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Exploration of plus-size female teens' apparel fit and sizing in the United States

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Exploration of plus-size female teens’ apparel fit and sizing in the United States

by

Laurel D. Romeo

A dissertation submitted to the graduate faculty
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Major: Apparel, Merchandising, and Design

Program of Study Committee:
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Iowa State University
Ames, Iowa
2013

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ABSTRACT

The purpose of this study was to investigate apparel issues experienced by plus-size female teens aged 12-17 in the context of the functional, expressive, and aesthetic (FEA) consumer needs model. The specific objectives were to: (1) Examine whether current American Society for Testing and Materials (ASTM) sizing categories meet the measurement needs of participants; (2) identify specific areas of the body where these individuals were not satisfied with the fit of their current ready-to-wear apparel; and (3) explore the current U.S. ready-to-wear apparel FEA needs for this target group.

Mixed-methods approach was used for this study with 30 female teens, representing six separate ethnic backgrounds, with body mass indexes in the overweight or obese categories. Data collection included 3D body scans to capture anthropometric body measurements and shape at 37 key apparel fit locations and interviews to obtain demographic information and in-depth responses from participants and family members.

Quantitative and qualitative data were analyzed, compared, and combined to corroborate findings. ASTM standardized sizes were compared to both individual and group averaged body measurements at 37 key locations to identify where differences existed. Body measurements, shape, and apparel size were examined, in combination with interviews, to determine participant’s satisfaction with fit and the FEA attributes of their apparel. Participant characteristics were cross-tabulated with interview themes and subthemes using content analysis approach.

Findings revealed functional apparel fit needs with this group have not been addressed by the current ASTM standardized sizes. Additionally, their expressive and aesthetic desires have not been satisfied by the apparel available to them. Previously
unidentified issues were uncovered: Use of maternity and male apparel for adequate ease, apparel purchased at resale stores or borrowed for better fit, and, plus-size teen’s definition of apparel comfort. Participants also gave advice to industry to target this niche market.

The implications of this study include a need for a large scale study to update the anthropometric data of the U.S. teen population, size and style modification of apparel brands to capture the plus-size teen market, design curriculums that address the needs of niche markets, and continuous research with plus-size teen apparel needs.
CHAPTER 1 INTRODUCTION

Plus-Size Apparel Market

In the United States (U.S.), apparel, commonly referred to as clothing, accounted for $199 billion in retail sales during 2011 (NPD, 2012). An additional $34.16 billion of online apparel sales were reported by U.S. companies in 2011 (Apparel drives, 2012). Stock market analysts project that in 2013 teens in the U.S. will spend $200-$300 billion with an estimated 40% of that spending being on fashion related items (Fox, 2013). Forbes, and the website marketresearch.com, reported that in 2011 sales of women’s and girl’s plus-size apparel had become a $47 billion a year industry (Kids plus-size, 2011). The plus-size market continues to be the fastest growing segment in the fashion business (Dilea, 2013; Plunkett Research, Ltd., 2013). Industry projections have identified the U.S. plus-size market to be one of the most crucial factors affecting the profit and growth of the apparel retail industry (Kim, Jolly, & Kim, 2007).

Plus-size teens, not unlike their cohorts of normal weight, have been found to display a strong interest in fashion (Ogunnaike, 2009; Scardino, 2003; Wilson, 2001). In 2002, female adolescents reported their top spending category was apparel, indicating they spent an average of $104.34 per month on fashion items (Chen-Yu & Seock, 2002). Plus-size teens, however, have reported difficulty finding properly fitting apparel and have indicated they would increase their purchases if appropriately sized garments were available to them (Brock, Ulrich & Connell, 2010; Connell & Ulrich, 2005; Kang, 2004).

Ready-To-Wear Apparel

Humans have used apparel for reasons of modesty, protection from the elements, adornment, status, and as an expression of self from the earliest recorded history (Horn,
1968). Throughout most of human existence, apparel was custom made from measurements taken from an intended wearer and fit to the individual’s size and shape (Brown & Rice, 2001; Lee & Steen, 2010). With the advent of the industrial revolution, the form of ready-to-wear garments became a new way to acquire one’s apparel (Brown & Rice, 2001). Ready-to-wear garments are mass produced in standardized sizes, stocked in retail stores, and intended to be immediately worn by the purchaser (Calasibetta & Tortora, 2003; Kidwell & Christman, 1974). Unlike custom apparel which had been produced for a specific customer, ready-to-wear garments are made to fit a target customer whose precise body size and measurements are not known by the manufacturer (Chun-Yoon & Jasper, 1993). In order to produce garments for a target customer, it became necessary to standardize sizes according to body types based on statistical averages derived from anthropometric surveys (Moore, Mullet & Young, 2009).

In the U.S., the first recorded attempt at standardizing apparel sizes was during the Civil War. Between the years of 1861 and 1865, soldiers were measured and the results compiled into size charts enabling the mass production of uniforms (Brown & Rice, 2001). Further research was conducted in 1941 by O’Brien and Sheldon when measurements were taken from 10,042 adult female volunteers (O’Brien & Sheldon, 1941). The data were then updated by the U.S. Department of Commerce (1970). These studies became the basis for the current sizing system published by the American Society for Testing and Materials (Devarajan & Istook, 2004).

The American Society for Testing and Materials (ASTM), now called ASTM International, provides sizing charts for infant, children, women, and men based upon anthropometric measurements (ASTM, 2011). These charts, although not strictly adhered to
by manufacturers, are used as a guideline for the sizing of ready-to-wear apparel (Keiser & Garner, 2008; Woodson & Horridge, 1990). More recent attempts to collect anthropometric data from the general public were the SizeUK study conducted in 2001, and the SizeUSA study conducted in 2002 by [TC]^2, the makers of the Image Twin 3D body scanning hardware and software ([TC]^2, 2011).

Although ready-to-wear garments have been produced for over 150 years, the technical issue of garment fit has never been fully addressed (Ashdown & Dunne, 2006). One of the most difficult challenges facing the apparel industry today is the ability to provide well-fitting garments to a broadly defined target market (Ashdown, Loker, & Adelson, 2005). Studies conducted on satisfaction with apparel have reported that approximately 50% of women cannot find satisfactorily fitting apparel (Ashdown, Loker, & Rucker, 2007). In 2010 alone, poorly fit garments were a significant contributor to the $198 billion of apparel returns (Clifford, 2011).

Niche markets, narrowly defined markets in which target customers share a unique characteristic (Keiser & Garner, 2008), often experience additional apparel fitting issues and the plus-size market has been identified as a segment where fit is a constant concern of consumers (Brock et al., 2010; Connell & Ulrich, 2005; Deckert, 1999; Kang, 2004). Numerous researchers have identified two issues that prevent apparel companies from solving their fitting issues: the lack of information concerning fit needs for different body sizes and shapes, and the lack of current anthropometric data for niche markets within the civilian population (Ashdown et al., 2005; Bouchez, 2011; Brock et al., 2010; Clifford, 2011; Connell & Ulrich, 2005; Connell, Ulrich, Brannon, Alexander, & Presley, 2006; Devarajan & Istook, 2004; Faust, Carrier, & Baptiste, 2006; Goldsberry, Shim, & Reich, 1996; LaBat &
Accurate anthropometric data are essential to producing well-fitting garments. A niche market where little anthropometric data are available is the plus-size female teen, aged 12-17 years (Amaden-Crawford, 2005; Armstrong, 2010). Neither the [TC]² studies nor ASTM have collected or published data on this segment of the plus-size market (ASTM, 2001; ASTM, 2004; ASTM, 2008; K. Davis, personal communication, January 18, 2011). Additionally, no reported studies where anthropometric data were collected, and in-depth interviews conducted, investigating apparel fitting issues experienced by plus-size females aged 12-17 years could be located.

A third issue preventing the industry from providing well-fitting garments to their target customers is the lack of methodologies to standardize sizes and pattern grading for apparel mass customization (Mpampa, Azariadis, & Sapidis, 2010). The advanced technology of mass customization is thought to be the future of the international apparel industry. The industry cannot move forward, however, until viable methods of block development and grading, adaptable to a variety of body shapes and sizes are developed (Ashdown & Dunne, 2006; Clifford, 2011; Keiser & Garner, 2008; Mpampa et al., 2010). Solving these three issues are essential if apparel manufacturers are to fully realize the profit potential of catering to niche markets.

**Problem Statement**

In the fast paced ever evolving apparel marketplace plus-size apparel continues to be the fastest growing segment (Byron, 2005; Plunkett Research, Ltd., 2013). The latest U.S.
Census taken in 2010 reported 22,040,340 male and female adolescents between the ages of 15 and 19 years (U.S. Census Bureau, 2010). It is estimated that approximately 17% of all adolescents are overweight or obese (Center for Disease Control, 2011b). Worldwide the overweight or obesity among teens has been increasing at an accelerated pace (World Health Organization, 2011). However, research published by Pan, Blanck, Sherry, Dalenius, and Grummer-Strawn (2012) suggested that the rate at which teens are entering the overweight or obese categories may be leveling.

In general, female teens not only display a greater interest in apparel fashion, but also shop for and purchase more apparel than male teens (Anderson & Meyer, 2000; Arnold & Reynolds, 2003; Mangleburg, Doney, & Bristol, 2004; Teenage consumer spending, 2013). For the female plus-size teen finding apparel which fits and reflects the latest fashion may be more difficult than for male plus-size teens. The ASTM category and sizes for males although based on outdated anthropometric data do contain a plus-size category for the immature growing male body referred to as husky (ASTM, 2009a). Females are included in the teen obesity statistics, but currently there is no plus-size apparel category that addresses the unique body shape, fit, and design needs of a growing female teen (Center for Disease Control, 2011b; Connell & Ulrich, 2005). Female plus-size apparel defined by the industry standards includes size 14 or larger and is only available in the adult women category (ASTM, 2001; 2004). Therefore, a plus-size female teen often finds it necessary to purchase apparel from the women’s department which may not meet the fit requirements of growing bodies or provide the desired age appropriate styles or fashion (Brock et al., 2010). The importance of female teens to retail sales and the lack of a plus-size apparel category for
female teens are two compelling reasons for investigating this segment of the plus-size niche market.

In order to design and manufacture apparel that will address both the wants and needs of this important niche market an in-depth understanding of both its sizing and fit requirements as well as aesthetic preferences is necessary. Yet, there are no current anthropometric measurements of overweight and obese female teens aged 12-17 years available as a guideline to apparel manufacturers to facilitate development of apparel for this group (Ashdown et al., 2005; ASTM, 2001, 2004; Davis, personal communication January 18, 2011). The most recent large scale attempts to update anthropometric data conducted by the industry consultant firm [TC]² excluded individuals under the age of 18 gathering data on only individuals old enough to give their legal consent (Davis, personal communication January 18, 2011). Additionally, no studies have been identified investigating issues surrounding the sizing, fit, and apparel preferences for female teens aged 12-17 years. Therefore, up-to-date anthropometric and qualitative data are needed by apparel manufacturers desiring to target this niche market.

The emerging technology of apparel mass customization, the manufacturing of customized apparel at mass production prices, promises to improve garment fit, yet there are currently no methodologies to standardize sizes and pattern grading for mass customization. Without a viable methodology based upon current anthropometric survey data, the industry will not be able to utilize the available technology (Mpampa et al., 2010). The lack of current anthropometric data and understanding of unique fitting issues of plus-size female teens aged 12-17 years, in conjunction with the lack of methodologies for sizing and grading
for mass customization, make it extremely difficult and costly for apparel manufacturers to
effectively break into and target this niche market.

**Theoretical Framework**

This research was framed around Lamb & Kallal’s (1992) Functional, Expressive and
Aesthetic (FEA) Consumer Needs Model. The model attempts to incorporate the functional,
expressive, and aesthetic aspects necessary in apparel design to fulfill both consumers’ wants
and needs. It can be applied to apparel designed for individuals whose needs are not
currently met in the marketplace (Lamb & Kallal, 1992). For this research, this model is
particularly suited for the investigation of apparel issues surrounding plus-size female teens
as it considers if apparel available to the consumer satisfies utilitarian needs, is visually
pleasing to the wearer, and communicates the desired message to others, all of which have
been shown to be important apparel considerations for teens (Anderson & Meyer, 2000;
Although the model addresses the complete apparel design development and implementation
process, this research was only concerned with the components of the model, from the target
customer identification through the preliminary ideas phase.

The target customer is located at the core of Lamb and Kallal’s (1992) FEA model.
In this model, in order to provide the target customer with apparel that satisfies her wants and
needs, the designer must develop a profile of her which includes demographic and
psychographic information, physical characteristics, apparel needs created by her various
activities and style preferences. The FEA model proposes that the target customer is
encircled by culture that influences and molds her apparel desires and style preferences.
Culture not only influences her functional, expressive, and aesthetic apparel wants and needs, but in turn is influenced by these.

Functional, expressive and aesthetic apparel wants and needs are not viewed as separate or mutually exclusive, but as interrelated on three continuum of relative importance. The three continuums are: Functional-expressive acknowledging apparel must be useful while providing the wearer the opportunity for self-expression; expressive-aesthetic being concerned with the symbolic message conveyed by apparel while providing a sense of beauty or pleasure to observers; and aesthetic-functional considering apparel should be visually appealing while fulfilling its specific purpose (Lamb & Kallal, 1992).

In the FEA model, the design process begins with problem identification based on an analysis of the target customer and her relationship to the three continuums. Problems which interfere with her apparel’s ability to fulfill these wants and needs must be identified at this stage before moving on to the preliminary ideas stage where possible solutions to the problem are investigated (Lamb & Kallal, 1992). This research was conducted to identify current problems experienced by the study participants; female teens aged 12-17 years, and suggest possible solutions to them and the apparel industry under this framework.

**Purpose of this Study**

The overall purpose of this study was to investigate apparel fitting issues experienced by plus-size female teens aged 12-17 years in the context of the FEA model with a view to improving apparel fit within this niche market. This exploratory study was conducted to provide (1) a foundation for future large scale nationwide research with the intent to develop an additional ASTM sizing category for plus-size female teens and (2) apparel manufacturers
with the information needed to manufacture apparel suited to the unique needs of this niche market.

The specific objectives of this study were to:

1. Examine whether current ASTM sizing categories meet the measurement needs of plus-size female teens aged 12-17 years participating in this study.

2. Identify specific areas of the body where plus-size female teens aged 12-17 years are not satisfied with the fit of their current ready-to-wear apparel.

3. Explore the current U.S. ready-to-wear apparel needs in terms of functional, expressive, and aesthetic aspects for plus-size female teens aged 12-17 years.

**Definition of Terms**

The following are definitions of the key terms investigated in this study.

**Adolescence:** The years from puberty to adulthood may be divided into three stages: early adolescence the ages twelve and thirteen; middle adolescence the ages fourteen to sixteen; and late adolescence the ages seventeen to twenty-one (American Academy of Pediatrics, 2012). In this research, the term adolescence will be used interchangeably with adolescent, teen, or teens.

**Anthropometer:** “a rod that may be separated into sections…with one or more sets of scale markings, plus one or more secondary scales…mounted at right angles on fittings that slide along the primary rod” (Roebuck, 1995, p. 29).

**Anthropometric data:** “measurement data on the dimensions of specified areas of the human body collected by using scientific methods” (Moore et al., 2009, p. 212).
**Anthropometric methods:** “the basic working tools for the analysis and development of engineering design requirements by human factors and ergonomics professionals” (Roebuck, 1995, p. 2).

**Anthropometric survey:** “the process of measuring specified body areas of a large sample of the population being studied” (Moore et al., 2009, p. 212).

**Anthropometry:** “the science of measurement and the art of application that establishes the physical geometry, mass properties, and strength capabilities of the human body” (Roebuck, 1995, p. 1).

**Apparel:** “clothing, not necessarily fashionable” (Frings, 2005, p. 355). In this dissertation the words clothes, clothing, and garments are used interchangeably with apparel as study participants were more familiar with those terms.

**Apparel fit:** “apparel fit is defined as the relationship between the size and contour of the garment and those of the human body” (Shan, Huang & Qian, 2012, p. 1). In this paper may also be referred to as fit. Fit can be both subjective from the wearer’s viewpoint or objectively judged against brand standards. It includes the aesthetic enhancement or distraction created and comfort or discomfort experienced while wearing the garment (Newcomb & Istook, 2011).

**Armseye:** “an armhole with a curved area between the mid-armhole and the underarm and side seam intersection” (Moore et al., 2009, p. 212).

**Block:** “the pattern for a basic garment without any style features added” (Beazley, 1999, p. 67).

**Body Mass Index (BMI):** “a measure used to determine childhood overweight and obesity. It is calculated using a child's weight and height. BMI does not measure body fat
directly, but it is a reasonable indicator of body fatness for most children and teens” (Center for Disease Control, 2011a, p. 1).

**Body scanning:** The process to utilize a 3D body scanner an instrument designed to create an accurate three-dimensional computer image of the human body and produces a cloud of point data which indicate anthropometric measurements of length, width, circumference, body angles, landmark points, shape, and volume (Bye, LaBat, & DeLong, 2006).

**Culture:** A set of shared attitudes, values, goals, practices, beliefs, social forms, and traits of racial, religious or social groups that characterizes a group, institution or organization that molds its members perceptions and attitudes (Falon, 1990).

**Data cloud:** Points of data obtained from a 3D body scanner used to create a 3D digital twin of a person (Granger, 2012; Leong, Fang & Tsai, 2013).

**Drop value:** The difference between key circumference measurements (Chun-Yoon & Jasper, 1993).

**Ease:** “difference between the body measurements of the intended wearer and the measurements of the finished garments” (Keiser & Garner, 2008, p. 369).

**Fashion:** “a sociocultural phenomenon in which a preference is shared by a large number of people for a particular style that lasts for a relatively short time, and then is replaced by another style” (Calasibetta & Tortora, 2003, p. 150). “a reflection of our times and a mirror of the prevailing ideas in our society” (Keiser & Garner, 2008, p. 525).

**Mass customization:** “the application of mass-production techniques to the production of a single customer-configured garment” (Keiser & Garner, 2008, p. 376). It
includes the ability to create a garment custom sized and fit to an individual (Cheng & Cheng, 2012).

**Niche market:** “a narrowly focused target customer” (Keiser & Garner, 2008, p. 67). For this research plus-size female teens are considered to be this market.

**Obesity:** “BMI at or above the 95th percentile for children of the same age and sex” (Center for Disease Control, 2011a, p. 1).

