USING SIZEUSA TO IMPROVE APPAREL FIT

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ABSTRACT

Consumer dissatisfaction with apparel fit is a major issue for the apparel industry, and causes big problems for fashion designers who are trying to improve fit. Much of the difficulties inherent in current efforts to improve fit can be attributed to the lack of size and shape information available for today's U.S. population. The advent of 3D body scanning has enabled the collection of anthropometric data that can be obtained more quickly and accurately than traditional manual measurement allows. SizeUSA, a national sizing survey of the U.S. population, was conducted in 2003 and used 3D body scanning technology to acquire measurement data of roughly 10,000 men and women. This study provides the most comprehensive and representative data that is currently available, and has allowed for research that could transform and dramatically improve the apparel design process and the fit of resulting garments.

This study utilized body shape classification software known as FFIT© for Apparel to analyze and discover the true shapes of current U.S. women. Results showed that the most predominant shape in the population is the Rectangle shape, followed by the Spoon, the Inverted Triangle, and then the Hourglass. Measurement data from current ASTM sizing standards used by the industry was then analyzed using the software to determine the shapes that each of these standards best fit. Results showed that ASTM Missy, Junior, and Over 55 standards seem to be largely ineffective at accommodating the predominant shapes in the current population of women, with the Missy and Junior standards exclusively targeting the Hourglass shape. Development of new ASTM sizing standards or modification of company sizing strategies based on these results would improve technical design processes, apparel fit, and consumer satisfaction.

1. INTRODUCTION

The apparel fit problem is a major concern for the apparel industry as a whole, due to the consumer dissatisfaction that the problem has caused, and its effect on consumer purchasing decisions and financial performance. Many apparel companies have traditionally been ill-equipped to define or solve apparel fit problems due to a lack of sizing information about current U.S. women. Often, the only information that companies have regarding consumer satisfaction with fit is in the form of apparel returns, which certainly does not capture lost sales and fitting-room frustrations that are significant components of the problem.

Body scanning has revolutionized the apparel industry, providing the resources needed to complete SizeUSA, the National Sizing Survey. Body scanning allows for the collection of many body measurements very quickly, resulting in more accurate anthropometric data than hand measuring could ever supply. SizeUSA, completed in 2003, was the first anthropometric sizing study performed since 1939, and was the first-ever representative sizing study completed on the U.S. population. The release of the data in 2004 has given

the apparel industry the ability to obtain a better understanding of the shapes and sizes of the current U.S. population. In addition, a variety of demographic and psychographic information was also collected in SizeUSA that allows for the segmentation of the sample into distinct consumer groups for further study. In this way, SizeUSA has broad implications for the improvement of apparel fit.

This study used SizeUSA anthropometric data representing U.S. females to determine the body shapes that predominate in today's U.S. market. Rather than simply focusing on the measurement data alone, a whole-body approach was used to compare people of varying sizes using a proportionate analysis of bust, waist, hip, high hip, abdomen, and stomach measurements.

2. BRIEF REVIEW OF LITERATURE

2.1 Apparel Fit Issues

Sizing strategies used by many apparel companies have resulted in widespread consumer dissatisfaction with apparel fit, which affects store patronage and financial returns. A 1999 study by Kurt Salmon Associates found that 62% of U.S. consumers are very dissatisfied with the fit of their apparel (Kurt Salmon Associates, 1999). When considered along with the fact that comfort and fit are two of the leading determinants in apparel purchases, the apparel fit problem should be a major concern for technical design teams within the apparel industry (Kurt Salmon Associates, 1998).

Among the sizing strategies that contribute to the apparel fit problem are the use of outdated ASTM sizing standards as a basis for company sizing strategies, as well as the practice of vanity sizing. Many manufacturers have realized the marketing advantage of "vanity sizing," in which garments are labeled as smaller sizes than actual body measurements. Women are more likely to purchase these garments labeled with smaller sizes, simply for self-esteem and vanity purposes. As a result, manufacturers have started to size garments smaller than actual measurements in the hopes of increasing sales (Tamburrino, 1992a). The result of this practice means that many sizes today do not correspond to any actual body measurements, but are instead arbitrarily chosen by manufacturers (Chun-Yoon & Jasper, 1993).

