3D Body Scanning's Contribution to the Use of Apparel as an Identity Construction Tool

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Abstract. Humans use apparel as an artifact to construct their identities and present it to the outside world. Beyond textiles and clothing style, garment fit contributes to this image presentation. This research, conducted on the Hong Kong market shows that women view 3D body scanning technology positively and that it therefore could prove an effective and efficient tool, both from a consumer's and from a seller's point of view, in facilitating the body image creation.

Keywords: Body image, 3D body scan, apparel, fashion.

1 Introduction

Throughout the ages clothing has not only fulfilled a need for protection but has also played a role in defining the wearer's personality and determined his or her status in society. Yet selecting a garment that advantages one's silhouette and projects the right image often, for most, proves a difficult if not impossible task. Style, color and textile are, to a large extent, subjective decisions: *de gustibus et coloribus non est disputandum*. Yet fit is a very objective criterion. Until a few years ago, the only way to identify a fitting garment was to try it on. The invention of 3D body scanning technology is rapidly changing this situation. Not only is it a possible first step toward mass customization, but it may also be used, by retailers, as an added customer service tool helping them identify the best fitting garments, thereby improving their satisfaction with the shopping experience.

2 Literature Review

The following section first discusses the importance of clothing in the individual's image formation. It then proceeds to a brief presentation of 3D body scanning technology and its potential use in helping women selecting the best fitting and most advantaging pieces of clothing.

2.1 Personal Identity and Styling

Clothing is worn daily yet it serves more than a mere protection need. Leroi-Gourhan [11], Wolfe [18] and Boucher [3] state that clothing has always served the same three

V.G. Duffy (Ed.): Digital Human Modeling, HCII 2009, LNCS 5620, pp. 19–28, 2009.

basic human needs: (1) protection (physical need), (2) adornment and identification (psychological needs), and (3) modesty and status (social needs or role). For Kefgen and Touchie-Specht [9] clothing forms a nonverbal communication. The way people dress tells others, what kind of a person they are or would like to be perceived as. Johnson and Foster [7] point out that clothing has a language of its own providing. It may not be appropriate to judge a book by its cover but many argue that the cover certainly helps selecting the book.

Body image can be positive or negative, accurate or inaccurate, particularly as we form this image in comparison with others and in relation to cultural views of fashion. The evaluative dimension of body image is known as *body cathexis* [8]: the indication of an individuals' satisfaction or dissatisfaction with their different body parts [10; 16]. Body cathexis is closely related to the person's global self-image, self esteem, and self concept [16; 17]. Rasband [14] showed that an accurate and objective body image is necessary as it plays a significant part in clothing selection and appearance. Clothing becomes part of your body image, a second skin in establishing new physical boundaries for yourself.

Over the last few decades, various studies have focused on five elements of a garment important in achieving a better clothing message: line, shape, color, texture and pattern. In order to understand how clothing can impact on the way someone looks, body figures must be understood even if standards or beliefs change with times or who makes the decision. Authors generally recognize eight more or less standard female body shapes:

- Ideal figure: the shoulders and hips have similar width, the bust size is medium the waist is small. The abdomen is flat to slightly curved, the buttock is moderately curved and thighs are slim. The figure is well balanced. The weight is just enough to cover the bones.
- Hourglass figure type: the hourglass shape appears full-rounded in the bust and hip, with a small waist. The bust is more often larger than average as well as the hips. The waist is well indented waist. Hips and buttocks are smoothly rounded.
- Triangular figure type: the triangular figure seen from the front looks narrower above the waist and wider below. The excess of weight appears on the buttocks, the low hips, and the thighs. Women with this type of figure appear unbalanced from top to bottom with the shoulders narrower than the hips. The bust and the waist are usually small to medium.
- Inverted triangular figure type: the inverted triangle gives the opposite look. It appears wider above the waist and narrower below. The shoulder, the upper back, and the bust look prominent.
- Rectangular figure type: women with a called rectangular figure seams to have nearly the same width at shoulders, waist, and hips. Their waist line doesn't seem well defined and their body lines look straight.
- Tubular figure type: similar to the rectangular, the weight is considerably below the average or ideal range.
- Diamond figure type: points up with narrow shoulders and hips in combination with a wide midriff and waist. The midriff and upper hips do not appear to taper inward towards the waist.