**Overweight:** “BMI at or above the 85th percentile and lower than the 95th percentile for children of the same age and sex” (Center for Disease Control, 2011a, p. 1).

**Pattern grading:** “the process of systematically increasing and decreasing the dimensions of a master pattern into a range of sizes for production” (Moore et al., 2001, p. 3).

**Plus-size:** “sizes in women’s apparel that are at the upper range of sizes manufactured. Generally, retailers place size 14 and above in this category” (Calasibetta & Tortora, 2003, p. 371).

**Plus-size teen:** Refers to teens whose girth measurements exceed those of normal weight teens of comparable height. For this dissertation, includes persons with excess body fat or increased muscle mass in comparison to teens of the same age and height.

**Product development:** “design and engineering required for products to be serviceable, producible, salable, and profitable” (Glock & Kunz, 2005, p. 641).

**Self-concept:** How one thinks and feels about herself (Horn, 1968).

**Self-image:** How one sees herself or how she would like to be viewed by others (Schiffman & Kanuk, 2004).

**Size charts:** Containing apparel sizes and their associated body measurements. Apparel manufacturers develop size charts to reflect their target market (Lee & Steen, 2010).
**Somatotype:** “(body types). They are the endomorph, the mesomorph, and the ectomorph” (Marshall, Jackson, Stanley, Kefgen, & Touchie-Specht, 2004, p. 138).

**Target customer:** An imaginary customer who embodies the demographic, lifestyles and physical characteristics of the customers for which apparel is designed and marketed (Lee & Steen, 2010).

**Target market:** “a well-defined customer group to which a business wants to sell” (Keiser & Garner, 2008, p. 67).

**Teens:** The years from puberty to adulthood (American Academy of Pediatrics, 2012). In this research the term will be used interchangeably with adolescent, adolescence, or teen.

**Uneven grading:** “or nonlinear grading is achieved when it is determined that the target customer is shaped somewhat differently than the standards in sizing charts” (Keiser & Garner, 2008, p. 375).

**Vanity sizing:** “placing a smaller size label on a larger size garment” (Keiser & Garner, 2008, p. 357).
CHAPTER 2 REVIEW OF LITERATURE

This chapter will explore the plus-size female teen as an apparel consumer and provide a comprehensive overview of what is currently known about this niche market, including spending habits, social, cultural, and fashion influences; and whether the ready-to-wear apparel is available fulfills her needs and wants. Issues related to the current sizing systems and obstacles faced by apparel manufacturers wishing to produce apparel for this niche market will be discussed.

This chapter follows the approach outlined in Lamb and Kallal’s (1992) Functional, Expressive and Aesthetic (FEA) Consumer Needs Model to examine the target customer and identify the underlying issues preventing a plus-size female teen from acquiring the desired apparel. Figure 1 illustrates the summary of this chapter organized under the various components of the model through the problem identification stage and outlines the review of literature in the context of the FEA model. The model begins by identifying the target customer, and proceeds to consider the culture surrounding the target customer as a basis for exploring the customer’s functional, expressive, and aesthetic wants and needs. Once a full understanding of the target customer is gained, the problem identification phase begins by clarifying issues which limit the designer’s ability to provide apparel that meets these wants and needs.

The Target Customer

The FEA Consumer Needs Model (Lamb & Kallal, 1992) recognizes that a complete profile of the target customer is essential and may include demographic and psychographic information as well as physical characteristics, activities, and preferences.
Figure 1. Summary diagram of review of literature in context of the consumer’s functional, expressive, aesthetic wants and needs
The profile may also involve clarifying the customers’ wants and needs in the context of a product use situation. For this research, the target customer is a plus-size female teen aged 12-17 years. This can include those who are clinically overweight or obese, and teen athletes who have larger than average girth measurements for teens of the same age and height (Connell & Ulrich, 2005; Keiser & Garner, 2008). The plus-size female teen encompasses a wide demographic and psychographic profile, as she may belong to any income level, ethnicity, reside anywhere in the world, and have very diverse interests (Zanigrillo, 1990).

**The Target Customer and Size Related Issues**

The target customer for this research is the 12-17 year old female. Females of this age group have been included in the reports issued concerning the rise in obesity rates among teens. Developed and developing nations, worldwide, are experiencing an increase in teens who are overweight or obese (World Health Organization, 2007). According to the World Health Organization (WHO), in 2005, approximately 1.6 billion adults, over the age of 15, worldwide, are overweight, and at least 400 million of them are classified as obese. The World Health Organization (2011) report stated that obesity rates continue to increase at an alarming rate worldwide with even low-income countries more than doubling the rate of obese citizens since 2008. In the U.S. adolescents aged 12-19 years have experienced an increased obesity rate of 13.1% since 1980 (Center for Disease Control, 2010).

For children of the same age and sex from 2-19 years of age, overweight is defined as a Body Mass Index (BMI) at or above the 85th percentile and lower than the 95th percentile and obesity is defined as a BMI at or above the 95th percentile for children of the same age and sex (Center for Disease Control, 2011a). BMI is calculated by the formula: (weight in pounds / height in inches x height in inches) x (703) (Center for Disease Control, 2012).
Although there is an obesity classification for children, concern exists among health professionals regarding the use of the word obese due to the stigma associated with it (U.S. Department of Health and Human Services, 2010).

Obesity has become an important global public health concern, with overweight and obesity rates growing particularly rapidly in Brazil, Morocco, India, China, Saudi Arabia, and Thailand (World Health Organization, 2007). For the first time in history, many nations are finding that they must, simultaneously, face the issues of starvation and obesity of their citizens (The world is fat, 2007; World Health Organization, 2007). Developed nations such as the U.S. and the United Kingdom have been dealing with increasing overweight and obesity rates of their teens for some time (Center for Disease Control, 2011b; United Kingdom Department of Health, 2011).

Childhood and adolescent obesity has increased at an alarming rate in the U.S., tripling since the 1970’s (Singh & Kogan, 2011). In 2011, it was estimated that approximately 17% of all children and 32.6% of females aged 12-19 in the U.S. were overweight or obese (Center for Disease Control, 2011b; U.S. Census Bureau, 2010). A report released earlier this year by the American Heart Association (2013) revealed that 23.9 million children aged 2-19 are currently overweight or obese. The recent increase in the prevalence of overweight and obese teens in the U.S. has been partially attributed to the increase of: the socially disadvantaged, low-incomes, high-unemployment rates, and non-English speaking households (Singh & Kogan, 2011). Higher rates of obesity have also been observed among adolescents when parents are less educated, family income is closer to the poverty level, or the child resides with a single mother (Singh & Kogan, 2011). Obesity rates also vary by ethnicity, with a recent study reporting rates among Black and Hispanic children...
and teens at 23.86% and 23.42%, respectively compared to the overall rate of 17% (Singh & Kogan, 2011).

Additionally, some teens are classified in the overweight or obese category with body weight above the normal range for their age and height; yet do not have excess body fat. Teen athletes, due to increased muscle mass, may fall into this category and require plus-size apparel to accommodate increased girth measurements (Center for Disease Control, 2011a; Connell & Ulrich, 2005).

Although government agencies worldwide have documented the increasing weight and, therefore, size of the worlds’ teens (Center for Disease Control, 2011b; World Health Organization, 2007; United Kingdom Department of Health, 2011), the only plus-size apparel recognized by the U.S. apparel industry is women’s plus-size designed for the mature female overweight-to-obese figure (ASTM, 2001, 2004, 2008; Calasibetta & Tortora, 2003; Keiser & Garner, 2008). Currently, there is no standardized apparel sizing for plus-size teens or anthropometric survey data that addresses the needs of plus-size teens aged 12-17 years (ASTM, 2001, 2004, 2008; Connell et al., 2006; [TC]\textsuperscript{2}, 2011). Due to this, plus-size teens often experience difficulty finding apparel that is both age appropriate and fits their size and shape (Ashdown et al., 2005).

**The Target Customer and Apparel Purchases**

According to Mintel (2004), an international marketing intelligence firm, in recent years significant demographic changes have occurred worldwide. The world has not had so many adolescents since the baby boomers were teens. Today’s teens have grown up in a world closely connected by technology. International communications have created the global teenager, one who is more homogeneous in fashion taste, values, and spending
patterns, and having more in common with teens in different nations than with older persons in their same country (Parker, Hermans, & Schaefer, 2004). Miller (1995) argued that the international media created the global teen and the “Americanization” of fashion and culture. She reported that 87% of Latin American, 80% of European, and 80% of Far Eastern teens identified the U.S. as having the most influence on their fashion and culture.

Teens may value fashionable apparel more than any other age group (Koester & May, 1985). A survey of teen spending conducted by Seventeen Magazine in 2009 revealed that 75% of teens would choose a new pair of shoes over 50 new MP3 music downloads, and that 63% would rather have a new pair of jeans than a concert ticket (Teen spending, 2011). In 2013, 41% of girls aged 13-18 surveyed in the U.S. reported purchasing 10 or more apparel items in a 6 month time period (Teenage consumer spending, 2013). A 2011 survey of apparel consumption habits of females aged 16-24 in the U.K. revealed almost one third of participants purchased apparel just because they liked the item, even if they had no need for it (Mintel, 2011). In 2013 it was reported that most of a teen’s disposable income is spent on fashion related items (Boris, 2013). The global teen may not only value fashionable apparel more than any other age group, but may also spend more money on that apparel.

In 2007, it was estimated that there were 26 million 12-17 year-olds in the U.S. with an aggregate income of $80 billion and spending 42% of money they earned on apparel (Schaefer, Parker, & Hermans, 2009). Four years later, in 2011, an estimated 32 million teens in the U.S. spend over $172 billion per year (Bachlet & Crozier, 2012). This trend in teen spending appears to be steady as in 2013 teens are expected to spend $200-$300 billion with 40% of purchases apparel related items (Fox, 2013). Chain Store Age reported in 2002 that, on average, U.S. teens spent $135 per month on apparel and related products. A study
conducted that same year with 14-18 year-olds revealed that female teens shopped for apparel two to three times a month spending an average of $104.34 per month (Chen-Yu & Seock, 2002). A 2013 study of 5,200 teens with an average age of 16.3 years revealed teens spend approximately 21% of their money on clothing, 9% on shoes and an additional 10% on accessories and personal care items (Boris, 2013). In Britain, 33% of 16-18 year-olds reported they shop for apparel at least once a week (Mintel, 2011). Interviews conducted in 2012 by the ABC news show 20/20 with teen girls and their mothers revealed brands such as Tiffany, Coach, and Armani Exchange were favorites among high school girls and that it is common for girls to carry their items to school in $200.00 purses (Stossel, 2012). Apparel may be the top spending category for the teen’s own money; nevertheless, they are not the only ones paying for their apparel.

In the U.S., parents and grandparents of teens reported spending an average of $883 in the spring of 2008 and an additional $1,085 in the fall of 2008 on their teen apparel (Teen spending shifts, 2009). More recent research conducted in 2012 found U.S. family members spent an estimated $208.7 billion dollars a year in purchases for teens (Teenage consumer spending, 2013). However, the U.S. is not the only country where teen apparel purchases continue to be financed by extended family members. Several studies in other countries support this fact.

China’s one child policy has been credited with creating “little emperors”, an estimated 200 million 10-19 year olds who are cherished and indulged by parents and grandparents, accounting for $4.1 billion in teen apparel sales per year (Parker et al., 2004). Japan, with its comparatively small number of teens, is ranked number four in the world teen market (Krauss, 2001). In Italy, teens have been shown to exert a strong influence on their
parent’s apparel spending, with Italian teens preferring certain brand names of jeans, sweatshirts, jackets and athletic footwear (Engle, Blackwell, & Miniard, 1995).

Niche markets are often identified as having potential for sales growth (Engle et al., 1995) and this appears to be the case with the plus-size apparel market, which continues to be the fastest growing segment in apparel retailing (Byron, 2005; Dilea, 2013). With plus-size apparel of women and girls reaching sales of $47 billion a year (Kids plus-size, 2011) with the market conservatively projected to increase 2.2% per year (Binns, 2013) the plus-size teen market offers tremendous growth potential for apparel manufacturers.

Unlike the housing and general retail markets, having suffered during the worldwide recession between 2005 and 2010, the apparel market for consumers aged 16-24 years has seen a 17% growth (Mintel, 2011). Teens have responded to the worldwide economic recession by adjusting their apparel acquisition habits, purchasing more sale items, and shopping at discount stores rather than specialty stores to maximize their purchasing power (Cotton Inc., 2009). A possible explanation for this continuous sales growth is that teens have fewer financial obligations and their plans to purchase apparel has little to do with their personal financial outlook, in contrast to adults, who plan to purchase based upon their financial outlook (Cotton Inc., 2009).

For an adolescent, shopping for apparel is more than a business transaction. It is a social event to be shared with friends (Arnold & Reynolds, 2003; Mangleburg et al., 2004). Chen-Yu and Seock (2002) found recreation to be the number one apparel shopping motivation of teens. Female teens, in particular, enjoy shopping for apparel with friends (Meyer & Anderson, 2000). A survey of teen apparel spending habits conducted by Market Research World revealed that girls are purchasing apparel online less than boys. The
researchers concluded that online shopping lacked the social aspects of apparel acquisition, which is important for many teen girls (Teens slowly increase, 2011). Social shopping for apparel with friends begins in late childhood to early adolescence and one study reported that, by age 12, over 45% of participants had begun shopping with friends for some apparel items (Meyer & Anderson, 2000).

In addition to the social aspect of being at the store with friends, another reason researchers have proposed as to why teens like to shop with friends is to eliminate or lessen the chance of purchasing and wearing an item which will not be considered fashionable by their peers (Mangleburg et al., 2004). Research has shown that adolescents aged 13-19 years, in particular, look to peers for information about socially correct fashion, and both males and females reported valuing their friends' opinions on fashion trends (Anderson & Meyer, 2000). Eighty one percent of girls in one study reported their heavy reliance on friends and peers as a source of the latest trends (Teenage consumer spending, 2013). Francis and Dickey (1984) found that changes in apparel satisfaction occurred following product use. Satisfaction or dissatisfaction with a purchase has been shown to result from a comparison of the pre-purchase expectations to the actual outcomes that are experienced from product use (Engle et al., 1995). For the teen, this outcome often involves peer acceptance or rejection of the purchased item (Schiffman & Kanuk, 2004).

A teen shopping alone is at greater risk of purchasing and wearing an item of apparel that will not be viewed favorably by his/her peers, resulting in decreased satisfaction about the purchase (Schiffman & Kanuk, 2004). Findings suggest that shopping with a friend reduces the perception of risk and uncertainty concerning a purchase (Kiecker & Hartman, 1993) and increases the buyer’s confidence about the purchase decision (Kiecker & Hartman,
Research has also shown that the outcome experienced by product use directly affects repurchase intentions (Engle et al., 1995). Therefore, when an adolescent wears an apparel item purchased during group shopping and receives a positive response from his/her peer group, confidence concerning purchases are increased and will be reflected in the number of items purchased and the amount of money spent on future purchases. This assumption was confirmed by a 2004 study which found teens who shop with friends were found to purchase more items and spend more money than those who shopped alone (Mangleburg et al., 2004).

Teens are influential consumers, and fashionable apparel appears to occupy an important place in a teen’s life (Koester & May, 1985; Schaefer et al., 2009). For the adolescent, shopping for apparel is more than a business transaction; it is a social event to be shared with friends (Teens slowly increase, 2011). Within the global teen population, the number of overweight and obese individuals is increasing at an alarming rate (World Health Organization, 2007). This trend is reflected in the accelerated pace at which the plus-size apparel market has been growing (Byron, 2005; Plunkett Research, Ltd., 2013). The FEA Consumer Needs Model proposes that the target customer is surrounded by and immersed in the prevailing culture. This culture influences and molds her perceptions and desires (Lamb & Kallal, 1992). Teen’s spending habits, however, are not the only cultural influences working on her. The prevailing culture may affect their perception of her body and the apparel she purchases as we will now explore.

**Cultural Influences on the Target Customer**

In Lamb & Kallal’s (1992) FEA Consumer Needs Model, culture encircles the target customer. Fashion has been defined as “A reflection of our times and a mirror of the prevailing ideas in our society” (Keiser & Garner, 2008). Culture plays a significant part in
one’s perception of the ideal body figure (Apeagyei, Otieno, & Tyler, 2007). Cultural values which impact gender, age and social attitudes dictate what is perceived to be the ideal body shape and size at a particular point in history (Apeagyei et al., 2007; Fallon, 1990). It is important to note that at this point in history a thin body shape and low body weight is considered attractive, and the mass media reflects this in its negative portrayal of overweight and obese individuals (Heuer, McClure, & Puhl, 2011). The current preference for thinness has been observed not only in adolescents who are overweight, but also those of average weight. Researchers found that young women, both athletes and non-athletes, tended to overestimate their body size and said that their ideal size would be thinner (Hallinan, Pierce, Evans, DeGrenier, & Andres, 1991). This preference for thinness is not exclusive to young women. Harris and Harris (1992) reported that thinness in both men and women was preferred across a wide range of age, ethnicity, and genders.

The prevailing preference for a thin body shape is reflected in the average runway model who is estimated to be 5 feet 9 inches tall, and to weigh 110 lbs, yielding a BMI score of just 16 (Klonick, 2006). The media portrayal and fashion industry use of underweight models promoting an unrealistic body size has come under scrutiny in recent years. In 2008, plans to ban unhealthily thin catwalk models under age 16 from London Fashion Week were abandoned due to pressure from the apparel industry (Razaq & Davis, 2008). The fashion industry promotes a thin body shape, although, in 2002 it was estimated 60% of American women wore size 14 or larger which is considered plus-size by the industry’s standard (Minor, 2002). By the year 2013, that estimate had risen to 70% of all shoppers requiring plus-sizes (Murray, 2013). Fashion styles, therefore, do not necessarily fit all body shapes and sizes and a teen’s figure may not resemble that of the models who display the apparel,
causing the teen to experience negative feelings towards her body (Tselepis & de Klerk, 2004).