The use of ASTM sizing standards has further complicated the apparel fit issue for consumers. Apparel sizing standards currently issued by the American Society for Testing and Materials (ASTM) are not mandatory, are not widely used, and when they are used, they are commonly only referenced as a basis for sizing strategies, with customized modifications being made by individual companies for their own target market needs. The result is very different sizing strategies in place for each apparel company, and widespread confusion for consumers who may wear a variety of sizes across different apparel brands.

2.2 Current ASTM Apparel Sizing Standards

The lack of use of current apparel sizing standards is often attributed to the biased, outdated anthropometric data upon which these standards are based. This data came from an anthropometric study designed and implemented by Bureau of Home Economics specialists O'Brien and Shelton, which was the first scientific sizing study performed for women. This study collected 59 body measurements manually, but was unfortunately plagued with many problems (O'Brien & Shelton, 1941).

First, the study was biased because all of the 14,698 subjects were white and they were predominantly between the ages of 18 and 30. Additionally, all of the women were measured in the states of Arkansas, California, Illinois, Maryland, New Jersey, North Carolina, Pennsylvania, and the District of Columbia. Last, all of the women measured were volunteers, meaning they were most likely part of a group of women who were fairly satisfied with their bodies (O'Brien & Shelton, 1941). As a result of these problems, the subjects measured did not sufficiently represent the ethnic makeup, age distribution, geographic distribution, or body shapes of the U.S. population at that time. In addition, the demographic and lifestyle changes that have characterized the U.S. population over the last several decades means that the use of this data to construct current sizing standards may not be appropriate.

Even with the obvious problems associated with the use of outdated data from the 1940's, the lack of anthropometric data available for research (until recently) has rendered the creation or modification of sizing standards very difficult. The three current sizing standards, discussed below, are commonly targeted toward populations of certain age groups (though they are also used for marketing).

2.2.1 Misses' Standard – ASTM D5585-95

In 1995, the ASTM released a voluntary standard, called ASTM D5585-95, which specifies sizes 2 through 20 to be used by the apparel industry in the classification of Misses' apparel. This standard was derived from the same database from the 1940 study and modified slightly according to a compilation of what was considered to be industry "best practices" at the time (ASTM, 1995a). The U.S. population has dramatically changed since the O'Brien and Shelton study from 1940, influenced by increased immigration, sedentary lifestyles, changing nutrition and exercise, and growth in minority groups (LaBat, 1987, Meek, 1994, Tamburrino, 1992a, 1992b). The current Missy sizing standard does not account for any of these changes.

2.2.2 Over 55 Women's Standard – ASTM D5586-95

Research conducted by Reich and Goldsberry at the University of Georgia in 1993 resulted in the creation of ASTM D5586-95, a sizing standard for women ages 55 and older (ASTM, 1995b). This standard attempts to accommodate some of the changes of the female body as it ages. Some of these changes include a decrease in stature, increases in waistline, hips, and buttocks, and changing posture (Renfrow, 1996). The fact that no

sizing standard until then had confronted these issues caused many women over 55 to experience trouble in dressing rooms nationwide, and researchers expect that the results found in this study are not unique to women just over 55.

2.2.3 Juniors Standard – ASTM D6829-02

The most recent apparel sizing standard created for women's apparel was released in 2002. Known as ASTM D6829-02, this standard classifies sizes 0 through 19 to be used in Juniors' apparel.

As obvious from the discussion of the history of sizing standards above, standards based on anthropometric data representative of the current U.S. population do not exist. As a result, the apparel sizing systems used by firms often ignore the needs of specific groups, contributing to apparel fit problems and confusion for consumers.