- Oval or full-rounded figure: the weight is noticeably above the average and larger throughout the figure where body lines are full-round curves. (Rasdand and Liechty, 2006)

Numerous fashion articles are written every year focusing either on the body or parts of the body such as "*C'est moi, ma personalite, mon style*" [5] or *InStyle* [1]. Each describes and shows two dimensional figures and ways to improve upon them. *Instyle,* for example, talks about "curvy women" stating that these women should showcase their waist and curves without over emphasizing them; steer clear of anything to tight or clothes that are cut straight un-and-down and fabrics that are thin. It provides tips to select garments that flatter the body, or part of it, for each body figure: short, narrow shoulders or broad shoulders, full bust or small bust, heavy arms, well defined tummy, short-waisted/long legs or long-waisted/short legs, bottom heavy, etc. For Rasband and Liechty [15], a garment can change the visual of the body figure, even in areas where it may appear difficult.

According to Rasband and Liechty [15] a garment line creates shape and form. Yet to fully take advantage of this wisdom, women need to know their body shapes.

2.2 3D Body Scanner

A 3D body scanner is the size of a fitting room. It uses cameras or safe lasers to capture up to 300,000 data points for each person's scan. The scanning process takes only a few seconds. Within a few minutes the software automatically extracts hundreds of body measurements. Data on body shape and body volume can also be automatically extracted. The resolution of the final scan is quite accurate. Data can be transferred directly from the scanner over local networks or the web (Shape Analysis Limited, 2008).

In the early stages of the 3D body scanning technology many argued that this technology would mostly be used to provide custom fitting services. Many thought that it would bring consumers into the design and production stages, resulting in well-fitting, made-to-measure garments at competitive prices and turnaround times. Although it has not quite reached this point yet, 3D scanning has come to play an important for some apparel retailers and producers. It contributes to mass customization by enabling retailers to rapidly collect three-dimensional (3D) data and to send it to manufacturers who tailor the garment to fit individuals [2].

In addition to custom fitting, 3D body scanning technology also improves the body measurement data used in traditional mass production [4]. Industry and academic researchers are beginning to use large amounts of anthropometric (body measurement) data captured by body scanners to adjust the sizing systems of ready-to-wear clothing lines in order to provide better fitted garments ($[TC]^2$, 2004).

Another application of 3D body scanning is the Virtual Try-on. Consumers can now virtually try garments on. An individual's scan is visualized on a computer while clothing of various sizes is superimposed (in 3D) on a rotatable image (http://www.bodyscan.human.cornell.edu/scene0037.html, [2]). The computer application highlights areas of good and bad fit, helping the user to select the most appropriate product according to his or her body size and shape.

Body scanning data will also increase the number and accuracy of measurements used in size prediction (match between one's body and garments on offer). The

combination of virtual try-on with size prediction not only provides consumers with the brands and sizes that fit their measurements and proportions best, but also lets them virtually view garments on their scan and choose the design they prefer. This process combines objective fit information and with fit preference.

Locker and Ashdown [12] noticed that Commercial applications of body scanning (mass-customized clothing, improved ready-to-wear sizing systems, and virtual try-on) will only be viable if consumers agree to being scanned. They surveyed a group of women they scanned in the course of one of their studies enquiring about their level of comfort with, and interest in, body scanning. The answer was resoundingly positive on both counts regardless of size, age, or their satisfaction with the fit of available ready-to-wear pants. Almost all were willing to be scanned again and many were willing to be scanned every year or whenever their weight changed.

They also found very positive reactions to commercial applications and research using body scan data. Participants found the virtual try-on application more appealing than custom-fit clothing or patterns, size prediction, or personal shopper applications. Women also selected virtual try-on as the most likely to influence them to buy more clothing on the Internet.

