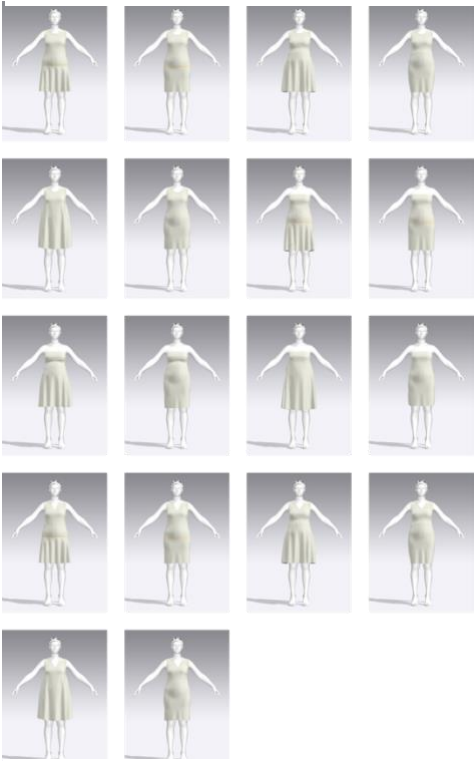
APPENDIX IX: CLO3D RENDERED DRESS STYLES ON BODY SHAPES



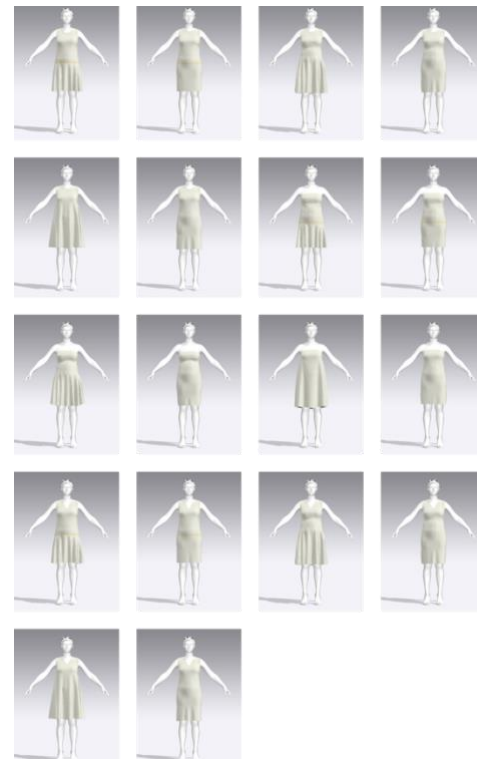
Dress style variables for hourglass



Dress style variables for inverted triangle



Dress style variables for oval



Dress style variables for rectangle



Dress style variables for triangle





APPENDIX X: STYLIST RECRUITMENT FLYER

STYLISTS NEEDED




for research study on Dress Style Recommendation

Do you dress clients by their body shapes? Do you select dresses for clients to hide imperfections and highlight certain areas? Share your thoughts and opinions with us by participating in this research.

Participant stylists will be asked to:

			
Meet online for 60 min	Answer questions about dress styling techniques	Sketch/draw dress styles for different body shapes	Share opinion & thoughts on fit and aesthetic dress styles


What is in it for you?


-  Monetary compensation
-  Connect directly with Cornell Fashion Research team
-  The ability to contribute to fashion style recommendation system


Are you eligible?

- Working stylists with portfolio
- Experienced with styling & dressing different body shapes

If you are interested:

 wz74@cornell.edu

 626-679-7796



APPENDIX XI: PARTICIPANT RECRUITMENT FLYER

Are you interested in selecting dresses for your body shape?

👉 We would like to invite you to participate in a brief survey. Your responses will help us evaluate the preferred dress styles to develop a recommendation system for different body shapes.

📊 The survey is very brief and will take about 10-15 minutes to complete. Please click the link below or copy and paste the link into your Internet browser.

Survey link: tinyurl.com/4yu398re

😊 Your participation in the study is completely voluntary and all of your responses will be kept confidential. No personally identifiable information will be associated with your responses to any reports of these data. The Institutional Review Board has approved this survey.

Thank you very much for your time and support!




Figure 3. Control Group Recruitment Flyer

Are you interested in selecting dresses for your body shape?

👉 We would like to invite you to participate in a brief survey. Your responses will help us evaluate the preferred dress styles to develop a recommendation system for different body shapes.

📊 The survey is very brief and will take about 10-15 minutes to complete. Please click the link below or copy and paste the link into your Internet browser.

Survey link: tinyurl.com/2p8jkd3s

😊 Your participation in the study is completely voluntary and all of your responses will be kept confidential. No personally identifiable information will be associated with your responses to any reports of these data. The Institutional Review Board has approved this survey.

Thank you very much for your time and support!





Figure 2. Experiment Group Recruitment Flyer