The current preference for thinner bodies and smaller sizes is also reflected in how some apparel manufacturers market their brands. Zara a world leader in fast fashion has refused to increase its apparel sizes to accommodate the increasing size needs of Americans. In their stores a size 6 or 8 is considered a large and extra-large (Chang, 2012). In 2013, the popular teen retailer Abercrombie & Fitch received much negative publicity over statements made by its CEO Mike Jeffries regarding a customer petition urging the retailer to carry larger sizes. Jeffries was quoted as saying:

_In every school there are the cool and popular kids, and then there are the not-so-cool kids. Candidly, we go after the cool kids. We go after the attractive all-American kid with a great attitude and a lot of friends. A lot of people don't belong [in our clothes], and they can't belong. Are we exclusionary? Absolutely._ (Abercrombie, 2013)

One method of gaining brand loyalty through sizing is the practice of vanity sizing, labeling a garment with a size smaller than it actually is (Keiser & Garner, 2008). Vanity sizing is often employed by more expensive brands, as they have learned from experience that women will pay more for a garment and are more likely to make a purchase when a garment fits and has a size label smaller than they normally wear (Brown & Rice, 2001). For this reason, Silverman (2009) suggested that vanity sizing and ego make labeling a garment plus-size tricky for apparel manufacturers, as customers who are particularly concerned with label size may find it difficult to purchase a garment labeled plus. Clothing is not the only apparel item in which the size number is a concern for consumers. It is estimated that 88% of women buy shoes that are a size too small (Belk, 2003).
Reddy and Burns (2011) found that a change in apparel size led to body dissatisfaction for some young women. One participant reported that she did not purchase jeans for two years because she did not like the size number on the garment that fit. In another study, a mother of a plus-size teen confessed to cutting the size label out of her daughter’s sweatshirt so she would not know it was sized large. This mother expressed concern over how her daughter’s classmates would treat her if they saw a label marked large or extra-large while changing for gym class (Brock et al., 2010). It is interesting to note that the very successful teen retailer, Hot Topic, chose to create a new numbering system unique to their store for their plus-size apparel and found these items were so popular that they could not keep the garments in stock (Hobson, 2001).

While promoting the prevailing cultural ideal of thinness, the mass media has come under criticism for simultaneously promoting a stigma of overweight individuals. A recent study found overweight and obese individuals were portrayed in a negative context 72% of the time (Heuer et al., 2011). These individuals were less likely to be portrayed as professionals, expert advocates, journalists, or healthcare providers in the media than individuals of average weight (Heuer et al., 2011). It has been suggested that the obesity stigma in the mass media has contributed to the acceptability of prejudice towards overweight and obese persons and this prejudice has been shown to exist among children as young as 3 years old (Gibson, 2011; Heuer et al., 2011). Obese individuals who view these negative images may be inclined to accept this negative stereotype leading to emotional and physical health consequences (Heuer et al., 2011).

The target customer for this research is a plus-size female teen aged 12-17 years. Based on previous studies (Koester & May, 1985; Parker et al., 2004; Zangrillo, 1990) the
following assumptions are made for this research: (1) demographically, she can be any ethnicity, income level, or nationality; (2) she lives in a world where she shares more in common with teens worldwide than any other generation in history, due to technology; and (3) fashion and shopping occupy a significant place in the life of her peers. However, she is surrounded by a prevailing world culture which prefers thinness despite the fact that there are more overweight individuals than underweight for the first time in history (Mirskey, 2007).

Functional, Expressive, and Aesthetic Design Considerations

Once the target customer and her cultural influences are defined, the FEA Consumer Needs Model then explores the functional, expressive, and aesthetic aspects of apparel available to the customer (Lamb & Kallal, 1992). These aspects are described as existing on three separate yet related continuums: The functional expressive continuum, the expressive aesthetic continuum, and the aesthetic functional continuum. The model acknowledges that all are important aspects of apparel design, but for any given garment one aspect may take precedence. Each of these design considerations will be investigated in the context of the target customer for this research.

The Functional Expressive Continuum

The functional expressive continuum addresses the ability of apparel to be useful while conveying a message about the wearer (Lamb & Kallal, 1992). The functional aspects of the garment include its fit, comfort, provision for range of motion, ease of dressing and undressing, and the physical protection it offers and the expressive component is related to how the garment addresses the target customer's need to express her values, status, roles and self-esteem through the apparel worn (Lamb & Kallal, 1992).
Adolescent Apparel Satisfaction and Self-Esteem. Adolescence brings about biological and cognitive changes. These changes are characterized by vagueness, confusion, and discontinuity of self, and are accompanied by a period of redefining one’s role in society (Steinberg, 2011). During this time approval from one’s peers and the desire to feel part of a group are particularly important to the adolescent’s self-esteem (Horn, 1968).

When investigating the relationship between apparel comfort and the level of self-esteem among adolescent females in social, school, and leisure situations, Daters (1990) reported that apparel comfort and fit were found to be very important to young women’s self-esteem in both social situations and at school. The effect of obesity on self-esteem appears to increase as a child moves into adolescence. Studies have shown little difference in self-esteem between obese and healthy weight children aged 7-12 years, but obese participants aged 13-18 years, displayed consistently lower levels of self-esteem compared to healthy weight teens of the same age (Gibson, 2011).

Clothing Deprivation and Social Participation. In this study, the terms apparel and clothing are used interchangeably and understood to mean the garments one wears. Clothing deprivation has been defined as the relative absence of satisfaction with one’s clothing; dissatisfaction or discontent with clothing in relation to physical and psychological comfort; discontent with clothing in relation to peers; and the feeling of not having enough clothing to be satisfied (Francis, 1990). The social and psychological effect that clothing deprivation has on adolescents has been investigated by several researchers over the past 50 years (Brock et al., 2010; Francis, 1990, 1992;, 1968; Ryan, 1966; Vener & Hoffer, 1959).

A positive relationship exists between an adolescent’s satisfied with his or her apparel and social participation, membership, and participation in organizations, and popularity
among peers (Francis, 1992; Kelley, Daigle, LaFleur, & Wilson, 1974). Ryan (1966) asserted that the amount of time an adolescent is engaged in social activities is dependent upon the way others perceive his/her appearance, as well as upon the teen’s own feelings towards his/her clothing. High school girls reported declining to participate in social activities, such as attending a dance, because they did not have the appropriate clothing (Ryan, 1952; 1953). In addition to not having what the adolescent perceived to be appropriate clothing, Francis (1992) found that the inability to buy clothing resulted in decreased social activity and lower social competency for teens. This may be the case for the plus-size teen who, due to size, may be unable to purchase apparel in the styles she seeks and is forced to settle for apparel that does not project the desired image (Brock et al., 2010; Francis, 1992). This could interfere with the teen’s ability to use apparel as a vehicle to change social peer groups or gain acceptance into an aspirational group.

A study investigating college student’s attitudes towards obese individuals revealed the participants regarded obese persons as less active, pleasant, intelligent, successful, valuable, beautiful, sexually attractive, and as being less interested in fashion and apparel than persons of average weight (Rutherford-Black, Heitmeyer, & Boylan, 2000). In general, research has found that overweight and obese adolescents have fewer friends, are less liked and are rejected more often than healthy weight teens (Gibson, 2011). Social participation is essential during the teen years and lack of social participation has been found to contribute to juvenile delinquency, school dropout and psychiatric problems in later years (Francis, 1992). Health professionals recognize that regular physical activity and a healthy diet are two important factors in obesity prevention and reversal (Singh & Kogan, 2011). However, an
overweight or obese teen may be less likely to engage in social and physical activities if unable to find appropriate apparel to wear (Francis, 1992).

Apparel has been shown to play a significant role in an adolescent’s social and psychological development. Clothing deprivation, whether real or imagined, has been shown to affect an adolescent’s participation in social events (Francis, 1992). Using apparel to project the desired self-image may be particularly difficult for the female plus-size teen as teens and their mothers have expressed concern over finding apparel that is stylish and fits their size and shape (Brock et al., 2010).

**The Expressive Aesthetic Continuum**

The expressive aesthetic continuum addresses the messages conveyed by apparel and the pleasure obtained by the beauty of the item (Lamb & Kallal, 1992). The expressive component includes the target customers’ values, roles, status, and self-esteem, whereas, the aesthetic component is concerned with art elements, design principles, and the relationship of the body to the garment.

**Adolescence, Physical Changes, and Emotional Well-being.** Adolescence is the transitional period between childhood and adulthood and is a time when drastic changes take place physically, socio-psychologically, and cognitively (Tselepis & de Klerk, 2004). As individuals progress from early to late adolescence, they become less satisfied with appearance of both their bodies and their apparel (MacGillivary & Wilson, 1997). Weight related dissatisfaction with one’s body has been found to be related to impairment in the emotional well-being of overweight adolescents which is an important part of one’s overall health (Mond, van den Berg, Boutelle, Hannan, & Neumark-Sztainer, 2011).
Body dissatisfaction, or, the difference between actual and ideal body size, has been noted in girls as young as 5 years and continue to increase as children progress through adolescence (Gibson, 2011). Young women are not alone in exhibiting dissatisfaction with their body size. While females consistently desire to be thinner, adolescent males desire to be bigger (Gibson, 2011). Satisfaction or dissatisfaction with one’s body has been found to be a key determinant in apparel preferences (Alexander, Connell, & Presley, 2005; Kaiser, 1990). Apparel and appearance play a particularly important role for the teen, as they imagine their behavior and appearance being under constant scrutiny (MacGillivray & Wilson, 1997).

Adolescence is also a time of searching and experimentation with different social roles as one develops self-concept and self-image (Horn, 1968). Self-concept has been described as how one thinks and feels about him or herself and social self-image as how one perceives others think or feel about them (Horn, 1968). Consumer behavior researchers have expanded the definition of self-image to include different types. These include: the actual self-image – how the consumer sees themselves; the ideal self-image – how they would like to see themselves; and the social self-image – how they feel others see them (Schiffman & Kanuk, 2004).

It has been argued that there is an extended self-concept that encompasses possessions and that an item takes on meaning beyond its utilitarian use. Apparel has been shown to be one such item (Engle et al., 1995). Apparel can serve as an extension of self, helping one to define for themselves and others who they are, what they like, and how they feel (Farmer & Gotwals, 1982). In addition to changing one’s self-image through dress, Schiffman and Kanuk (2004) further suggested that a consumer’s apparel can be seen as a
way to confirm or extend the self-image and that a teenage girl might see herself as more desirable, fashionable, and successful because she owns a sought after apparel item.

Kwon (1991) investigated the relationship between apparel and emotions and found that females tend to use apparel to mitigate negative mood states, such as feelings of insecurity. Likewise, a study investigating behavior relative to apparel and appearance found that adolescent females are more concerned than males that their apparel receives approval from others and more often use apparel to promote a good feeling (MacGillivary & Wilson, 1997). A study conducted in the U.K. investigating the relationship between trying on apparel while shopping and mood, emotion, and personality of young women found that personality is reflected and managed in apparel choice. Additionally, the mood the wearer wishes to communicate with apparel will affect her behavior, whether this trait is consistent with the wearer’s personality or she is experimenting with a desired or ideal personality (Moody, Kinderman, & Sinha, 2010).

**Adolescence: The Effect of Group Identification and Peer Pressure on Apparel Choices.** Adolescence is a time when one is particularly susceptible to the influence and opinions of peers (Daters, 1990). The degree of influence exerted by a peer group is dependent upon the degree of contact one has with the group (Rath, Bay, Petrizzi, & Gill, 2008). Groups which exert the greatest influence are those small enough to facilitate unrestricted face-to-face interaction, as is the case in high school (Engle et al., 1995). School is an arena of intense social relationships and group association (Eicher, Baizerman, & Michelman, 1995). Peer groups are an essential part of an adolescent’s social and psychological development and apparel plays an important role in these developmental
processes (Chen-Yu & Seock, 2002). For the adolescent, apparel can be an enhancement of self and contribute to feelings of self-acceptance, self-respect, and self-esteem (Horn, 1968).

It has been suggested that conformity to peer group norms is driven by an adolescent’s desire to fit in with a group, thereby, receiving a perceived security and encouragement (Anderson & Meyer, 2000). This type of social pressure, referred to as normative social influence (Rath et al., 2008), can be observed in peer group conformity to apparel styles and has been reported to begin as early as age eight (Meyer & Anderson, 2000).

When a consumer wishes to change or improve themselves, apparel and accessories offer a way to alter their appearance and thus create a new self (Schiffman & Kanuk, 2004). Often in this process, a particular person or group is used as a reference for appearance modification (Schiffman & Kanuk, 2004). Horn (1968) wrote that group identification through apparel is observed most prevalently and overtly during adolescence and that the group chosen for emulation is the one in which the individual aspires to belong. When one aspires to belong to a group, acceptance is a primary concern. Therefore, he/she will exhibit a desire to adopt the norms, values, behaviors, and preferences of the group (Schiffman & Kanuk, 2004). Items that promise peer acceptance, particularly items related to personal appearance, as is the case with apparel, receive considerable attention as an adolescent tries to build self-identity (Daters, 1990). High school students emphasized that an effective way to change peer group associations was to alter their style of apparel (Eicher et al., 1995).

Aspirational groups exert a strong influence on product choices (Engle et al., 1995) and adolescents’ peers are an important source of influence on apparel purchases (Shim & Koh, 1997). Both direct (personal communication) and indirect (observation) social
interaction have been shown to influence consumer purchasing behavior (Peter & Olson, 2008). Schiffman and Kanuk (2004) suggest that different reference groups influence a person’s apparel choices at different points in time, and products that are especially conspicuous and status revealing, such as fashion apparel, are purchased with the intent of receiving a positive reaction from the sought after reference group.

Fashionable apparel is an effective means of appearance management for teens (Kidd, 2006). The apparel a teen wears while at school signifies the peer group with which he or she identifies (Eicher et al., 1995). The meanings communicated by apparel depend upon the subjective interpretation of the observer (Roach-Higgins & Eicher, 1992). However, high school students were found to share a common interpretation of apparel and categorized fellow students into social groups based upon what they wore (Eicher et al., 1995). In this study, twenty distinct social groups were mentioned. The most frequently mentioned were jocks, freaks, preppies, nerds, and punks. Students classified as preppies, for example, were observed to wear “expensive, nice clothes.” Jocks were described as wearing nice jeans and brand names. Nerds, in contrast, were described as wearing apparel that was out of style, looked ugly like something their parents had bought, or was a hand me down. Freaks and punks were both reported as wearing black leather and t-shirts. The distinction between the two groups was made based upon hair styles, make-up and accessories (Eicher et al., 1995).

Another study investigating the relationship of apparel to group identity of adolescents observed that apparel serves as a highly visible cue to class, culture, and social differentiation in a school setting. When 14 year olds attending a private high school in an upper middle class suburb of the U.S. were asked to describe their fellow students, the most frequently given responses linked the apparel worn and where they shopped to the social
class (group) they associated with at school. The researchers concluded that, for the adolescent in this study, “you are what you wear” (Engle et al., 1995).

For the adolescent, the message they send may have a profound effect on how they are perceived and treated by their cohorts (Eicher et al., 1995). According to one study, college students perceived the moderately and morbidly obese as being less concerned with fashion, designer labels, garment price, following fashion trends, and obtaining high-quality garments than those of a normal weight and size (Rutherford-Black et al., 2000). The apparel one wears conveys a message about the wearer and the adolescent’s peers may not be the only ones influenced by the apparel worn while at school (Marshall et al., 2004). A study examining the attitudes of high school teachers towards obese teens reported that teachers regarded these teens as unkempt, emotional, less likely to succeed, and as having more family problems compared to teens of average weight (Cornette, 2011).

Peer pressure has been shown to manifest itself as the adolescent’s desire to have apparel comparable to that of peers (Francis, 1990). Some adolescents, however, find that their apparel is a source of embarrassment, discomfort, or criticism rather than an expression of self (Horn, 1968). The lack of apparel which reflects a teen’s personal interest and taste can have an effect on how they are perceived and treated by their peers and others and can have an effect upon self-concept and social self-image (Eicher et al., 1995; Engle et al., 1995).

**The Aesthetic Functional Continuum**

The aesthetic functional continuum examines the beauty or desirability of the garment and how well the garment fulfills specific needs such as fit and comfort (Lamb & Kallal, 1992). The aesthetic component includes art elements, design principles, and the body to
garment relationship and the functional component includes the fit, range of motion, comfort, ease of dressing and undressing, and the physical protection the garment provides (Lamb & Kallal, 1992).

**Garment Fit and the Plus-Size Adolescent.** Garment fit refers to how well a garment conforms to a person’s three-dimensional body (Brown & Rice, 2001). A well-fitting garment will hang freely as the person moves, have adequate ease for comfort and movement, and will not cause wrinkles, bulges, or folds in the fabric due to straining or excess fabric (Farmer & Gotwals, 1982; Liechty, Pottberg, & Rasband, 1992). Five elements of fit have been identified, including: fabric grain; set – a smooth fit with no unwanted wrinkles; line – the manner in which the structural lines of the garment conform to the lines of the body; balance – the garment appears even on both sides of the body; ease – the amount of difference between the body’s measurement and the garment measurement (Keiser & Garner, 2008). Niche markets often experience apparel fitting issues and the plus-size market has been identified as one in which fitting issues are a particular concern for consumers (Brock et al., 2010; Connell & Ulrich, 2005; Deckert, 1999; Kang, 2004).

Well-fitting apparel has been shown to be important to one’s psychological and social well-being and to play a significant role in social interaction, personal acceptance, and perceived sociability (Goldsberry et al., 1996). Apparel that is well fitting contributes to feelings of personal attractiveness and self-confidence (Kidd, 2006). It is also comfortable to wear and enhances one’s appearance and self-esteem (Deckert, 1999). Whether a garment fits well or not may be a matter of personal taste, as individuals vary in their preference for fit and fit standards vary with fashion (Keiser & Garner, 2008; Marshall et al., 2004).
However, it is often easier for consumers to find apparel in a color, style, and price that they like than to find a garment that is well fitting (Brown & Rice, 2001). For decades, mass production strategies have had a negative impact on the design and fit of apparel (Mpampa et al., 2010). Plus-size teens have been shown to be as interested in fashion as their peers of average weight and size; yet, larger size girls do not flock to the mall the way that their normal size cohorts do (Kang, 2004; Kids plus-size, 2011; Meng, 2007; Ogunnaike, 2009; Scardino, 2003; Wilson, 2001).

One possible reason for this was identified during an investigation of apparel purchasing issues among girls aged 9 to 14 (Brock et al., 2010). Plus-size girls reported difficulty finding apparel that fit in the styles they wanted. The mothers of the plus-size girls showed concern over the social and psychological effect that apparel shopping was having on their daughters. A key issue identified by the researchers was that the plus-size girls wanted to shop in the same stores as their average size friends, but were unable due to size limitations. The girls reported needing what they called half-sizes and described themselves as being stuck in between sizes. The mothers in this study were reported to repeatedly state their willingness to pay more for their daughter’s apparel if they could find items that fit. Interviews conducted with the girls in this study revealed several areas of concern with fitting. The girls reported that they were not able to fit in the Juniors category of sizing and needed to find apparel in either the Misses or Women’s sizes. In addition to the styles not being age appropriate, the garments were often too long, with necklines and waistlines cut too low (Brock et al., 2010).