2.3 FFIT© for Apparel

The advent of body scanning technology has allowed for the collection of more comprehensive, accurate measurement data, as well as the completion of SizeUSA, the National Sizing Survey. Researchers have developed a variety of approaches to analyze this data, including body shape classification software such as FFIT© for Apparel which was used in this study. Developed using Visual Basic Pro, Version 6.0 in 2002 and then validated in 2003, this software uses body scan measurement data as inputs, and then classifies subjects into one of nine distinct body shapes. Specifically, it only needs six body measurements (bust, waist, hip, high hip, stomach, and abdomen) to classify a person as a particular body shape (Hourglass, Bottom Hourglass, Top Hourglass, Spoon, Rectangle, Diamond, Oval, Triangle, or Inverted Triangle). Because it only relies on these six measurements, the shapes are defined at the most elemental level, without overly complicating matters by including torso length, posture, etc. (Simmons, 2002, Simmons, et.al, 2004, Devarajan, 2003).

FFIT© for Apparel has significant implications and uses for the apparel industry and for this research. For instance, measurement data for a specific population can be processed using the software to determine the shape characteristics for that population – which shapes predominate, which shapes do not exist in the population, etc. In addition, measurement data from sizing standards can also be processed using FFIT© for Apparel in order to determine the body shapes for which the standards most apply. An indication of how well specific sizing standards are meeting the body shape needs of a certain population can be obtained by comparing the results of the standard data and the body scan data.

3. METHODOLOGY

This research study had two main purposes:

1. To perform a shape analysis of the current U.S. population of females, focusing on three age groups represented by SizeUSA (corresponding to the ages typically targeted by ASTM standards):
    a. Ages 18-25
    b. Ages 26-55
    c. Ages 55+
2. To determine how well ASTM standards fit the current U.S. consumer, by performing the following comparisons of body shapes:
    a. The Junior Population (ages 18-25) vs. ASTM D6829
    b. The Missy Population (ages 26-55) vs. ASTM D5585
    c. The Over 55 Population (ages 55+) vs. ASTM D5586

To analyze question 1, SizeUSA measurement data from the total population of women was separated by age and evaluated using FFIT© for Apparel Software. This program sorted each subject's measurement data into one of nine body shape classifications (Rectangle, Spoon, Inverted Triangle, Hourglass, Top Hourglass, Bottom Hourglass, Triangle, Diamond, or Oval) and showed the body shapes that were predominant in each of the age groups being studied.

Measurement data from the three current ASTM sizing standards used by the apparel industry (Junior - D6829, Missy - D5585, and Over 55 - D5586) was then processed separately through FFIT© for Apparel, to determine the body shapes targeted by each of the sizing standards. The use of these standards is typically dictated by the age of the population being served by the apparel company using the standard (i.e. the Junior standard is for a younger population, while the Over 55 standard is used for women over 55 years old). While this is typical, the standards are not always used this way, with many companies modifying these standards or creating brand new standards for their own markets.

Excel graphs illustrating the body shapes targeted by each of the three current ASTM sizing standards were created and compared to the body shape distributions of women in the U.S. in the age groups being studied. This comparison indicated how well current ASTM sizing standards fit the body shapes that predominate in the U.S. population of women (and throughout the various age ranges).

4. RESULTS AND DISCUSSION

4.1 Junior Comparisons

Analysis of the body shapes found in the age range 18-25 showed that over half of the sample was rectangular in shape, approximately 15% were Spoon shaped, and only 12.5% were Hourglass shape. These three shapes represented the most predominant three shapes in this age group.

However, the Junior standard (ASTM D 6829) targeted the Hourglass shape through 100% of the sizes, as shown in Figure 1. This means that if apparel companies used this standard to produce a garment, consumers with the Hourglass shape would find the best fit with this garment. Consumers with different body shapes who attempted to purchase a garment made to fit Hourglass shapes would not likely be satisfied with the fit of their apparel.