Virtual try-on, custom-fitted clothing, and the creation of a "personal shopper" were rated highest in their potential contribution to find clothing that looks good on the body; custom-fit and size prediction were rated highest in helping to find clothing that fits them best. Participant confidence was also extremely high in the body scan data's applications as an effective way to obtain body measurements, an effective means to arrive at a good fit, and in improving the trustworthiness of an online screen image (figure 1) of their own body over an idealized body shape (avatar).

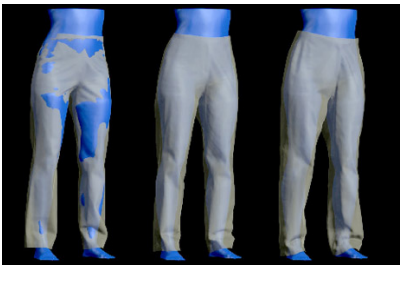

Fig. 1. Adapted from Cornell Body Scan Research Group (http://www.bodyscan.human.cornell.edu/scene0037.html)

Another approach to provide the consumer with a "personal shopper" is the avatar such as those being offered by *Lands' End* and *My Virtual Model* (figure 2).

Lands' End customers enter their body measurements and select a virtual model with a similar body shape in order to visualize clothing styles through their on-line store. *My Virtual Model* supplies the virtual try-on web interface for *Lands' End*, *Levi's*, *Kenneth Cole*, and other on-line retailers (*My Virtual Model Inc*., 2008).

According to Istook and Hwang [6], there is no doubt that scanners will become an important component of the shopping experience.

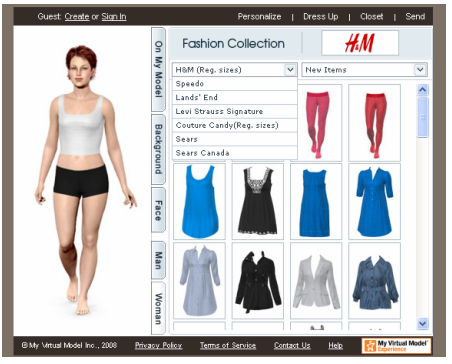

Fig. 2. *My Virtual Model*, Adapted from: http://www.mvm.com/brandme.php?id=10&lang_id=en

2.3 Styling Service Online

Styling services are now offered by cutting edge Internet companies such as *myShape.com* which boast of having more than 20,000 women's measurements on file. This company offers women the possibility to shop from personalized clothing collections matching their style, fit preferences, and body shapes and sizes (myShape, 2008).

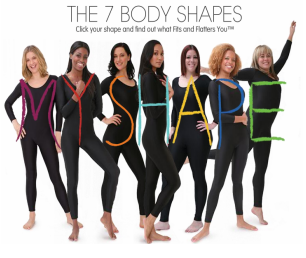

Fig. 3. The 7 body shapes Adopted from: www.myshape

In Wannier (2006), *myShape*'s chief executive states that the method seems to be working, particularly among women 35 and older. On the other hand, Mulpuru (2006), an analyst from Forrester Research states that *myShape*'s approach fails to gain a mass audience because the measuring process is too complicated. Only a small percentage of women would accept the site's offer to mail them a free tape measure, and fewer would go through the process of taking the measurements and logging them into the *myShape* system. One thing that might help *myShape* to reach a mass audience would be if the company somehow offered interested people to be 3D body scan in malls or other locations, saving them the trouble of measuring themselves [13].

3 Methodology

Many previous researches looked into the consumers' reaction to 3D body scanning; yet few researches studying the combination of 3D body scanning with a styling

service were found. Moreover, most were merely based on western countries. A questionnaire was therefore developed to determine if a potential market combining these two areas may exist in Asia and more specifically Hong Kong.