Effective sizing has been shown to be a valuable marketing tool used to target niche markets and can create and preserve customer satisfaction (Otieno, 2008).
ways for an apparel manufacturer to break into a niche market is to understand the fitting preferences and needs of that market (Deckert, 1999; Keiser & Garner, 2008). A good fit is an essential element of customer satisfaction (Marshall et al., 2004) and poorly fitting garments accounted for a significant amount of the $198 billion dollars of apparel returns in 2010 (Clifford, 2011).

**Standardized Sizing and the Plus-Size Adolescent.** Plus-size apparel customers present a challenge for standardizing pattern sizing and grading, as the additional weight gain is distributed differently according to a body’s somatotype (Marshall et al., 2004). Standard grading practices assume that as one measurement increases, a corresponding measurement increases, and that as a person moves from one graded size to another, they get taller and heavier (Connell & Ulrich, 2005). For a plus-size, the neck, upper arms, midriff, bust, and hips may not be proportionately larger than the shoulder length, arms, and legs, as one does not automatically become taller as they increase girth size (Deckert, 1999).

The adolescent’s body is in constant change as they grow and mature. Girls, in particular, experience waist and crotch length becoming too short and apparel becoming tight between the armseyes (Farmer & Gotwals, 1982). Additionally, a teen’s body is not proportioned the same as a mature adult from which the current sizing was derived. “Sizing options for female adolescents are not based on any current anthropomorphic data that reflects the body size and shape changes driven by puberty and weight gain” (Connell & Ulrich, 2005). As additional weight is distributed according to body type, one tends to gain weight in the areas where he or she is already the heaviest; therefore, fitting of garments for the mass market becomes more challenging (Marshall et al., 2004). One designer of plus-size apparel disclosed she had to go to the extra expense of using three models that carried
their weight in different places in order to calculate the right proportions for her garments (Byron, 2005). Several apparel manufacturers have chosen to not enter the plus-size market due to the extra costs associated with labor and the additional fabric necessary to achieve the proper fit (Byron, 2005; Kang, 2004).

**Body Shape and Apparel Fit.** An individual’s basic body shape affects the fit of apparel, and an understanding of the physical differences among body shapes is essential to the design and sizing of apparel (Connell et al., 2006; Connell & Ulrich, 2005; Deckert, 1999; Marshall et al., 2004; Zangrillo, 1990). Identification and classification of body shapes for apparel has been important to European researchers and manufacturers for some time. Often, body shape studies are performed in conjunction with anthropometric surveys in an attempt to develop standardized sizing (Vuruskas & Bulgun, 2011). In the U.S., however, the current sizing system for apparel product development is based upon one body shape, the hourglass (Pisut & Connell, 2007). Pisut & Connell, argue that although anthropologists and demographers study the effects of weight gain on shape, little of that research has been applied to improving the sizing and fit of apparel in the U.S.

Anthropologists have categorized human body shapes into the three basic somatotypes of endomorph, mesomorph, and ectomorph based on similarities in body composition, percentage of body weight that comes from fat tissue versus lean body mass, and the distribution of fat (Marshall et al., 2004). Due to genetics, a variety of combinations of these basic categories exist. Generally, endomorphic body types are characterized by soft round body parts with fleshy upper arms and thighs and a prominent abdomen. This body type has larger amounts of body fat and a shorter neck and limbs than the other two types, and muscle development is not prominent. The mesomorphic body type has a sturdy
muscular frame, large shoulders and chest, with well-developed arm and leg muscles, and minimum fat. Ectomorphic body types are tall and narrow, with linear muscular development. The limbs are long and thin, with very little body fat (Marshall et al., 2004).

In addition to the three somatotypes, four silhouettes (wedge, triangular, balanced, and rectangular) based on height and weight distribution have been identified (Marshall et al., 2004). The wedge silhouette has wider shoulders than hips. Its opposite, the triangular silhouette, has hips wider than shoulders. A balanced silhouette has hips and shoulder measurements that are equal, with the waist measuring 9-11 inches smaller. The rectangular silhouette has broad shoulders and hips, with little or no waist indentation (Zangrillo, 1990). When a person gains weight, it tends to be in the area of the body that is already the heaviest (Marshall et al., 2004).

In her book, Sewing for Plus Size, Barbara Deckert (1999) identified and named five silhouettes (apple, pear, potato, supersized, and madam peanut) that exist among overweight and obese persons based upon the basic silhouettes. These include the apple shape, which is a larger version of the wedge. Women with this silhouette are larger through the bust and midriff than the hips. The pear shape is a larger version of the triangular silhouette. The potato silhouette is round all over indicating its thinner counterpart is the balanced silhouette. The silhouettes, to which Deckert has given names, include the Supersized, which is a much larger version of the potato, and the Madam Peanut, which is seen in larger women who are usually very tall and big boned with well-defined waists and a fairly flat abdomen.

Body type determines how and where the weight will be distributed in the plus-size customer. Based upon that weight distribution, more ease in the key areas of upper arm, bust, crotch length, waist, hips, and thighs are needed to accommodate the larger size
(Deckert, 1999; Zangrillo, 1990). Incorporating somatotyping into the standardization of apparel sizing has been investigated by several researchers and all have concluded that to achieve optimum apparel fit, not only must the body’s dimensions be taken into account, but its shape as well (Connell et al., 2006; Devarajan, & Istook 2004; Faust et al., 2006).

Historically, plus-size apparel has been available only in women’s sized apparel (Calasibetta & Tortora, 2003). Plus-size apparel is cut fuller to accommodate a larger, heavier figure (Marshall et al., 2004). It is sized for the adult woman of average to above average height who is fuller in the torso girth, and weighs more than the Misses category figure (Keiser & Garner, 2008). Mature women, however, are not the only females whose figure is larger and heavier for their height as addressed by traditional apparel sizing categories. Research conducted by Connell and Ulrich (2005) included girls aged 9-11 years who were athletes, participated in field hockey, and required plus-size apparel. These girls had BMI scores, no doubt affected by muscle mass, which placed them in the overweight category (Connell & Ulrich, 2005).

Well-fitting apparel enhances the look of the wearer (Deckert, 1999); however, standardized sizing of ready to wear apparel does not take into account the various shapes and sizes which currently exist in the general population (Mpampa et al., 2010). Niche populations such as the overweight, obese, and some athletes often experience difficulty finding the styles of apparel they desire in sizes that fit their bodies (Connell & Ulrich, 2005).

**Problem Identification**

After a comprehensive understanding of the target customer’s influences, needs, and wants are identified, Lamb & Kallal’s (1992) FEA Consumer Needs Model then progresses to the problem identification phase including the beginning of the design process, the
acceptance of the situation, and a search for a resolution. In order to understand why there is a lack of apparel designed to meet the needs of plus-size teens and develop a plan to resolve the issue, an understanding of how the industry arrived at the current sizing system and the options for the future must be investigated.

**A History of Standardized Sizing in the Apparel Industry**

Brown and Rice (2001) explained that prior to the industrial revolution garments were hand made for the intended wearer from his/her measurements. Therefore, an individual’s size and shape did not affect their ability to purchase garments that fit their body. Machinery invented during the industrial revolution made textile processing, fabricating, and assembling fast, accurate, and economical, thus giving birth to the ready-to-wear industry.

Ready-to-wear is apparel that is mass produced in standardized sizes for a target market or target customer. Ready-to-wear is intended to be purchased and immediately worn and accounts for the majority of the apparel produced in the world today (Calasibetta & Tortora, 2003; Keiser & Garner, 2008; Kidwell & Christman, 1974). In order to produce ready-to-wear garments that are expected to conform to the approximate body shape, size, and fitting preferences of a target customer, standardized sizing has been established (Brown & Rice, 2001).

Sizing systems used today for ready-to-wear apparel originated with the proportional drafting systems developed by custom tailors in the eighteenth century (Ashdown, 1998). Standardized garment sizing is based on the assumption that people can be categorized by key anthropometric measurements. It also assumes, that based upon these body measurements, all persons within a given garment size will share similar size, shape, length, and width measurements (Keiser & Garner, 2008). Likewise, the pattern grading process,
which permits the increasing and decreasing in size of a particular style, assumes similarity between all persons within a category (Moore et al., 2009). Due to cost constraints in mass production of apparel, one sample-size pattern is developed, and other sizes are graded from it. An apparel manufacturer will develop a grading system for its target customer based upon available anthropometrical data. Grading assumes that, as one key area of the body increases, another corresponding area also increases. This, however, is not the case for plus-sizes who, as their girth measurement increases, do not necessarily become taller or have increased length of limbs and torso (Ashdown & Dunne, 2006; Connell & Ulrich, 2005).

In the U.S., the first recorded attempt at standardizing sizing for the mass production of garments was for men’s apparel during the Civil War (1861-1865). Soldiers were measured and the results compounded into size charts used as a basis for the mass production of uniforms (Brown & Rice, 2001). In 1941, the first large scale attempt to standardize women’s sizing was undertaken by Ruth O’Brien and William Sheldon. Anthropometric measurements were taken from 10,042 volunteers aged 18-55 years, serving in the U.S. Army (Devarajan & Istook, 2004; Keiser & Garner, 2008). This compiled data were published in 1948 by the U.S. Department of Commerce and became the basis for its 1958 Commercial Standard CS 215-58, Body Measurements for the Sizing of Women’s Patterns and Apparel. A revised version of CS 215-58 designated PS 42-70 was published in 1971 by the National Institute of Standards and Technology (Devarajan & Istook, 2004; Keiser & Garner, 2008; Moore et al., 2009). The American Society for Testing and Materials (ASTM), now called ASTM International, used PS 42-70 data to compile and update the ASTM D-5585 standardized sizing which is in use today for Misses sizing. It should be noted that D-5585 did not incorporate updated anthropometric data, but instead utilized
designer experience, market observations, and cross referencing of Army and Navy databases to arrive at its updates (Ashdown, 1998).

Likewise, the current standard size charts for Juniors D6829, “were derived originally from the 1970 Voluntary Product Standard PS 42-70 by the U.S. Department of Commerce National Bureau of Standards” (ASTM, 2008, p. 1). Standardized sizing for the women’s category published by ASTM is designated as D6960, and is also based upon data originating in 1941 (ASTM, 2004). ASTM’s committee D13.55 is charged with monitoring and updating these voluntary standards and does so by regularly reviewing the tables and suggesting updates based upon anthropometric research and industry input (Keiser & Garner, 2008).

Research conducted for the purpose of standardizing apparel sizes based upon anthropometric data has been conducted internationally as well. In 1950, an anthropometric survey of 5,000 adult women was conducted in England. In Germany, anthropometric surveys of women were taken in 1962, 1970, and 1983. France measured 8,000 men and women in 1968, in an attempt to identify common measurements that could be used to standardize apparel sizing (Moore et al., 2009). Croatia undertook an anthropometric survey of its population in 1961 and 1962, and apparel manufacturers in the Republic of Croatia still use that data today, despite acknowledging the need for current up to date measurements (Ujevic et al., 2006). Australia’s current sizing system is based upon even older data that was obtained by their last major anthropometric survey conducted in 1926 (Honey & Olds, 2007). Internationally, sizing standards exist, including ISO 8559, British standards BS 7231, and European standards EN 13402, which were based upon ISO standards with the purpose of developing a unified sizing system across Europe (Otieno, 2008).
The most recent attempts to update standardized sizing for apparel production was the SizeUK and SizeUSA studies conducted by [TC]², a U.S. based firm representing Image Twin, a 3D body scanner. The SizeUSA study collected anthropometric data in 2002 from nearly 11,000 adult men and women aged 18 and over representing a cross section of the U.S. population ([TC]², 2011). SizeUK, conducted in 2001, collected anthropometric data from more than 11,000 British women and was the first updated anthropometric data survey in the UK in 50 years (SizeUK, 2013). Researchers funded by the now defunct National Textile Center investigated sizing issues and compiled anthropometric data on girls and boys aged 9-14. Between 2004 and 2006, over 2,100 boys, girls, and their mothers were scanned, and data compiled, in an attempt to improve the fit of apparel for the tween market (Connell & Ulrich, 2006). These more recent studies, while valuable, have not covered the wide range of apparel sizing categories of infant to adult used by the industry and they have not been used to update or expand the current ASTM standards.

The current ASTM size charts have been based on anthropometric measurements dating to the 1940’s and do not reflect the current size, shape, and ethnic diversity present in today’s marketplace (Devarajan & Istook, 2004). To date, there has never been a comprehensive sizing study of the U.S. civilian population published (Bye et al., 2006). This has resulted in several issues concerning the standardized sizing and fit of ready-to-wear apparel, as will be discussed in the following section.

The world’s population is more mobile than at any other time in history. Many developed countries, such as the U.S. and Great Britain, have populations with diverse ethnic roots and anthropometric measurements due to immigration (Simmons et al., 2004). Additionally, bi-racial children share the racial characteristics of both parents. As body
proportions tend to vary considerably across racial groups, the development of standardized sizes that address these differences becomes more difficult (Simmons et al., 2004). The apparel industry operates internationally and there is a need for knowledge and understanding of the size requirements of various nations, in order to be competitive in the market place. Sizing charts, however, have been developed locally from anthropometric data collected in specific nations and reflect the body sizes and shapes of the citizens at that time (Chun-Yoon & Jasper, 1993; Otieno, 2008).

**Apparel Size Categories and Fit**

In the U.S., apparel companies specify their female target customer based on the major apparel size categories of Misses, Petite, Tall, Women’s plus, Women’s petite, and Juniors, and assume that all customers within each category share similar anthropometric measurements (Keiser & Garner, 2008). In reality, though, very diverse body types exist within apparel size categories. In a study of 1,026 women, close to 50 percent reported experiencing fitting issues with ready-to-wear apparel and over two-thirds reported fitting issues in more than one body location (Pisut & Connell, 2007). Misses sizes are cut for a well-proportioned adult figure that stands between 5 foot 5 inches and 5 foot 6 inches tall (Calasibetta & Tortora, 2003). According to Keiser and Garner (2008) Petite is designed for shorter women of average build and who stand 5 foot 4 inches and under. Tall is designed for women of average girth, but who stand between 5 foot 7 inches and 6 foot 1 inch. The women’s plus-size is designed for the adult woman of average to above average height who is more mature and fuller in the torso and weighs more than the Misses category figure. Women’s petite is intended for the adult figure which is shorter than average and fuller in the torso than the Misses category. Junior sizes fit a woman of about 5 foot 6 inches tall who has
a shorter torso and longer limbs and a less mature body development than the Misses category. Target customers for this category are expected to be a younger female.

England has a sizing system for women’s apparel defined by height and figure type. Height categories include: short, which is less than 5 foot 1 inch (155cm); average height, of 5 foot 1 inch (155cm) to 5 foot 4 inches (162.5 cm); or tall, which is 5 foot 5 inches (165 cm) and over. Within each height category, figure types are then classified by a bust to hip comparison (drop value). A very small bust is considered one in which the bust is 6 inches (15 cm) less than the hip measurement; a small bust is 4 inches (10 cm) less than hip measurement; a medium bust is 2 inches (5 cm) less than hip; a full bust is one where the hip is the same circumference as the bust; a large bust is 2 inches (5 cm) larger than hip; and extra-large bust type is 4 inches (10 cm) larger than hip (Chun-Yoon & Jasper, 1993).

In Germany, nine figure types were defined by height and hip types. Height has been grouped into short, average and tall. Within each height category are three classes based upon hip size. A slim hip is 1.38 inches (3.5 cm) smaller to .40 inches (1cm) larger than bust; the average hip is 1inch (2.5 cm) to 3.15 inches (8 cm) larger than bust; and the full hip is 3.35 inches (8.5 cm) to 5.12 inches (13 cm) larger than bust (Chun-Yoon & Jasper, 1993).

Hungary has a sizing system for women’s apparel based upon height and body build. Five height categories exist with each containing two figure types based on bust, waist, and hip circumference measurements. Those height categories are: 5 foot (152 cm); 5 foot 2 inches (158 cm); 5 foot 4 inches (164 cm); 5 foot 6 inches (170 cm); 5 foot 8 inches (176 cm). The body build categories include the normal figure where the hip measurement is 1.58 inches (4 cm) larger than the bust and the full figure where the hip is 3.15 inches (8 cm)
larger than the bust and the waist is .40 inches (1 cm) larger than the normal figure (Chun-Yoon & Jasper, 1993).

Other countries standardize their sizing for women’s apparel by height. Austria has a sizing system based upon two height groups. The short size is for a woman who is under 5 foot 4 inches (164 cm) and the average height size is for a woman over 5 foot 4 inches (164 cm) tall. Korea’s sizing system designates five height groups: 5 foot (150 cm); 5 foot 1 inch (155 cm); 5 foot 2 inches (160 cm); 5 foot 4 inches (165 cm); 5 foot 6 inches (170 cm) (Chun-Yoon & Jasper, 1993).

In 1991, the International Standards Organization (ISO) developed a revised sizing system for women’s apparel. This updated system classified body type as either A, M, or H based upon the difference between the hip and bust circumference (drop value). A difference (drop value) of at least 3.54 inches (9 cm) is required to be classified as a body type A. Type M has a drop value of 1.58 to 3.15 inches (4 to 8 cm), and type H has a drop value of 1.81 to 3.15 inches (3 to 4 cm) (Chun-Yoon & Jasper, 1993).

Consumers experience difficulty purchasing apparel when their size and body shape do not conform to the dimensions of the target customer (Farmer & Gotwals, 1982). Additionally, two individuals may share body measurements, but experience a different fit due to body shape (Vuruskan & Bulgun, 2011). An apparel line targeted to female teens in the United States will generally use the Juniors standardized sizing as a basis for pattern development. This standardized size, however, assumes an average body weight for its height (Keiser & Garner, 2008). Additionally, the Juniors category usually has not offered plus-size variations (Connell & Ulrich, 2005). For plus-size teens to find apparel that fits, it may be necessary to purchase items intended for the Misses or Women’s market. The items
designed for these markets are for more mature customers, therefore, the apparel may not be age appropriate and this can result in an unsatisfied customer or loss of sales for the apparel firm (Brock et al., 2010).