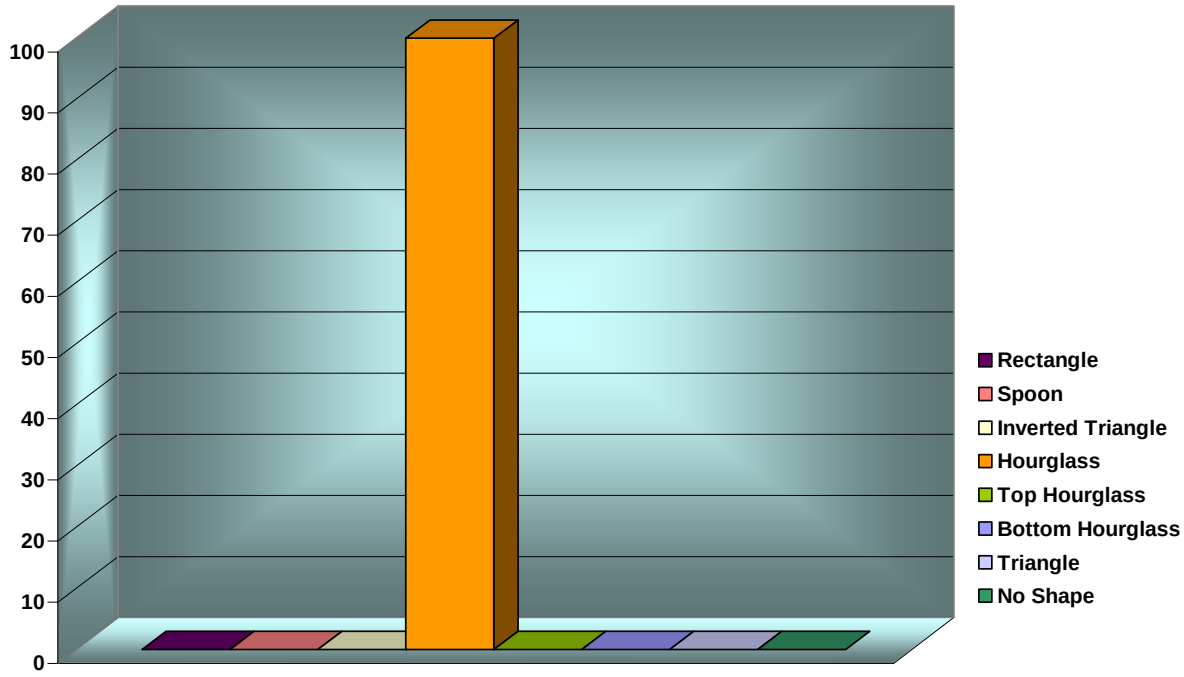

Figure 1: Shape targeted by current Junior standard (ASTM D 6829).

4.2 Missy Comparisons

Analysis of the body shapes in the 26-55 age range indicated that over 80% of this sample fell into the Rectangle, Spoon, and Inverted Triangle Shape categories. Eight percent were Hourglass in shape.

The evaluation of the Missy standard (ASTM D 5585) yielded similar results as the evaluation of the Junior standard, as illustrated by Figure 2. Once again, the Missy standard targeted the Hourglass shape throughout 100% of the size range. Like the Junior standard, apparel produced according to the Missy sizing standard would best fit women

with Hourglass shapes, and would likely leave women of other body shapes with less than desirable fitting apparel.