3.1 Questionnaire Design

The questionnaire was comprised of 26 questions divided into seven sections. The first section looked into the consumers' expectations in clothing; a better understanding of their thoughts and behavior providing a first input as to the need for the type of service this research is interested in. The second section tried to evaluate the consumers' awareness and knowledge of their body measurements and figure. In the third section, the questionnaire focused on time as a factor in clothing selection. The fourth section evaluated the consumers' difficulties in selecting clothing. The next section dealt with shopping habits. The next to the last section investigated the consumers' interest in using the 3D scanning-styling service should it be offered. Finally, the seventh section pertained to our respondents' socio-demographic characteristics.

3.2 Sampling and Data Analysis

A total of 128 women answered our questionnaire. The sample was a convenience one as the questionnaire was distributed to teachers, classmates, friends and relatives over the first 3 months of 2008. SPSS and Excel were used to process and analyze the data collected. Besides using descriptive statistics and frequency distributions to describe the sample population, cluster analysis were used to break it into smaller more homogenous groups.

4 Results and Findings

The following section presents some of our findings on women's purchases and perception of 3D body scanning technology.

4.1 Women's Garment Purchases

As our literature review revealed clothing serves different purposes. Figure 4 shows that second to fulfilling a basic need the HK women who participated in our survey stated that clothing should reflect their personalities and help them look beautiful. More than half of them believe that clothing helps build their self-esteem. This validated Leroi-Gourhan [11] and Wolfe's [18] study that people use clothes for three major reasons: physical, psychological and social. It also confirms that, as is the case with Westerners, clothing is not only fulfilling a need but also answers a "want" [15].

When asked where they purchase their clothes 99 women chose mall stores and boutiques, 68 answered that they bought them in stand-alone stores. None of them mentioned shopping (the impossibility to feel the material and see the garments being mentioned as the main reasons whereas the long store hours in HK reduced the need for on-line shopping).

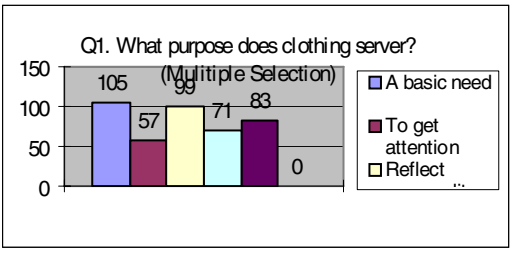

Fig. 4. Justification for clothing purchases

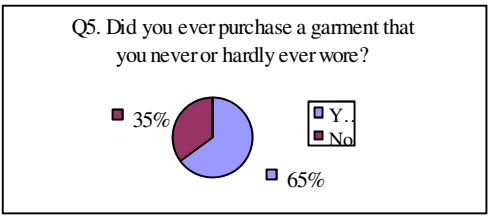

Fig. 5. Garment use

Interestingly 35% of the women surveyed admitted to having purchased a garment which they hardly ever wore as they felt it did not look good on them, did not advantage their body figure, or they did not feel confident when wearing it. All concerns mentioned had to do with image and psychological needs; none mentioned concerns about fit or comfort.

While 80% of our sampled admitted to searching for the garments most advantageous to their silhouette, 70% admitted they found it difficult to identify the style that accomplished this objective.

To the question of perceived time consumption to find fitting clothes (1 being the lowest and 5 the highest) over 50% of women scored a 4 or 5 and 37% scored a 3; a result which clearly shows that women find the process to be time consuming. When asked how much time they spend to choose a garment, 49% stated that they spend 5 to 15 minutes to choose a casual garment and 28% that they spend 15 to 30 minutes. For the selection of party clothes, 49% of our sample stated spending between 15 and 30 minutes and 23% between 30 to 60 minutes. Almost 40% of the women stated they take between 15 to 30 minutes to decide what to wear for an interview. As one could expect, the time to choose a garment for a special event (such as a wedding) increases with 56% spending 2 hours and 18% up to three hours.

When trying to identify if women were concerned with their body measurement and shapes (body figure) we found 50% of women scoring 4 and 5 (on a Likert scale where 1 identified a small extent and 5 a great extent). Our results also revealed that 62% of our sample had never heard about the "standard" body shapes before being shown the pictures taken from the literature review. Surprisingly 77were not sure about which body shape represent them best.