The current ASTM standardized sizes are not based upon up-to-date anthropometric survey data and the sizing categories date back to the 1940’s (Devarajan & Istook, 2004). The SizeUK survey taken in 2001 reveals that the typical British female has changed shape and size considerably since the 1951 survey data. Both bust and hip circumferences have increased 1 inch and waists have increased 6.5 inches. This has resulted in average women’s apparel sizes increasing from size 12 to 16 (SizeUK, 2013). The SizeUSA measurement data revealed that the average woman in the United States in 2002 was 5 feet 3.9 inches tall and weighed 157 pounds (Keiser & Garner, 2008).

Standardization of sizes is not mandatory in many countries where apparel firms may deviate from the suggested measurements (Keiser & Garner, 2008; Park, Nam, Choi, Lee, & Lee, 2009). Apparel manufacturers have been accused of purposely confusing garment sizing and grading sizes in an attempt to promote brand image (Silverman, 2009). When consumers find an apparel brand that fits, they are likely to stick with it, purchasing additional items under the same brand name and thus brand loyalty is achieved (Barbaro, 2006).

Currently, ASTM does not have an apparel size category which addresses the size and shape needs of the plus-size teen (Keiser & Garner, 2008). Internationally, attempts have been made to design sizing systems utilizing height and body shape, yet these have been formulated for the adult female figure and not the growing adolescent figure (Chun-Yoon & Jasper, 1993). Outdated anthropometric data, as well as apparel brand marketing strategies,
have been blamed for the difficulty many consumers experience with the fit of ready-to-wear apparel.

**Acknowledgment from the Apparel Industry of the Need for Updated Sizing**

A few apparel retailers have recognized the need for plus-size apparel for the teen market. These retailers have found it necessary to conduct their own research and product development, as no industry guidelines or current anthropometric data have been available to aid in pattern development and grading of plus-size Juniors apparel (Kang, 2004; Scardino, 2003). This research, commercially conducted and proprietary in nature, has not been published (Roebuck, 1995). Target, an international department store, announced in 2012 that it planned to spend $1 million to undertake a sizing study with the use of a 3D body scanner. This attempt to gather information on the size and shape of its customers is aimed at improving apparel fit (Stafford, 2012).

Hot Topic, a successful teen retailer, was one of the first to develop garments for larger size teens (Hobson, 2001). Recognizing that the plus-size teen body does not conform to the shape and size of the industry woman’s plus-size, Hot Topic developed an in-between sizing unique to their store. Apparel in this new size range became the retailer’s fastest selling items. Eventually, this success led to the development of the spin-off store, Torrid, in 2001, which caters to the needs of the female plus-size teen (Hobson, 2001). Phyllis Brasch Librach, founder of Sydney’s Closet an online store catering to plus-size teens, was inspired to open her business when her daughter was reduced to tears over not being able to find a dress for her homecoming dance. According to Librach, plus-size teens want Prom dresses that are gorgeous, age-appropriate, and trendy with a perfect fit (Sydney’s Closet, 2013). Sydney’s Closet was so successful that Librach opened another online store targeting
plus-sizes called, So What If.com, which carries casual and career wear for teens and women (Sydney’s Closet, 2013).

The goal of all apparel firms, whether they compete domestically or internationally, is to make a profit (Keiser & Garner, 2008). In order to make a profit and survive in an increasingly competitive marketplace, all businesses must remember, “the consumer is sovereign” – you must give the consumer what she wants (Engle et al., 1995). An environmental scanning study of the apparel industry concluded that apparel retailers must begin looking to the previously ignored plus-size market for sales growth (Kim et al., 2007). Today, it appears that overweight and obese female teens want fashionable apparel that fits their size and shape and they have reported that their needs are not well met by current apparel options available in most stores (Ashdown & Dunne, 2006). Plus-size apparel is not just for those who are overweight. Taller girls, or those who are broader in the shoulders and hips, but are a healthy weight for their height, may find a better fit with plus-size apparel (SizeUK, 2013). A major obstacle facing apparel manufacturers who develop apparel for plus-size teens is the current industry standards of sizing and anthropometric data available (Devarajan & Istook, 2004). A possible resolution to this problem may be found in technological advancements in the apparel industry (Vuruskan, & Bulgun, 2011).

**Technological Developments in Apparel Sizing and Fit**

For over a century, the apparel industry has been experimenting with standardized sizing of ready-to-wear, yet garment fit remains one of the most difficult technical issues facing the ready to wear industry (Shin & Istook, 2007). Computerization of the industry has resulted in advances in other areas of product development and manufacturing, but drafting garments which conform to an individual’s measurements and shape and ease requirements
still remains a difficult and imprecise task (Bye et al., 2006). One reason for this is that apparel sizing is not an exact science (Tait, 1998). Another reason is that the pattern blocks, wearing ease, and grading calculations are based on out of date anthropometric survey data (Bye, LaBat, McKinney, & Kim, 2008).

Mass customization, the future direction of the apparel industry, promises to provide customers with a garment fit to their individual measurements at a mass production price (Keiser & Garner, 2008). It is also expected to facilitate better inventory control and reduce product returns (Ashdown & Dunne, 2006; Clifford, 2011). Up-to-date anthropometric survey data are needed for the industry to transform from manufacturing on speculation (ready-to-wear) to manufacturing pre-sold garments (mass customization) (Connell et al., 2006). Once in production, the continued maintenance of up-to-date anthropometric data regarding target markets will be essential to the continued success of apparel mass customization (Mpampa et al., 2010).

Mass customization, like traditional ready-to-wear manufacturing, relies upon standardized sizes for pattern drafting and grading. To better facilitate this new technology and provide the promised fit to customers, new methodologies to standardize sizing are being investigated (Mpampa et al., 2010). Additionally, there is the need to evaluate existing pattern making models with regards to their ability to provide an acceptable fit for various body shapes and sizes (Otieno, 2008).

To make a mass customized garment from an individual’s measurements, the apparel manufacturer first starts with a chart that reflects the standard body measurements, the company’s graded measurements, and any additional areas within that style which can be altered (Ashdown & Dunne, 2006). Using CAD software, an individual’s measurements are
compared to manufacturer’s standard body measurements. Within each size in the range, differences between the individual's body measurements and the company’s standard chart measurements initiates the alteration process to modify the base pattern (Ashdown & Dunne, 2006). Fitting issues exist with mass customization software and are especially seen in plus-sizes. Connell et al. (2006) concluded that these fitting issues cannot be resolved until up-to-date anthropometric survey data of plus-sizes are available to the software programmers. The fit of apparel produced by means of mass customization can be further improved by incorporating software designed to capture the body somatotype and adjust pattern grading accordingly (Devarajan & Istook, 2004).

Apparel manufacturers who utilize this emerging technology will be more competitive in the marketplace. However, before mass customization can become commonplace and profitable, the technical issue of fit must be resolved. Current anthropometric data reflecting the general population and a new methodology for pattern drafting and grading is essential in solving this issue.

**Technological Advancements in Anthropometric Survey Data Collection and Analysis**

In order to create categories of apparel sizing, set standards and grading rules, and up-to-date accurate anthropometric data are necessary. The method used to collect anthropometric data have an effect upon its accuracy and ultimately its value for creating apparel sizes which offer a better fit. Current sizing standards published by ASTM were based on anthropometric data derived from manually measuring volunteers using traditional measuring equipment in compliance with procedures set forth in ASTM D5219, Standard Terminology Relating to Body Dimensions for Apparel Sizing (ASTM, 2009b).
Traditional tools used in anthropometric surveys include an anthropometer for straight measurements, tape measures for contour measurements, a spreading caliper, a right angle, and an adjustable square. Landmarks are marked on the body by either tying on elastic, directly marking the body with a pen, or by attaching adhesive tape to the body and placing a cross mark at key measuring points (Beazley, 1997; Roebuck, 1995).

Taking manual measurements can be problematic, as it requires that all persons taking the measurements do so precisely at the same points of the body (Faust et al., 2006). Problems which can arise include: locating body landmarks; the volunteer moves or shifts weight due to standing in one position for an extended period of time; or discrepancies occur when adjusting the tape to measure long or curved areas of the body (Bye et al., 2006; Chi & Kennon, 2006). To reduce variations in measurements, Croney (1977) found it necessary to have all members of the research team practice taking measurements for two months prior to beginning an anthropometric survey. Despite this preparation, variations in measurements were found to have occurred due to the adjustment of tension of the tape measure, failure to accurately locate anatomical features, and postural changes of volunteers during measuring session. These variations resulted in rejection of data for six of the participants due to irreconcilable errors in measurement.

The industry has long recognized the difficulty of designing flat patterns that are intended to fit the three-dimensional curves of the body. Traditional anthropometric survey data are not complete enough for the design of accurate 3D forms (Roebuck, 1995). Ashdown and Na (2008) suggest that to achieve a good fit, emphasis should be placed on the changes in body angles. These changes are difficult to measure manually, as Beasley (1997) concluded after conducting an anthropometric survey using traditional equipment:
Measuring the human body manually is not an easy task. Much is left to the judgment of the measurer such as the landmarking of the body, positioning of the equipment and tension of the tape measure...Other electronic scanning or photographic methods are being developed, but as yet are not fully reliable. (p.82)

Since her study was conducted, vast improvements in 3D body scanning and computerized recording of the data have taken place. Ashdown and Na reported in their 2008 study that “The use of three-dimensional (3D) body scans of participants in an anthropometric study makes it possible to take angle measurements that cannot be effectively taken using the traditional method of measuring directly on the body” (p. 293).

A 3D body scanner is an instrument designed to create an accurate computer image of the body. Cameras, using a white light or laser, map a 360-degree view of the body, resulting in a cloud of data points. Length, width, circumference, body angles, landmark points, shape, and volume measurements of the body are taken and a permanent electronic record is created for future reference and analysis in pattern development and grading (Bye et al., 2006).

Once the data have been collected, it must be analyzed. Analysis of the large volume of statistical data generated by an anthropometric survey has historically been a time consuming and daunting task requiring manual calculations, and most of apparel sizing and grading standards currently in use were compiled before computerized statistical data analysis programs were available (Beazley, 1998). These include, in the U.S.: the 1941 O’Brien and Sheldon study; Body Measurements for the Sizing of Women’s Patterns and Apparel in 1958; the Commercial Standard CS 215-58; and PS 42-70 in 1971. International studies include: the 1957 survey of British Women; surveys taken in Germany in 1962 and 1970; and the 1968 study conducted in France. Otieno (2008) concluded,
“Accessing raw data using manual methods could be slow, expensive, complicated and is subject to variation” (p.71). Today, computer software for statistical data analysis, such as Statistical Package for Social Sciences (SPSS), makes the analysis of large volumes of data fast and accurate (Beazley, 1998).

**Anthropometric Survey Use in Apparel Development**

To a person unfamiliar with apparel product development and technical design, solving the issue of garment fit may seem to be as easy as acquiring accurate measurements and carefully drafting patterns. It has been understood in the industry for years; however, that math alone cannot resolve drafting and grading issues. In his book, Sizing, Pattern Construction and Grading for Women’s and Children’s Garments, Philip Kunick stated:

> Statistics alone cannot solve our problems because we are dealing with an industry in which the influence of art, craft and fashion are all to be taken into account and the specialized knowledge of the technician must be used to link these diverse factors together. (Kunick, 1967 as cited in Beazley, 1998)

Therefore, researchers have found it valuable to include a qualitative component to an anthropometric survey when possible. Qualitative data have been useful in uncovering issues that were not apparent from the analysis of the mathematical data alone (Apeagyei et al., 2007; Brock et al., 2010).

Based upon research presented, a new sizing system needs to be developed for plus-size teens. In order to develop an effective sizing system, three problems must be resolved. First, a size must be defined by dividing the population’s body measurements into groups. Second, a decision must be made as to which measurements will be contained within each size, and lastly, the size must be designated in a way that the potential customer can recognize it as one which will provide the fit they desire (Beazley, 1997).
Beazley (1998) and Roebuck (1995) have both outlined how to use anthropometric survey data to develop an effective apparel sizing system for a target market. They both recommended the following six steps:

1. Selection of the appropriate data for analysis.
2. Selection of the key or basic sizing dimension.
3. Selection of intervals for the key dimensions which will establish sizing categories.
4. Developing for each sizing category all other dimensional data which would be used in the design or sizing of the item.
5. Conversion of the summary data to an appropriate design value for the end item in terms of fit and function.
6. Establishment of estimates of the sizing tariff (i.e. the proportion of the population that falls within the limits of each size category) for manufacturing of the end item.

To make recommendations for a new size category, an adequate sampling of the population is necessary. The current sizing systems, although based upon out of date anthropometric data, had large sample sizes. The 1941 survey conducted by O’Brien and Sheldon measured 10,042 volunteers (O’Brien & Sheldon, 1941). In England in 1950, and France in 1968, measurements were taken from 5,000 and 8,000 volunteers respectively (Moore et al., 2009). More recently, commercial efforts include both the SizeUK study in 2001 and the SizeUSA study in 2002, which each enlisted 11,000 adult men and women for 3D body scans ([TC]^2, 2011). Academic research conducted for the National Textile Center over a two-year period measured over 2,100 boys and girls (Connell & Ulrich, 2006). In a recent academic study conducted over a two-year period in Greece, anthropometric measurements of 12,180 men were collected using manual methods (Mpampa et al., 2010).

Apparel sizing and grading cannot be determined by statistical analysis alone, therefore, interviews with target customers can provide insight to unique fitting requirements (Apeagyei et al., 2007; Brock et al., 2010). Currently, there is no sizing system which
addresses the unique fitting needs of plus-size female teens aged 12-17 years. An obstacle to developing a sizing and grading system for this niche market is the lack of anthropometric data available. Female teens aged 12-17 years have not been included in recent commercial or academic anthropometric data collection studies aimed at updating sizing charts to improve apparel fit (Connell & Ulrich, 2006; Mpampa et al., 2010; [TC]^2, 2011). Therefore, their measurements are not currently known making it impossible to create realistic sizing charts. Accurate sizing charts, however, are necessary to the designing and manufacturing of apparel.

**Apparel Sizing Chart Creation**

Size charts are the artificial dividing of a range of measurements. When creating a size chart, the goal is twofold – first to be convenient for mass production and second to permit the customer to recognize the size that will provide the best fit (Beazley, 1999). To be convenient and cost effective for mass production, the sizing system should take into account the majority of the target market while not creating too many different sizes (Beazley, 1998; Mpampa et al., 2010). When defining size ranges, it is necessary that customers recognize the size which should fit them. So the assigning of a name or number to a set of garment dimensions becomes not just a statistical issues but a marketing one as well (Beazley, 1998).

Three steps are necessary to formulate a size chart for apparel based upon anthropometric data. First, a decision must be made as to what numeric value of the control measurements will be assigned to each size. Second, decide if these values need to be rounded up or down based upon statistical analysis, and third, add the required wearing ease allowances to key measurements (Beazley, 1999).
When organizing anthropometric survey data into sizing charts, a decision must be made as to which dimensions will be used as control or key measurements. These control measurements will be used to denote garment size. It is useful to choose a second and tertiary control measurement to improve fitting. To select the correct control measurement, survey data must be correlated (Beazley, 1998). Croney (1977) found correlation coefficients to exist between 19 measurements. These measurements include weight, bust girth, waist girth, abdominal ext. girth, hip girth, thigh girth, calf girth, upper arm girth, bitrochanteric width, interacromion width, height, cervical height, bust height, waist height, hip height, tibia height, sitting height, and nape to waist. Other anthropometric studies have found that there is little or no relationship between lengths and girths (Beazley, 1998; Mpampa et al., 2010). This is the case for plus-size, as larger girth measurements are not necessarily related to height (Connell & Ulrich, 2005; Deckert, 1999). In 2010, Mpampa et al. identified key measurements commonly used in manufacturing which should be considered control measurements for men’s apparel. These include chest girth, waist girth, neck girth, height, arm length, and inside leg length. However, in women’s apparel, and especially for plus-sizes, the additional control measurements of upper chest girth, full hip girth, bicep girth, shoulder length, bust apex, shoulder point to waist length, and crotch length are necessary to achieve a satisfactory fit (Deckert, 1999).

Once the statistical data have been evaluated and the control measurements have been decided upon, the amount of wearing ease for the pattern block must be determined. Wearing ease is an additional measurement added to the body measurement to allow for the free movement of the body. It takes into consideration how the shape of the body changes as it moves, including expansion and contraction of muscles. Adequate ease is as essential to
garment fit as accurate body measurements (Beazley, 1999; Gill, 2011). Differing amounts of ease are necessary in different parts of the garment, and the larger the wearer, the more ease is necessary to accommodate free movement (Beazley, 1999; Deckert, 1999). Additionally, the wearer’s body somatotype may affect the perception of ease in a garment, therefore, the perception of fit (Gill, 2011).

Traditionally, wearing ease requirements for block creation have been calculated by a difference between the flexed and relaxed muscle area, but some researchers have argued that it should be calculated as a percentage of the body measurement (Beazley, 1999). The amount of wearing ease added to a garment block is also dependent upon the fabrication of the textile, and the intended use of garment. More ease is needed for woven garments than knit, and a block intended for a knit garment with four-way stretch may have negative ease. Outerwear requires more ease, as it must comfortably fit over other apparel (Amaden-Crawford, 2005; Gill, 2011).

Grading the increasing and decreasing of a master pattern’s dimensions to produce a range of sizes for production (Moore et al., 2009) requires a knowledge of the various sizes and shapes of the target customer as well as the required wearing ease (Beazley, 1999). Recent research has investigated the incorporation of somatotype data into the creation of sizing charts. A software program developed at North Carolina University called Female Figure Identification Technique for Apparel (FFIT) has been used to categorize 3-D data and sort anthropometric survey data into categories according to somatotype (Devarajan & Isto, 2004). Mpampa et al. (2010) used a simple mathematical calculation of chest girth minus waist girth to classify basic men’s body shapes into six categories. These six categories were then used as a basis for size chart formulation.
Careful statistical analysis of the data derived in an anthropometric study is essential in providing a foundation for an apparel manufacturer to develop standardized size charts and accurately grade patterns to these various sizes (Beazley, 1998). Traditional methods of grading a pattern into various sizes have included adding a predetermined amount at key points on the block (Moore et al., 2009). The assumption has been made that customers would conform to these incremental changes as they move from one size to another (Ashdown & Dunne, 2006). However, it has been shown that plus-size customers do not necessarily increase in size in the manner assumed by the traditional methods (Connell & Ulrich, 2005). Body somatotype determines where excess fat is stored and, therefore, affects the fit of apparel in these areas (Marshall et al., 2004). In order to improve the fit of apparel for plus-size teens, current anthropometric data must be obtained and new sizing and grading methodologies need to be formulated (Brock et al., 2010). These methodologies should be applicable to both manual and computerized drafting and facilitate mass customization of apparel (Mpampa et al., 2010).