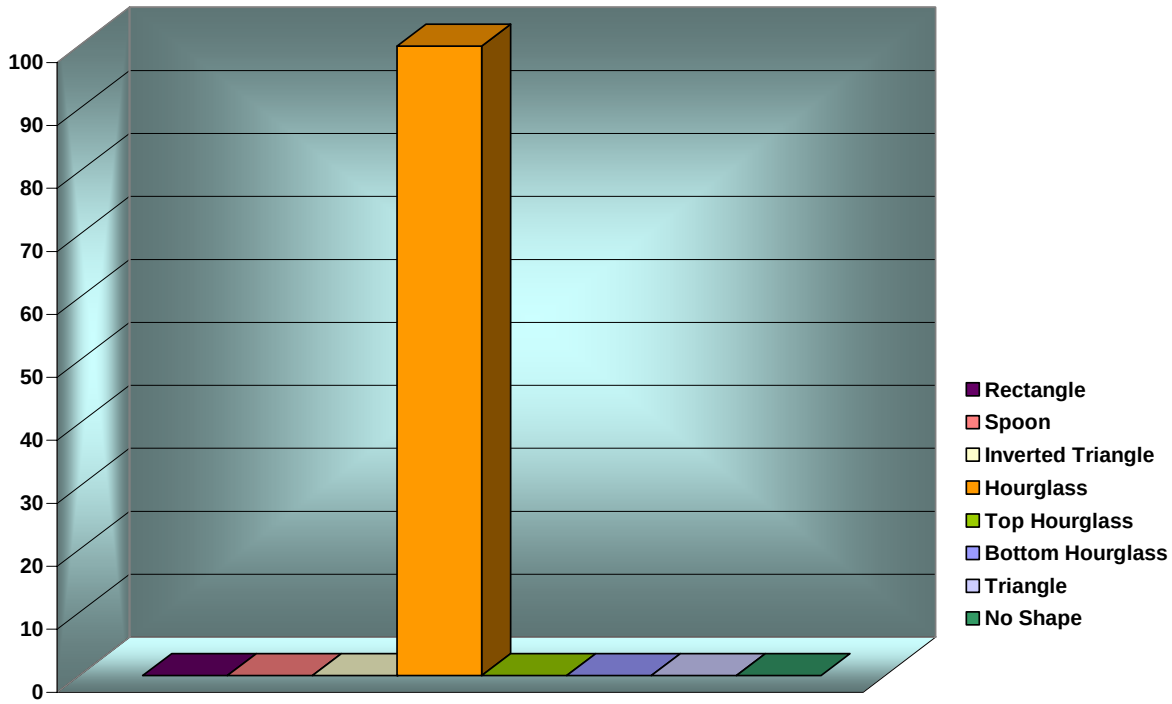

Figure 2: Shape targeted by current Missy standard (ASTM D 5585).

4.3 Over 55 Comparisons

Analysis of the over 55 sample from SizeUSA showed that most of the sample were Rectangle, Spoon, and Inverted Triangle shapes. When compared to the results of the analysis of the Over 55 family of standards, this standard performed better than the previous two standards. Most of the substandards within ASTM D 5586 targeted a combination of Spoon and Rectangle shapes, with some more heavily targeting Rectangles and others more heavily targeting Spoon shapes, as shown in Figure 3. While the Junior and Missy standards targeted one particular shape throughout the entire size range, all but one of the seven substandards within the Over 55 family of standards targeted two different shapes within their size ranges. The fact that these substandards targeted more than one shape means that depending on the size chosen within the size range, the garment (produced using these standards) may better fit people of varying shapes. This is extremely unusual for a sizing standard, because standards and sizing strategies typically target people of different sizes but not different shapes throughout entire size ranges.