4.2 3D Body Scanning

As we expected women were curious about body figures and body scanning although we were not sure if Hong Kong females were as "opened" as westerners and willing to be scanned. To the question as to how they would react to the possibility of being scanned in a retail store, 64% of women stated they would accept to then compare their body shape to the "standard" ones. Nearly 35% of our sample stated that they would visit a retail store more often if it offered styling recommendations. Nearly 40% believed that styling recommendation would reduce the risks of buying "unsuitable" garments.

Through a clustering analysis, we found that 50.8% of our sampled women clustered on the first group (aged 19 to 25, single, low income level, secondary or tertiary education level) which cared the most about their own body measurement. Our second group (15.8% of our sample, aged 26 to 32, single or married without children, middle income level, secondary or tertiary education level) cared much less. The third group (12.5% of our sample, aged 33 to 40, married with or without children, high income level, tertiary education level) did not seem to care about their body measurement.

Lastly the fourth group (20.8% of the sample, aged 26 to 35, married with children, high income level, tertiary education level) cared only marginally about their own body measurement.

A clustering analysis on the perceived time consumption of apparel shopping showed that 36.7% did not perceive apparel shopping as particularly time consuming (aged 19 to 25, single, low income level secondary or tertiary education). The second group (29.2% of sample, aged 19 to 30, single or married without children, middle income level, tertiary education) stated that apparel shopping was time consuming. A third group (20.8% of sample, aged 26 to 40, married with children, high income level, and tertiary education level) also finds apparel shopping to be time consuming. The fourth group (13.3% of sample, aged 19 to 32, married with or without children, high income, tertiary education) finds it highly time consuming.

A third clustering analysis was performed to identify willingness to go through a scanning process. In this case we identifier a first group (39.2% of sample, aged 19 to 32, single, low income, secondary to tertiary education) expressed no interest in trying the 3D body scanner. The second group (17.5% of sample, aged 19 to 25, single, low income level, tertiary education) expressed willingness to try the 3D body scanner. A third group (30.8% of sample, aged 26 to 40, married with or without children, high income, secondary to tertiary education) also expressed interest. The last group (12.5% of sample, aged 19 to 32, married with or without children, high income level, tertiary education) also expressed interest in trying the 3D body scanner.

Our fourth clustering analysis focused on the interest of our sample to pay for styling recommendations. Only one group (17.5% of sample, aged 26 to 40, married with or without children, high income, and tertiary education) stated that the provision of styling recommendations by a retail store would not influence them in their shopping patterns.

Lastly we conducted a clustering analysis to try and understand the relationship between the wish for styling recommendations and the willingness to try the 3D body scan. A first group (39.2% of sample) finds apparel shopping time consuming and

spends relatively little on fashion would like to be offered styling recommendations but expresses no interest in 3D body scanning. A second group 10% of sample) does not perceive shopping as being time consuming spends very little on fashion yet is interested in trying the body scanner as well as being offered styling recommendations. A third group (25% of sample) was comprised of those who find shopping time consuming, spend moderately on fashion products, and are interested in trying the body scanner but will patronize a retail store because it offers styling recommendations. The last group (25.8% of sample finds shopping time consuming yet spends relatively more on fashion; they are uncertain about their interest in trying the body scanner but will patronize a retail offering styling recommendations.

5 Conclusions and Recommendations

Our results show that the group of consumers most interested in the body scan technology and in patronizing stores offering styling recommendations is comprised of individuals at the lower end of the spending spectrum on fashion. This finding begs the question: is it worthwhile investing in 3D scanning technology and in providing styling recommendations.

Unfortunately our research does not enable us to determine whether a "free body scanning / styling recommendations" offer would impact the amount of money these customers spend on fashion items. Yet it clearly indicates that 82,5% of women would appreciate styling recommendations and 35% would agree to an in-store 3D body scan. This clearly represents an opportunity which should be investigated further.

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