**Summary**

Lamb and Kallal’s (1992) FEA Consumer Needs Model provides a framework for this study to explore issues surrounding plus-size apparel for female teens. Adolescents are apparel customers who cannot be ignored. Collectively, they exhibit a stronger interest in fashion than any other age group and wield considerable financial influence (Boris, 2013; Koester & May, 1985). Apparel plays a significant part in the psychological and social development of adolescents and can affect how they are perceived and treated by their peers and others (Francis, 1992; Ryan, 1966; Rutherford-Black et al., 2000).
Plus-size apparel has the greatest growth potential of any retail category and plus-size teens have been shown to be as interested in fashion as their normal sized cohorts (Dilea, 2013; Ogunnaike, 2009). Plus-size consumers in particular have expressed they experience difficulty finding apparel that fits properly (Brock, et al., 2010; Connell & Ulrich, 2005; Kang, 2004). According to the literature review, the following three main reasons contributed to apparel fit problems: (1) the industry is working with out-of-date anthropometric data based on 70 year-old data taken from the adult population which has resulted in standardized sizes and grading practices that do not reflect today’s teen population; (2) standardized sizes and grading practices do not take into consideration the varying shapes of individuals; and (3) ASTM does not recognize a plus-size category for the immature adolescent body.

In order to solve the fitting issues currently experienced by the plus-size female teen and enable apparel manufacturers to effectively compete in this market, new anthropometric survey data of this niche market, utilizing the latest technology, are necessary. Additionally, a better understanding of the particular fitting issues experienced by plus-size female teens and what they desire in their apparel is necessary and supported by previous studies (Apeagyei et al., 2007; Brock et al., 2010).

Advancements in technology are changing the apparel industry and allowing for the fast, accurate collection, and evaluation of anthropometric data. The industry is moving toward mass customization of apparel which promises to provide customers with optimal garment fit. In order for mass customization to become a reality, the technical issue of apparel fit must be resolved. To do this, up-to-date anthropometric survey data must be collected, a comprehensive understanding of fit issues experienced by the target customer
must be achieved, and new methodologies for standardizing sizes and grading must be developed.

**Research Questions**

To explore apparel fit and sizing issues encountered by plus-size female teens aged 12-17 years, to determine if the apparel available to them satisfies their functional, expressive and aesthetic wants and needs, and to identify areas of the body where standard grading practices must be altered, an exploratory study was conducted utilizing a mixed methods research design. Based on the review of literature, the following three research questions were developed:

RQ1: Do the anthropometric measurements of plus-size female teens aged 12-17 years participating in this study fit into any of the current standardized sizes published by ASTM?

RQ2: Are plus-size female teens aged 12-17 years satisfied with the fit of apparel available to them?

RQ3: Does the ready-to-wear apparel available to plus-size female teens aged 12-17 years satisfy their functional, expressive and aesthetic wants and needs?

Answers to these questions were found by utilizing a mixed-method research design. RQ1 was answered by collecting anthropometric data of plus-size female teens aged 12-17 years using a [TC]² NX-16 white light 3D body scanner and comparing the scanned measurement data to the current ASTM standardized apparel sizing charts for Juniors, Misses and Women’s. RQ2 and RQ3 were answered by conducting face-to-face detailed interviews with participants and family members and then holistically analyzing the quantitative and qualitative data.
CHAPTER 3 METHODOLOGY

This chapter includes a description of the research design, sample recruitment, instruments, data collection procedures, and data analysis procedures used for this research. A mixed methods research design was used to explore apparel fit issues experienced by plus-size female teens aged 12-17 years, and to determine whether the current ready-to-wear apparel available to them satisfies their functional, expressive, and aesthetic wants and needs.

Johnson and Onwuegbuzie (2004) proposed the Mixed Methods Research Process Model consisting of eight sequential steps which were followed in this study: (1) write the research questions; (2) determine if a mixed methods research design is appropriate; (3) select the mixed methods design (as this research placed equal emphasis on the qualitative and quantitative, therefore, data collection was concurrent); (4) collect data; (5) analyze data; (6) interpret data; (7) legitimize the data by collaborating qualitative and quantitative results; and (8) draw conclusions and write the final report.

Step 3 above required the researcher to make a decision as to whether qualitative or quantitative data have equal or a dominant status in the evaluation and interpretation of results. For this research, it was decided that qualitative and quantitative data results would share equal status. Step 7 required the researcher to justify the use of mixed methods by fully utilizing its dual approach in “assessing the trustworthiness of both the qualitative and quantitative data and subsequent interpretations” (p. 22). This was achieved by cross-referencing participant quotations with quantitative data reported in Chapter 4 under Research Findings and Discussion to holistically arrive at an answer to the research questions.
Population and Sample

Participants for this study were recruited from members of the general public living in the Midwest region of the U.S., over a six month period, from October 2012 through March 2013. Potential participants were recruited from all ethnicities and income levels. A target number of 25 to 50 females, 12-17 years of age who wore plus-size apparel, were sought to participate in this research. The target sample size for this study was reasonable based on previous apparel related studies that collected both anthropometric and qualitative data and included sample sizes of 22, 41, and 80 participants (Brock et al., 2010; Connell & Ulrich, 2005; Connell & Ulrich, 2006). In addition, Onwuegbuzie and Collins (2007) conclude that, when a qualitative and quantitative data are collected concurrently from participants who have been purposefully selected due to possessing the unique characteristics of the phenomena under investigation, a minimum of 21 participants is sufficient.

Only potential participants who currently had a Body Mass Index (BMI) at or above the 85th percentile for children of the same age and sex, or who indicated in prescreening that they required plus-size apparel, were considered eligible for this research. Determination of BMI was based on The Stature-for-Age and Weight-for-Age percentiles for girls 2 to 20 years chart, published in The U.S. Department of Health and Human Services Centers for Disease Control and Prevention 2000 CDC Growth Charts for the United States: Methods and Development Report (2002) which used the National Center for Health Statistics formula BMI = (weight in pounds / height in inches x height in inches) x (703) (Center for Disease Control, 2012) to determine percentile ranking. Some participants were athletes and did not appear overweight on visual inspection, as their BMI was a reflection of muscle mass rather
than adipose tissue. However, these individuals, as well as those who were overweight or obese, had been identified as needing plus-size apparel (Connell & Ulrich, 2005).

A potential participant was excluded from enrolling in this research if she was disabled and unable to stand for the 3D body scanning process. The rationale for this was that, although, she may share common characteristics with the population under investigation, she represents a separate niche market. Potential participants were also excluded from enrollment for either of the following reasons: (1) did not fall into the age requirement for study inclusion and (2) did not require plus-size apparel.

Approval of the Use of Human Subjects

The Iowa State University (ISU) Institutional Review Board (IRB) Human Subject Review Committee evaluated and provided written approval for this research prior to recruitment of participants. Original approval was received on all procedures and forms (see Appendix A). One month after the original approval was received; a modification to provide $25.00 of the incentive for study participation was applied for and received (see Appendix A). This modification was applied for when it became apparent that participants were traveling as much as 150 miles to participate in the research and the cash incentive was intended to defray travel expenses. Following are the final documents that were submitted and approved by the ISU Human Subject Review Committee: Use of the [TC]² NX-16 white light 3D body scanner, Recruitment Letter (see Appendix B), Recruitment Flier (see Appendix C), Newspaper Advertisement (see Appendix D), Public Service Announcement (see Appendix E), Phone Script (see Appendix F), Appointment Confirmation (see Appendix G), Informed Consent Document (see Appendix H), Entry Form for Drawing of iPod (see Appendix I), and Interview Instrument (see Appendix J). The rights and welfare of the
human subjects were appropriately protected, any foreseeable risks to the subjects were avoided, and the confidentiality of data from voluntary participants was assured.

**Recruitment of Study Participants**

Participants for this research were recruited through various ways such as Recruitment Letter, Recruitment Flier, Newspaper Advertisement, and Public Service Announcement (see Appendices B-E) by the following approaches.

The Recruitment Letter was sent via email to all members of the Ames Chapter of the American Sewing Guild, all persons with an Iowa State University email address, placed on the website of the Iowa State University Nutrition and Wellness Research Center, and delivered by hand to acquaintances of the researcher. The Recruitment Letter and Recruitment Flier were emailed to consumer science teachers for the Des Moines, Ames, Boone, Marshalltown, Story City and Roland school districts, and the Ames chapter of the Girl Scouts with follow up phone calls made to answer any questions about the study. Diet clinics with adolescent weight reduction programs in the Ames and Des Moines area were contacted via phone and emailed copies of the Recruitment Letter (see Appendix B and C).

The Newspaper Advertisement was: (1) placed three consecutive months in the Sun, a county wide home delivered newspaper with a circulation of 40,000 homes; (2) featured on the front page of the Sun’s online version of the paper; and (3) placed in the Craigslist online classified ads website in all metropolitan areas in the state of Iowa (see Appendix D). The Recruitment Flier was: (1) placed on community information boards in the public library, grocery stores, fitness centers, and the Boys and Girls Club of Ames; (2) given to apparel stores in the Ames and Des Moines areas, which cater to plus-sizes or teens; (3) posted in
each of their facilities at the Youth shelters in Ames and Boone counties; and (4) included twice in the statewide newsletters for Iowa State University Extension, and 4H.

A Facebook account was created and the Newspaper advertisement posted to https://www.facebook.com/PlusSizeClothingResearchAtIowaStateUniversity this permitted study participants to inform friends and family about the study thus encouraging snowball sampling, a technique whereby the researcher obtains additional participants through previous participants (Huck, 2008). The news department of WHO TV, Channel 13, Des Moines in Iowa came to the campus and interviewed the researcher about the study. That interview aired statewide on the 5:00 p.m. television news broadcast of February 25, 2013 and their official website posted the interview video as well as the Newspaper Advertisement. The Public Service Announcement was read on the following radio stations in Ames and Des Moines: KASI-AM, KURE, Iowa Public Radio, KHOI, WOI, KCCQ and News 1040 WHO during the month of March 2013 (see Appendix D and E).

These organizations and news outlets were chosen because they either have members or circulation within the target age, or persons related to potential participants. Additionally, the Ames chapter of the American Sewing Guild, 4H, and Girl Scouts offer apparel-related classes and include members who expressed interest in both apparel fit issues and 3D body scanning.

Recruiting participants for this study was particularly difficult for two reasons: (1) lack of access to the age group under investigation and (2) intimidation of the study requirements for some 12-17 year old females. All school districts within 50 miles of the ISU campus were contacted and rejected the researchers request to have recruitment materials made available to students and their parents. The request to make recruitment
materials available was also denied by the diet clinics associated with McFarland Clinic in Ames and Mercy Hospital in Des Moines, Iowa. Additionally, for the girls to participate in this research they had to self-identify as plus-size and be willing to discuss their apparel fit issues in a laboratory setting on university campus with the researcher.

**Instruments**

**3D Body Scanner**

The [TC]² NX-16 white light 3D body scanner was used to collect anthropometric data from the participants. This device is a 4 by 5 feet box equipped with 32 cameras (8 cameras for each column), capturing the body from a 360-degree view resulting in a cloud point data which produce a true-to-scale body model ([TC]², 2012). The scanning process takes approximately 10-15 seconds and provides over 400 measurements of the participant’s body ([TC]², 2012). The scanner is outfitted with a private dressing area and contains automatic extraction software recording the participant’s shape and measurement data ([TC]², 2012). The automatically extracted data are formatted according to those published in American Society for Testing and Materials International (ASTM) Body Measurements for Adult Female Misses Figure Type, Sizes 2-20 (ASTM, 2001).

The measurement data collected from the automatic extraction software of the 3D body scanner included: Full stature height, bust circumference, waist circumference, high hip circumference, full hip circumference, mid neck circumference, neck base circumference, armseye, upper arm circumference, elbow circumference, wrist circumference, thigh circumference, mid-thigh circumference, knee circumference, calf circumference, ankle circumference, vertical trunk length, crotch length total, cervicale height, waist height, high hip height, hip height, crotch height, knee height, ankle height, center front waist length,
center back waist length, across back shoulder width, back width, front chest width, shoulder length, shoulder slope arctan, arm length, arm length CB to wrist, bust point to bust point, neck to bust point, and scye depth. Figure 2 presents the outputs of 3D scan data including all body measurements mentioned above as well as side and front views of a participant’s 3D scan image.

![3D Scan Image](image)

Figure 2. Outputs of a participant’s side and front view of 3D scan image and automatic extraction measurement data.

*Note.* Different colors in 3D scan image only indicate different area of the human body. Extraction measurements shown are based on the ASTM body measurement location guideline.

Data derived from the 3D body scan were used concurrently with qualitative data to answer research question 1: Do the anthropometric measurements of plus-size female teens aged 12-17 years participating in this study fit into any of the current standardized sizes published by ASTM?
Interview Instrument

A two section Interview Instrument was developed by the researcher for this study (see Appendix J). It contained a preprinted participant number, seven questions gathering participant characteristics under the Demographic Survey section, and 19 interview questions under the Interview Questions: Apparel Fit Issues section. Interview questions were designed to provide the researcher with a detailed understanding of issues surrounding the participant’s apparel options.

Interview items include: aesthetics of apparel available to the participant, specific fitting issues, shopping experiences, apparel worn to school, apparel for extracurricular activities, apparel comfort, apparel fit, concerns about her apparel, and advice for the industry about plus-size apparel for teens. Questions were developed based on previous research investigating teens and apparel related issues (Alexander et al., 2005; Andeson & Meyer, 2000; Brock et al., 2010; Chen-Yu & Seock, 2002; Connell & Ulrich, 2005; Connell & Ulrich, 2006; Daters, 1990; Eicher et al., 1995; Francis, 1992; Kelly et al., 1974; Koester & May, 1985; MacGillivray & Wilson, 1997; Meyer & Anderson, 2000; Tselepis & deKlerk, 2004).

To assist participants in identifying areas of their apparel where they were not satisfied with the fit, frontal and rear sketches of a female croquis were created using Microsoft Visio graphics software (see Figure 3). Each croquis contained numbered lines identifying an area of the body. The nineteen numbered lines appearing on the croquis correspond to key measurement areas of the body used for drafting and fitting apparel (ASTM, 2009b; Brock et al., 2010; Deckert, 1999).
The interview data were used in conjunction with quantitative data to answer research question 2: Are plus-size female teens aged 12-17 years satisfied with the fit of apparel available to them? and research question 3: Does the ready-to-wear apparel available to plus-size female teens aged 12-17 years satisfy their functional, expressive and aesthetic wants and needs?

![Figure 3. Female croquis with key body measurement areas.](image)

Note: Vertical arrows correspond to length measurements and horizontal arrows correspond to circumference measurements.

**Data Collection Procedures**

Potential recruits contacted the email address given in Recruitment Letter, Recruitment Flier, Newspaper Advertisement, and Public Service Announcement, and provided their name and a phone number and time that the researcher could contact them. The researcher then contacted the potential participant via phone using the Phone Script to confirm that the recruit met the study inclusion requirements and to answer any questions the potential participant or legal guardian had concerning the research (see Appendix B-E).
Potential participants meeting the study inclusion criteria and who agreed to participate in the research were scheduled for a date and time to come to the campus. If the legal guardian did not plan to accompany the recruit to the campus, and have another adult accompany her to the appointment, the Informed Consent Document (see Appendix H), was emailed to the legal guardian with the Appointment Confirmation (see Appendix G). The recruit and guardian were instructed that the guardian must read and sign the consent form and it must be given to the researcher on the appointment day or the recruit would not be permitted to participate in the research. The Appointment Confirmation contained a link to a campus map indicating the location of the Human Nutritional Sciences Building lobby where the participant and legal guardian were instructed to meet the researcher.

The recruit and guardian were met in the lobby of the Human Nutritional Sciences Building by the researcher and escorted to the Body Scanning Lab. The researcher introduced the overall purpose of the study, and the recruit and her guardian were each asked to read and sign the Informed Consent Document (see Appendix H). The participant was assigned a randomly chosen participant number preprinted on the Interview Instrument (see Appendix J). Randomly chosen participant numbers were used to further protect the participant’s identity. The participant number was connected to the Interview Instrument, the recorded face-to-face interview, and 3D body scan. The name of the participant or her guardian was not associated to any of data collected.

After signing the Informed Consent Document, each participant was asked to fill out the first four questions of one’s characteristics on the Interview Instrument (see Appendix J) and then, to fill out the Entry Form for Drawing of iPod (see Appendix I). The participant was then given $25.00 cash for her participation. As the cash payment was compensation for
expenses incurred traveling to the campus it was given to the participant prior to data collection. Some participants traveled 3-4 hours by auto to engage in the research and the money was presented to them before collecting data as a show of good will and appreciation for their effort. Providing the cash prior to data collection assured the participant she would be compensated for her travel expenses even if she chose to end the appointment before all data were collected. Additionally, it further ensured that the minors were willingly participating in the research, as they were instructed they were not obligated to answer any questions which made them feel uncomfortable and they could end the appointment and leave at any time having already received their compensation.

The participant then had her weight taken on a Health-O-Meter model HDR743DQ1-41 E091BN digital scale and height measured by standing next to a vertically placed tape measure. The results were then recorded on the Interview Instrument to document that she met the study inclusion of Body Mass Index (BMI) requirements and used to calculate her BMI.

The researcher then conducted a face-to-face interview with the participant using the questions 1-19 under the Interview Questions: Apparel Fit Issues section of the Interview Instrument (see Appendix J) and the interview was digitally recorded. The legal guardian and other family members who were present with the participant’s approval were instructed by the researcher that they could add any additional comments after the participant had finished answering each question.

Following the interview, a scanning suit in the appropriate size was chosen for the participant. Scanning suits were purchased specifically for this research and each suit consisted of a white colored long sleeve T-shirt, tights, and latex swim cap, or acrylic ski cap.
A scanning suit fitting close to the body was necessary to obtain accurate measurements and body contours. The cap covered and contained the hair allowing the white light scanner to obtain an accurate reading, and further protected the identity of the participant. Three sets of T-shirts and tights were purchased in the sizes Large, 1X, 2X, 3X, 4X and 5X which allowed for mixing and matching of sizes to accommodate each participant's individual size and shape. Five swim caps and five ski caps were purchased in one-size-fits-all. The participant was given the choice of whether to wear a swim or ski cap to cover her head. Participants were informed that the scanning suit was designed to fit very close to the body and would feel very snug.