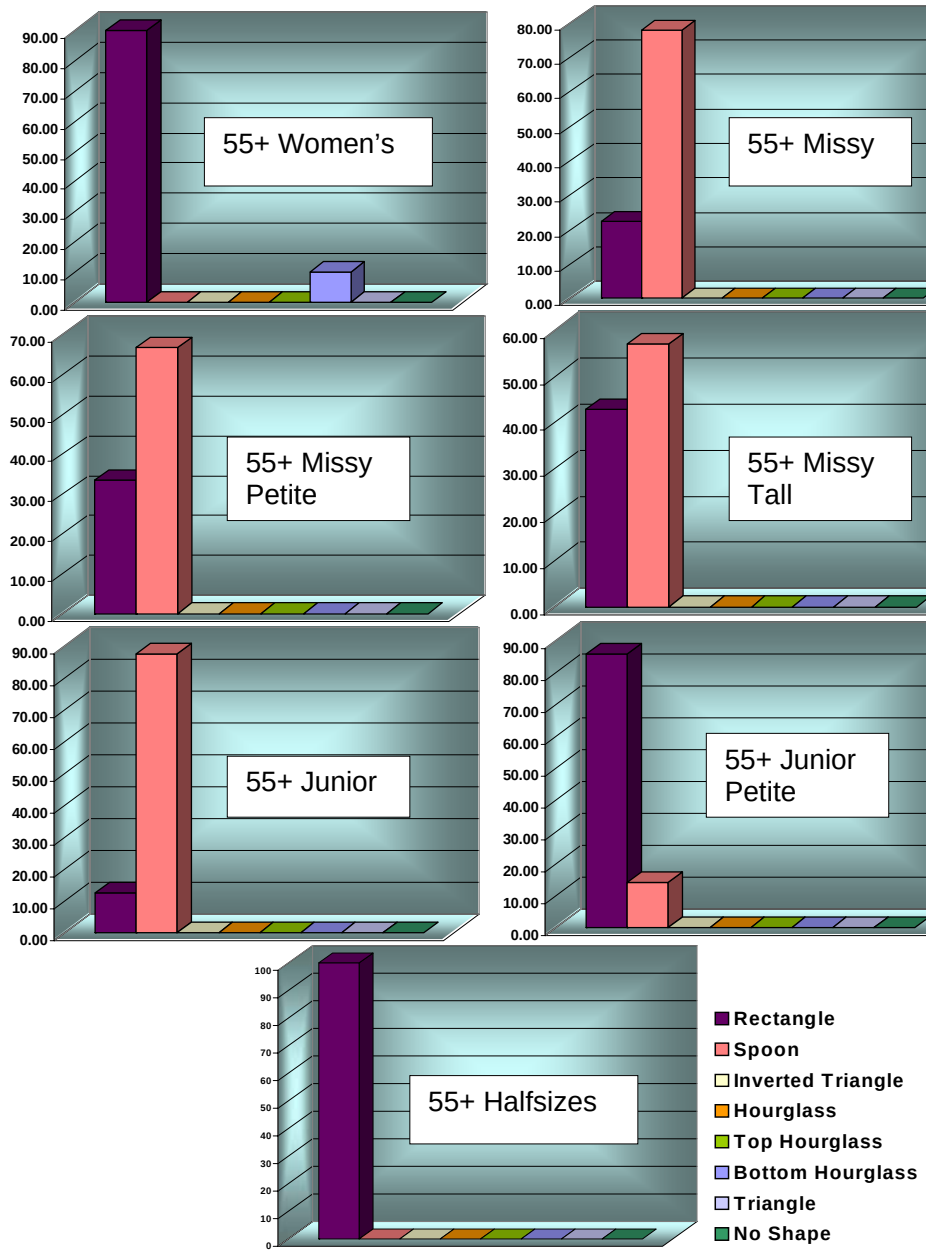

Figure 3: Shapes targeted by the current Over 55 family of standards (ASTM D 5586).

Since the Over 55 standard targets both Rectangle and Spoon shapes, which are more predominant in all age categories than the Hourglass (which most apparel companies use as fit models), one may question if this standard may be appropriate even for the Junior and Missy age groups. However, the Over 55 standards were created to accommodate the body shapes and changes that are characteristic of this particular age group. Thus, they are not ideal for Junior and Missy populations.

5. CONCLUSIONS AND IMPLICATIONS FOR FUTURE RESEARCH

In sum, the Junior and Missy sizing standards targeted the Hourglass shape across all sizes, but the Hourglass shape represented only a small portion of these respective age groups. The Over 55 standards targeted a combination of Rectangle and Spoon shapes, which accommodates a larger portion of their target groups, but still ignores the second most predominant shape in this age range (Inverted Triangle).

These results help to explain some of the inconsistencies and problems related to apparel fit, but also point to possible solutions. SizeUSA can be analyzed according to the variety of demographic, lifestyle, and shopping information collected to determine the body shapes that predominate for specific target populations. Company sizing standards can then be modified according to the proportions that are most appropriate for target customers.

The results of this study not only suggest improvements to individual company sizing strategies, but also the need for the revisions of ASTM sizing standards. The standards currently in place are largely inadequate at meeting the needs of most of the population of U.S. women. The significance of the Rectangle shape in all three age groups indicates that a sizing standard based on the Rectangle proportion may be appropriate for a big portion of today's women. Development of additional shape-based sizing standards would also provide the industry with a "bank" of standards that companies could choose from to create garments that fit their target populations better.

Overall, this study has shown that apparel companies can use SizeUSA data and body shape analysis software to classify the body shapes that predominate for specific target populations, and adjust their sizing strategies accordingly to result in the best fitting garments for their customers.

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