The participant was shown the private dressing area attached to the 3D body scanner and instructed on the use of the body scanner. She was shown how to stand in the scanner and where the trigger button was located. The legal guardian and other family members were permitted to view the scanner and ask questions prior to the participant changing into the scanning suit.

The participant was then given a scanning suit to change into, and instructed to remove all apparel, with the exception of undergarments and to enter the scanner directly after changing into the scanning suit. Once the participant entered the 3D body scanner and indicated she was ready to begin the scanning process, she was instructed to stand facing forward and to place her hands on the bar in front of her. She was instructed that she might want to close her eyes to avoid discomfort from the flashing lights as the machine captured her image.

Three separate scans were taken of each participant to ensure the accuracy of capturing body scan data. Averaged values derived from a series of 3D body scans have
been used by researchers to increase the accuracy of findings (Ashdown, Choi, & Milke, 2008; Kouchi & Mochimaru, 2011; Leong et al., 2013; Leong, Fang, & Tsai, 2007; McKinnon & Istook, 2002; Tomkinson & Shaw, 2013). Additionally, 3D body scanners have produced errors in locating landmarks on nonstandard body shapes resulting in inaccurate measurements (Han, Nam, & Shin, 2010). Landmarks are physical base points, such as surface indentations or protruding bones, used as measurement guides (Han & Nam, 2011). Overweight individuals often have unclear physical landmarks, which may result in scanning errors and inaccurate measurements (Han et al., 2010; Leong et al., 2007). Once the scanning process was completed, the participant was asked to change back into her clothes and return to the main part of the room.

The participant was given the opportunity to view her 3D body scan image, if she desired. She was also offered, via email, a copy of her scan and measurements in PDF format. Both she and her guardian were thanked for their time and given a guided tour of the Apparel, Merchandising, and Design program facilities if they chose to view it. The researcher then escorted the participant and her guardian back to the lobby of the Human Nutritional Sciences Building.

When the data collection period ended, all Entry Form for Drawing of iPod forms were placed in a box (see Appendix I) and one was randomly chosen by the researcher. The winner of the drawing was contacted via email and informed their receipt of the iPod through the U.S. postal service. The iPod was purchased from a local retailer and mailed to the winner along with a gift receipt in the event she wanted to exchange it for any reason. The package was insured and tracked by the U.S. Postal Service to verify receipt.
Data Analysis Procedures

Data analysis consisted of three phases of analysis: (1) quantitative data analysis; (2) qualitative data analysis; and (3) integrative data analysis of quantitative and qualitative data.

Quantitative Data Analysis

Statistical Package for Social Sciences (SPSS) 17.0 was used to calculate participant’s demographic characteristics. Microsoft Excel was used to calculate participants’ average and differential measurements from the ASTM standardized size.

Three 3D body scans were taken of each participant. Measurements from each of the 3D body scans were printed in PDF format shown in Figure 2. The three PDF printouts for each participant were labeled with the participant’s number followed by A, B, or C. Data from PDF’s A, B, and C were averaged on the participant’s individual Excel spreadsheet and the average values transferred to a master Excel spreadsheet containing all participants by: (1) PDF data were copied and pasted into a text format document using NoteTab Light 7.1 software; (2) data were formatted for ease of import into Excel by eliminating unwanted spaces; (3) an individual Excel spreadsheet was created for each participant; (4) text file data for scans A, B, and C were transferred into separate columns in the individual Excel spreadsheet using the data import function; (5) the three columns of measurements were averaged with results displayed in column four; and (6) column four, the average measurement for each participant, was then transferred into the master Excel spreadsheet containing the average measurements of all participants with the copy and paste function.

The master Excel spreadsheet was then used to compare each participant’s measurements to the ASTM category and size which most closely fit her bust, waist, and full hip measurements. The landmarks of bust, waist, and full hip were chosen because these are
the three primary circumference measurements used to determine size in ready-to-wear apparel (Keiser & Garner, 2008; Lee & Steen, 2010; Liechty et al., 1992). To determine which category and size the three key measurements most closely conformed, each participant’s average measurements were visually compared in the ASTM sizing charts for Body Measurements for Juniors, Sizes 0-19, Body Measurements for Adult Female Misses Figure Type, Sizes 2-20, and Standard Table for Body Measurements Relating to Women’s Plus-Size Figure Type, Sizes 14W-32W (ASTM, 2001, 2004, 2008). The participant’s three key measurements of bust, waist and full hip were compared to each of the 11 standardized sizes for Juniors, the 10 standardized sizes for Misses, and the 10 standardized sizes for Women’s; until the category and size which most closely matched at least two key measurements was found. Once a category and size had been determined, the ASTM measurements for that category and size were transferred to the master spreadsheet in a column next to the participant’s average measurements.

ASTM measurement category and size data were extracted from the ASTM PDF file and transferred to the master Excel spreadsheet by: (1) creating a temporary Excel spreadsheet to organize data; (2) the entire size chart table from the ASTM PDF was then copied and pasted into a text format document using NoteTab Light 7.1 software; (3) data were formatted for ease of import into Excel by eliminating unwanted spaces; (4) the search and replace function in NoteTab Light 7.1 was used to replace any fractional symbols with its decimal equivalent; (5) the text file was then imported into the temporary Excel spreadsheet using the data import function; (6) unwanted measurements were removed and rows were rearranged to correspond to the sequence of measurements in the master spreadsheet; and (7) the appropriate column containing the predetermined category and size most closely aligned
to each participant’s average measurements for bust, waist, and full hip was then copied and pasted into the master spreadsheet in the column next to each participant’s average measurements.

Missing data from the ASTM standardized charts were handled in the following manner. Measurement data captured by the 3D body scans with the use of the ASTM automatic data extraction function produces data formatted according to the Body Measurements for Adult Female Misses Figure Type, Sizes 2-20 (ASTM, 2001). Juniors and Women’s measurement charts differ from Misses in the following data: (1) ASTM standardized sizes for both Juniors and Misses include stature with an incremental increase in height corresponding to an incremental increase in size. However, the Women’s category does not include incremental stature, but instead uses an average stature of 66 inches for all sizes. Therefore, when Women’s sizes were used in the master Excel spreadsheet, the stature was 66 inches regardless of size; (2) Arm Length CB to Wrist does not appear in the Women’s size chart and was, therefore, designated as N/A in the master spreadsheet; and (3) Mid Neck Circumference, Mid-Thigh Circumference, and High Hip Height measurements do not appear in the Junior size chart and were designated as N/A in the master spreadsheet.

Measurements not properly captured during the 3D body scan resulted in the word Error appearing rather than a numerical value on the automatic extraction data. Where this occurred on one of the 3D scans, the measurements captured for that point on the other two scans were averaged on the participant’s individual Excel spreadsheet. If no data were captured at that point on any of the scans, that point was designated on the master spreadsheet as Error and that point was not used in comparison to the ASTM standardized sizes.
The only data needed to be converted into a similar form for comparison were Shoulder Slope Degrees from the ASTM standardized charts. The 3D body scan extraction software reported the Shoulder Slope Arctan values rather than slope in degrees. The Shoulder Slope Degrees value appearing on each of the ASTM standardized sizes was converted into its tangent value. This was performed with a calculator by entering the value for degrees and pressing the tangent button to arrive at the corresponding value. The result was checked by reversing the process and confirming the original value was achieved.

The master Excel spreadsheet was used to calculate the participants’ differential measurements, those being the difference between the participants’ measurements and the ASTM standardized measurements for the apparel size and category which is the closest fit to the averaged measurements. These values were then used to corroborate statements made during the interview. Total average differential measurements were calculated as the difference between ASTM standardized sizes and the participants in this study. This was accomplished by summing the difference for each participant and dividing by the total number of participants.

Both individual and average differential measurements were compared with the ASTM standard size and graphed for a visual depiction of the data and are contained in Chapter 4 Research Findings and Discussion. Average differential measurements were used to identify extreme outliers. Extreme outliers for this study were defined as measurement values of two or more inches from the standardized measurement value. Two inches has been determined to be the maximum amount that a block can be altered at any grading line or that a working pattern can be altered at a grading line to accommodate individual size requirements (Handford, 2003). These results were used to discuss the average deviation of
this study population from the ASTM standardized sizes and grading issues and provides a basis for answering research question 1.

To ensure the accuracy of data transferred from the PDFs of the 3D body scan and ASTM size chart to the master Excel spreadsheet, data were checked two times by two separate researchers at each of the following steps: (1) When data were transferred from the PDF to the text file; (2) when transferred from the text file to the individual or temporary Excel spreadsheet; and (3) when data were transferred to the master spreadsheet.

The apparel category and size with the greatest number of participants was used to examine body shape variations which can exist within a given category and size. A data cloud of each of the participants within this group was placed into a visual graph for ease of comparison shown in Chapter 4 Research Findings and Discussion. The visual inspection of body shape was referenced to the participants’ fitting issues discussed in the interview with a comparison of fitting issues and body shape between members of this group discussed.

**Qualitative Data Analysis**

Excel was used to track interview themes and sub-themes. SPSS was used to calculate Chi-Square to determine whether a relationship existed between participant characteristics and sub-themes.

Interviews conducted with the participants were digitally recorded and transcribed to Microsoft Word with the aid of Dragon Naturally Speaking 11.5 software. The use of transcription software can increase accuracy and reduce time needed to transcribe qualitative data (MacLean, Meyer, & Estable, 2004). The following steps were taken to ensure accuracy of transcription: (1) the researcher sat at the computer with headphones and a microphone; (2) the digital recording of the interview was played and stopped every few words; (3) the
researcher then repeated into the microphone the dialogue and it was automatically typed on the screen by the software; (4) the recording was reversed and replayed with researcher reading the dialogue to check for accuracy; (5) if an inaccuracy occurred it was corrected and the sentences rechecked for accuracy; (6) on completion of the transcription, the researcher listened to the interview again while reading the text; (7) if a mistake was found, it was corrected and the passage listened to again while checking the text; (8) satisfied with the accuracy of the transcription, the researcher checked her notes for any additional information regarding the interview which needed to be added to the transcription such as participant gestures, and these were added in brackets at the appropriate place in the interview; (9) when a family member used the participant’s name during the interview the name was removed from the transcribed data and designated as [Name] in its place; and (10) when additional comments were added, a note was placed at the top of transcription sheet indicating the bracketed information was added, post transcription, to increase the understanding of the dialogue.

The 230 pages of transcribed interviews were then coded for themes and subthemes, by two coders working independently, with the use of an Excel spreadsheet. An Excel spreadsheet was formatted with the participant’s number placed in the first column and subsequent columns labeled as themes emerged, with a 1 being placed in the columns discussed by the participant (Creswell, 2009). Subthemes were organized under main themes. Main and subthemes were reevaluated throughout the review and coding process and subthemes were combined when appropriate (Spiggle, 1994). Upon completion of coding, all subthemes were totaled. Any subtheme which had been discussed by less than 3 participants, or 10%, was reviewed again for content and placed into a broader subtheme.
The two coders then met to discuss themes and subthemes. Discrepancies in subthemes were discussed until an agreement was reached. Agreed upon subthemes were combined and titles adjusted to better represent the content. Then a third coder reviewed and verified coding and themes as well as agreements made by the two coders.

Regarding the credibility of coding qualitative interviews, Hayes and Krippendorff (2007) stated that, “The key to reliability is the agreement observed among independent observers” (p.78). Therefore, to increase credibility and reduce bias in assigning themes, the coding of the transcribed interview was cross-checked by two independent researchers (Creswell, 2009). Codes assigned by researchers were formatted in an Excel spreadsheet and imported into SPSS. Inter-coder reliability was calculated with SPSS using Cohen’s Kappa. Cohen’s Kappa is widely used to calculate inter-coder reliability for nominal data (Lombard, Snyder-Duch, & Campanella-Bracken, 2002). For exploratory research, an acceptable level for inter-coder reliability is 70% (Lombard et al., 2002). Inter-coder reliability for this study was 99%.

SPSS was used to calculate Chi-square values to determine if a relationship existed between the themes which emerged during the interview and participant characteristics. Chi-square is an appropriate test to determine whether a relationship exists between two variables (Huck, 2008).

Quantitative and qualitative results were then holistically used to answer the three research questions. Participant characteristics, differential measurements, interview themes, selected quotations, and Chi-Square results were reported and discussed in Chapter 4 Research Findings and Discussion.
CHAPTER 4 RESEARCH FINDINGS AND DISCUSSION

The overall purpose of this study was to investigate apparel fitting issues experienced by plus-size female teens aged 12-17 years, framed around the functional, expressive, and aesthetic model with a goal of improving apparel fit within this niche market. After the target customer has been defined in the context of teen’s culture, issues impeding her ability to fulfill her functional, expressive, and aesthetic apparel wants and needs are identified in the problem identification stage. The next stage, the preliminary ideas stage, defines the target consumer’s functional, expressive, and aesthetic wants and needs in the context of the problems which have been identified by Lamb and Kallal (1992). This chapter covers the problem identification and preliminary ideas stages by presenting study findings and identifying and discussing problems while answering the three research questions.

In this chapter, a brief overview of research findings is presented followed by an in-depth examination of both the quantitative and qualitative findings used to answer each research question. The chapter then conveys the participants’ advice for the apparel industry, and concludes with a brief summary of key findings.

The findings of this study are useful in both academia and industry and provide: (1) insight into specific apparel fit issues experienced by plus-size female teens; (2) areas where the girl’s functional, expressive, and aesthetic wants and needs have been hampered by the apparel available to her; (3) agreement with previous research findings; (4) explanation for assumptions reported in previous research; (5) information previously unpublished surrounding plus-size female teens and apparel; and (6) advice from participants for apparel manufacturers targeting the plus-size teen market.
Research Findings

Research findings will be reported by the following orders: Sample characteristics, quantitative data findings, qualitative data findings, findings by research questions, and advice for the apparel industry.

Sample Characteristics

A total of 52 potential participants responded to recruitment advertising and expressed interest in the study. Twelve respondents did not satisfy the study inclusion criteria of either age or apparel size and were disqualified from participation. Three respondents chose not to participate after receiving additional information about the study requirements. Three respondents made an appointment to participate but canceled having decided not to participate. Four respondents made an appointment to participate, but did not show up for their scheduled appointment and chose to not reschedule. Finally, a total of 30 participants completed the study. An adult legal guardian was present in the Body Scanning Lab with the researcher and participant during the entire research appointment. Additional family members (e.g., grandmothers, fathers, siblings), were also permitted to attend the research appointment and be present during data collection with the participant’s approval.

A participant sample reflecting each of the ages under investigation in this study was obtained. Reflecting the demographics of the region in which the study sample resides, 78% of the 30 participants reported their ethnicity as White/European American. The remaining 22% of participants reported their ethnicity as one of the following, African American/Black, White/ European American and Hispanic American/Latina, African American/Black, African American/Black, American Indian/ Native American, or Hispanic American/ Latino & Native Hawaiian/Other Pacific Islander. The sample included
participants in each grade level in school from sixth grade through twelfth. Seventy-four percent of the participants represented the upper range of the BMI scale at > 95 percentile, indicating they were classified as obese by the Center for Disease Control (2012).

Participant characteristics are shown in Table 1 and the information of each participant’s BMI calculations is reported in Appendix K for future usage.

Table 1. Demographic characteristics for the sample (N=30).

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Number of Participants</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Twelve</td>
<td>5</td>
<td>16</td>
</tr>
<tr>
<td>Thirteen</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>Fourteen</td>
<td>7</td>
<td>23</td>
</tr>
<tr>
<td>Fifteen</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Sixteen</td>
<td>7</td>
<td>23</td>
</tr>
<tr>
<td>Seventeen</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White/European American</td>
<td>23</td>
<td>78</td>
</tr>
<tr>
<td>White/European American and African American/Black</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>White/ European American and Hispanic American/Latina</td>
<td>1</td>
<td>03</td>
</tr>
<tr>
<td>African American/Black</td>
<td>1</td>
<td>03</td>
</tr>
<tr>
<td>African American/Black and American Indian/ Native American</td>
<td>1</td>
<td>03</td>
</tr>
<tr>
<td>Hispanic American/ Latino and Native Hawaiian/Other Pacific Islander</td>
<td>1</td>
<td>03</td>
</tr>
<tr>
<td>Grade in school</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sixth</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>Seventh</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Eighth</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>Ninth</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>Tenth</td>
<td>7</td>
<td>23</td>
</tr>
<tr>
<td>Eleventh</td>
<td>2</td>
<td>07</td>
</tr>
<tr>
<td>Twelfth</td>
<td>1</td>
<td>03</td>
</tr>
<tr>
<td>Body mass index (BMI) percentile</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 95</td>
<td>22</td>
<td>74</td>
</tr>
<tr>
<td>95</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>93</td>
<td>1</td>
<td>03</td>
</tr>
<tr>
<td>86</td>
<td>2</td>
<td>07</td>
</tr>
<tr>
<td>85</td>
<td>1</td>
<td>03</td>
</tr>
<tr>
<td>71</td>
<td>1</td>
<td>03</td>
</tr>
</tbody>
</table>

*Note.* BMI percentile based on The Stature-for-Age and Weight-for-Age percentiles for girls 2 to 20 years chart, published in The Department of Health and Human Services Centers for Disease Control and Prevention 2000 CDC Growth Charts for the United States: Methods and Development Report (2000).
Quantitative Data Findings

Each participant had three 3D body scans taken and the results averaged to ensure accuracy. Bust, waist, and full hip measurements of each participant were used to determine which American Society for Testing and Materials International (ASTM) apparel category and size most closely conformed to her averaged measurements. All participants could be assigned to an ASTM apparel category and size based upon their key measurements of bust, waist, and full hip measurement (see Table 2). However, this was a compromise, as no individual had measurements that strictly aligned to the standardized measurement at all three key measurement locations. Only 19% of participants had measurements that permitted them to wear apparel in the Juniors category containing apparel designed for the immature female body. The remaining 81% required either Misses or Women’s sizes which are designed for a fully-grown woman (Keiser & Garner, 2008).

One of the study objectives was to determine whether current ASTM sizing categories meet the measurement needs of plus-size female teens aged 12-17 years participating in this study. An investigation of average differential measurement deviation from the ASTM standardized sizing gives insight into whether the size requirements of the study population as a group are met by standardized sizing. It also identifies general measurement points where the study population measurements are misaligned with the ASTM standardized sizes.

Differential measurements were calculated by taking the difference between the participant’s averaged 3D scan measurements and the ASTM standardized measurement at any given location shown in Table 3. Differential measurements at 37 separate locations revealed individual variations of 0.01 to 11.19 inches from the ASTM standardized
measurement (see Table 3). As a result, participants would experience the following fitting issues: (1) apparel may fit in some locations and not others and (2) her measurements fall between two or more standardized sizes. This supports the findings of Connell and Ulrich (2005) study that standard pattern grading methods do not accommodate the fit requirements of plus-sizes, and Brock et al. (2010) study that plus-size teens experience difficulty finding a single size which fit and reported the needed for half-sizes, as one size was too tight but the next larger size was too large.

Table 2. Participant’s size affiliation under the ASTM apparel category and size (N=30).

<table>
<thead>
<tr>
<th>Category</th>
<th>Size</th>
<th>Number of Participants</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Juniors</td>
<td>Size 11</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Size 13</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Size 15</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Size 17</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Size 19</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Misses</td>
<td>Size 14</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Size 16</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Size 18</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Size 20</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>Women’s</td>
<td>Size 20</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Size 22</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Size 24</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Size 26</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Size 30</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Size 32</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

*Note. Each participant’s size affiliation is assigned by her bust, waist, and full hip measurements.*
Table 3. Participant’s differential measurements from the ASTM category and size (N=30).

Differential measurements of each participant’s apparel size

<table>
<thead>
<tr>
<th>Measurement location</th>
<th>P1 Women’s 22</th>
<th>P2 Women’s 20</th>
<th>P3 Misses 14</th>
<th>P4 Women’s 24</th>
<th>P5 Women’s 26</th>
<th>P6 Women’s 22</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Stature Height</td>
<td>0.25</td>
<td>-1.00</td>
<td>2.00</td>
<td>-1.50</td>
<td>2.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Bust Circumference</td>
<td>-0.22</td>
<td>2.27</td>
<td>-0.76</td>
<td>-0.42</td>
<td>-0.50</td>
<td>-0.56</td>
</tr>
<tr>
<td>Waist Circumference</td>
<td>-6.68</td>
<td>-2.69</td>
<td>-7.47</td>
<td>-3.49</td>
<td>-5.37</td>
<td>-4.75</td>
</tr>
<tr>
<td>High Hip Circumference</td>
<td>0.61</td>
<td>1.62</td>
<td>-1.34</td>
<td>1.97</td>
<td>2.27</td>
<td>1.88</td>
</tr>
<tr>
<td>Full Hip Circumference</td>
<td>1.82</td>
<td>-0.42</td>
<td>-0.11</td>
<td>2.34</td>
<td>2.86</td>
<td>1.69</td>
</tr>
<tr>
<td>Mid Neck Circumference</td>
<td>2.17</td>
<td>1.98</td>
<td>0.23</td>
<td>0.27</td>
<td>0.96</td>
<td>2.64</td>
</tr>
<tr>
<td>Neck Base Circumference</td>
<td>2.20</td>
<td>1.88</td>
<td>-0.47</td>
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Note. Measurements in inches. N/A indicates a measurement is not included in ASTM standards for that category. Error indicates the measurement was not captured during scanning process. Negative value indicates participant’s measurement was greater than the ASTM measurement. Positive value indicates participant’s measurement was less than the ASTM measurement.
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Table 3. (Continued)  
Differential measurements of each participant’s apparel size

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<td>-0.22</td>
<td>0.98</td>
<td>-0.31</td>
</tr>
</tbody>
</table>
Differential circumference and length measurements of each study participant were extracted from Table 3 and graphed separately to provide visual illustration of each participant deviation from the ASTM standard sizes (see Figures 4 and 5). According to these figures participant measurements were found to deviate from ASTM standard measurements more in circumference than length. The greatest deviation in circumference was 11.19 inches, whereas, the greatest length deviation was 8.55 inches. Deckert (1999), observed that plus-sizes often have proportionally larger than average sizes on the areas of neck, bicep, midriff, bust and hips without significant differences in length measurements when compared with individuals of average weight and size. An in-depth examination of these findings is presented in the Research Questions Answered section of this chapter.

Differential measurements were averaged for the study population to investigate similarities among participants. Average differential circumference and length measurements are displayed in Figure 6 and Figure 7, respectively. Average differential measurements revealed extreme outliers, which for this study was defined as measurements with a 2 inch or greater deviation from the ASTM standardized measurement (Hanford, 2003). As shown in Figure 6, extreme outliers were observed in the circumference measurements of mid-thigh, back width, armscye, and waist. An extreme outlier in length measurements was observed at the vertical trunk.
Figure 4. Participant's circumference measurement deviation from the ASTM standard size. *Note.* Negative values indicate participant’s measurement greater than the ASTM standardized size. Positive values indicate participant's measurement less than the ASTM standardized size. Zero on Y axis means zero deviation from the ASTM standard measurement.
Figure 5. Participant's length measurement deviation from the ASTM standard size.

Note. Negative values indicate participant’s measurement greater than the ASTM standardized size. Positive values indicate participant's measurement less than the ASTM standardized size. Zero on Y axis means zero deviation from the ASTM standard measurement.
Figure 6. Average circumference measurement deviation from the ASTM standard size.

Note. Zero value indicates the ASTM standard measurement. Negative value indicates the average measurement for the study population was greater than the ASTM standard measurement. Positive value indicates the average measurement for the study population was less than ASTM standard measurement. Values represent the average for N=30.
Figure 7. Average length measurement deviation from the ASTM standard size.

*Note.* Zero value indicates the ASTM standard measurement. Negative value indicates the average measurement for the study population was greater than the ASTM standard measurement. Positive value indicates the average measurement for the study population was less than ASTM standard measurement. Values represent the average for N=30.
Collectively, plus-size teen participant measurements were found to deviate from the ASTM standardized measurement at all of the 37 measurement locations. All data for these points were retraced to the original scans to ensure accuracy of the results. Average circumference measurements deviated from the ASTM standard measurements from 0.03 to 3.91 inches; whereas; average length measurements deviated from the ASTM standard measurements from 0.05 to 5.83 inches.

Individual differential measurements shown in Figures 4 and 5 and average differential measurements shown in Figures 6 and 7 produced opposite results. Circumference measurements had the greatest deviation from the ASTM standardized measurements for individual differential measurements and length measurements had the greatest deviation from the ASTM standardized measurements for average differential measurements. Two explanations for this can be offered. First, the extreme outliers existing in the individual differential circumference measurements in Figure 4 were minimized when averaged with the group in the average differential circumference measurements in Figure 6. Second, individual length measurements contained more extreme outliers than individual circumference measurements. This can be seen in the vertical trunk length and total crotch length measurements in Figure 5 resulting in higher average differential length measurements in Figure 7.

Vertical trunk length and total crotch length measurements share a common measurement location and as overweight individuals have unclear physical landmarks, scanning errors can result (Han et al., 2010; Leong et al., 2007). Both of these measurements require the scan to record the length area including the area between the upper thighs around the crotch (see Figure 8). Some participants had upper thigh circumferences that caused the
thighs to touch and thus interfered with the accuracy of the measurement. Evidence of this can be seen when comparing the 3D data point clouds of participant 15 and participant 16 (see Figure 9). Participant 15 had the lowest BMI of any participant in this study at the 71 percentile and submitted to the study because she reported continual apparel fit issues resulting from body shape and muscle mass acquired as a teen athlete. Participant 16 is representative of 74% of the participants with a BMI of > 95 percentile. The accuracy issues with these measurements will be discussed under the Limitations section in Chapter 5 Summary and Conclusions.

Figure 8. Vertical trunk and crotch length measurement locations.
Figure 9. 3D scan data clouds of all participants (N=30).

*Note.* Participant number denoted as P followed by the numeric value. Side and front view of 3D clouds are provided for each participant.
Body shape can influence one’s experience with apparel fit and individuals wearing the same size may experience different fit issues due to body shape (Connell et al., 2006; Deckert, 1999; Mpampa et al., 2010; Vuruskan & Bulgun, 2011). An investigation was made of the apparel fit experiences that participants with different body shapes had with a given category and size.

The apparel category and size with the greatest number of participants was Women’s size 22. Figure 10 contains 3D data clouds for each participant in this group. This group was used to make general observations concerning the variation of body shapes that can exist among a given standardized size. Observations were cross referenced with quantitative data shown in Table 3 and participants’ comments during the interview. An expanded discussion is contained in the Research Questions Answered section of this chapter.

Figure 10. 3D scan data clouds of the participants in the ASTM women’s size 22. Note. Category and size based on participant’s bust, waist, and full hip measurements.
Qualitative Data Findings

Thirty interviews were conducted, each from 12-45 minutes in length, with the average interview lasting 20 minutes. If the participant gave her approval, adult family members also commented during the interview. A total of 28 mothers, 3 grandmothers, and 1 father shared their experiences and observations regarding the participant’s apparel during the interview. Interview data were coded by two independent coders and then checked by a third coder resulting in an Inter-coder reliability of .99. Nine main themes containing 3 to 14 sub-themes emerged from the interviews (see Table 4).

In 80% of the interviews, participants related experiencing trouble with apparel fitting in one area, but not another. Ninety-seven percent of participants reported they needed to try on apparel prior to purchase to ensure accurate fit with 80% giving this as the reason why they did not shop online or from catalogs. Eighty percent of participants identified particular items of apparel that they regularly experienced difficulty acquiring in their size. Sixty-seven percent of participants said they did not feel their apparel was as fashionable as their peers and 37% related that apparel concerns were the reason they did not engage in a desired extracurricular activity. Sixty percent of participants said they would like the apparel industry to manufacture plus-size apparel in styles similar to those worn by their average size peers and 53% said they wished the industry would consider different shaped bodies when designing apparel.

Participants and their family members candidly discussed issues surrounding the participant’s apparel. Participants related their personal experiences with apparel shopping, and issues they have encountered regarding apparel worn to school and for extracurricular activities. Mothers, fathers and grandmothers also related apparel shopping experiences and
conveyed their concerns about the apparel available to the participants and possible effects it might be having on the girls’ social interaction and her ability to explore and develop her personal identity and style. Themes and sub-themes are discussed in-depth along with quotes from participants and family members in the Research Questions Answered section of this chapter.

To explore a relationship between participant characteristics (e.g., age, ethnicity, grade in school, BMI) and interview sub-themes, Chi-Square values were calculated with the SPSS software. Six sub-themes were found to be associated with participant characteristics. Three sub-themes were related to age; one to grade in school, one to ethnicity, and one to BMI percentile (see Table 5).

Table 4. Themes and sub-themes identified from interviews.

<table>
<thead>
<tr>
<th>Main Themes and Sub-themes</th>
<th>Total Responses</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific Fitting Issues with Apparel</td>
<td>169</td>
<td></td>
</tr>
<tr>
<td>Fits in one area and not another</td>
<td>24</td>
<td>80</td>
</tr>
<tr>
<td>Specific types of apparel</td>
<td>24</td>
<td>80</td>
</tr>
<tr>
<td>Too tight at thigh and calf</td>
<td>17</td>
<td>57</td>
</tr>
<tr>
<td>Too tight at upper arm</td>
<td>15</td>
<td>50</td>
</tr>
<tr>
<td>Too tight at bust</td>
<td>15</td>
<td>50</td>
</tr>
<tr>
<td>Too low of rise on pants</td>
<td>15</td>
<td>50</td>
</tr>
<tr>
<td>Too narrow at full hip</td>
<td>15</td>
<td>50</td>
</tr>
<tr>
<td>Too short in bodice exposing skin</td>
<td>11</td>
<td>37</td>
</tr>
<tr>
<td>Too tight at waist</td>
<td>10</td>
<td>33</td>
</tr>
<tr>
<td>Too low at neckline</td>
<td>9</td>
<td>30</td>
</tr>
<tr>
<td>Needs to constantly adjust apparel</td>
<td>9</td>
<td>30</td>
</tr>
<tr>
<td>Too tight at upper chest and armpit</td>
<td>9</td>
<td>30</td>
</tr>
<tr>
<td>Too tight across back</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>Often has spillage, flow over, or muffin tops</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>Apparel Shopping Experiences</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Must try on apparel in store to ensure fit</td>
<td>29</td>
<td>97</td>
</tr>
</tbody>
</table>

Note. Themes and sub-themes included comments made by the participant and family members. Percentage reflects the number of interviews out of 30 where the subtheme was discussed.
Table 4. (Continued)

<table>
<thead>
<tr>
<th>Main Themes and Sub-themes</th>
<th>Total Responses</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does not shop online or catalog because cannot try on for fit</td>
<td>24</td>
<td>80</td>
</tr>
<tr>
<td>Must try on multiple garments or go to multiple stores to find garment that fits</td>
<td>17</td>
<td>57</td>
</tr>
<tr>
<td>Has negative emotions surrounding apparel shopping</td>
<td>11</td>
<td>37</td>
</tr>
<tr>
<td>Does not purchase because cannot find apparel that fits</td>
<td>10</td>
<td>33</td>
</tr>
<tr>
<td>Has difficulty finding specific types of apparel</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>Had to purchase at resale or borrow apparel because could not find new that fit</td>
<td>4</td>
<td>13</td>
</tr>
<tr>
<td><strong>Apparel Fit</strong></td>
<td><strong>80</strong></td>
<td></td>
</tr>
<tr>
<td>Is not too tight</td>
<td>21</td>
<td>70</td>
</tr>
<tr>
<td>Is not too big</td>
<td>16</td>
<td>53</td>
</tr>
<tr>
<td>Is comfortable</td>
<td>12</td>
<td>40</td>
</tr>
<tr>
<td>Is flattering</td>
<td>11</td>
<td>37</td>
</tr>
<tr>
<td>Has adequate coverage</td>
<td>10</td>
<td>33</td>
</tr>
<tr>
<td>Has range of motion</td>
<td>10</td>
<td>33</td>
</tr>
<tr>
<td><strong>Industry Advice</strong></td>
<td><strong>72</strong></td>
<td></td>
</tr>
<tr>
<td>Styles similar to peers</td>
<td>18</td>
<td>60</td>
</tr>
<tr>
<td>Design apparel that fits different body shapes</td>
<td>16</td>
<td>53</td>
</tr>
<tr>
<td>Graphic designs, sequins, sparkles and youthful floral prints</td>
<td>15</td>
<td>50</td>
</tr>
<tr>
<td>Bright colors</td>
<td>10</td>
<td>33</td>
</tr>
<tr>
<td>Retail to carry more inventory in larger sizes</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>Dress clothes</td>
<td>4</td>
<td>13</td>
</tr>
<tr>
<td>Apparel that stretches for range or motion</td>
<td>4</td>
<td>13</td>
</tr>
<tr>
<td><strong>Apparel Comfort</strong></td>
<td><strong>70</strong></td>
<td></td>
</tr>
<tr>
<td>Is not too tight</td>
<td>21</td>
<td>70</td>
</tr>
<tr>
<td>Has range of motion</td>
<td>11</td>
<td>37</td>
</tr>
<tr>
<td>Has adequate coverage</td>
<td>10</td>
<td>33</td>
</tr>
<tr>
<td>Is soft</td>
<td>10</td>
<td>33</td>
</tr>
<tr>
<td>Feels like sweatshirts and T-shirts</td>
<td>10</td>
<td>33</td>
</tr>
<tr>
<td>Is not too loose</td>
<td>9</td>
<td>30</td>
</tr>
<tr>
<td><strong>Aesthetics of Apparel that Fits</strong></td>
<td><strong>56</strong></td>
<td></td>
</tr>
<tr>
<td>Desired styles or brands not available in her size</td>
<td>18</td>
<td>60</td>
</tr>
<tr>
<td>Designed for older women</td>
<td>15</td>
<td>50</td>
</tr>
<tr>
<td>Must wear boy’s or men’s apparel for fit</td>
<td>12</td>
<td>40</td>
</tr>
<tr>
<td>Settle for apparel she does not like</td>
<td>11</td>
<td>37</td>
</tr>
<tr>
<td><strong>School and Apparel</strong></td>
<td><strong>56</strong></td>
<td></td>
</tr>
<tr>
<td>Wants apparel to fit and cover body</td>
<td>22</td>
<td>74</td>
</tr>
<tr>
<td>Does not feel as fashionable as peers</td>
<td>20</td>
<td>67</td>
</tr>
<tr>
<td>Wants fashionable stylish apparel</td>
<td>10</td>
<td>33</td>
</tr>
<tr>
<td>Expressed concerned about daughter being teased about her apparel</td>
<td>4</td>
<td>13</td>
</tr>
<tr>
<td><strong>Apparel Concerns</strong></td>
<td><strong>40</strong></td>
<td></td>
</tr>
<tr>
<td>Comfort</td>
<td>16</td>
<td>53</td>
</tr>
<tr>
<td>Cost</td>
<td>14</td>
<td>47</td>
</tr>
<tr>
<td>Style</td>
<td>10</td>
<td>33</td>
</tr>
<tr>
<td><strong>Extracurricular Activities and Apparel Needs</strong></td>
<td><strong>32</strong></td>
<td></td>
</tr>
<tr>
<td>Plays on sport team</td>
<td>14</td>
<td>47</td>
</tr>
<tr>
<td>Required apparel has prevented her from engaging in desired activity</td>
<td>11</td>
<td>37</td>
</tr>
<tr>
<td>Required special order of uniform size</td>
<td>7</td>
<td>23</td>
</tr>
</tbody>
</table>
Table 5. Relationship between participant characteristics and sub-themes (N=30).

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Sub-Theme</th>
<th>Total Responses</th>
<th>$X^2$</th>
<th>df</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in years</td>
<td>Too short in bodice exposing skin</td>
<td>3</td>
<td>13.24</td>
<td>5</td>
<td>.02</td>
</tr>
<tr>
<td>Thirteen</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fourteen</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fifteen</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sixteen</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age in years</td>
<td>Often has spillage, flow over, or muffin tops</td>
<td>2</td>
<td>12.86</td>
<td>5</td>
<td>.03</td>
</tr>
<tr>
<td>Fifteen</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sixteen</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age in years</td>
<td>Does not shop online or catalog because cannot try on for fit</td>
<td>4</td>
<td>11.38</td>
<td>5</td>
<td>.04</td>
</tr>
<tr>
<td>Twelve</td>
<td></td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thirteen</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fourteen</td>
<td></td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fifteen</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sixteen</td>
<td></td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seventeen</td>
<td></td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade in school</td>
<td>Too tight at upper chest and armseye</td>
<td>2</td>
<td>13.18</td>
<td>6</td>
<td>.04</td>
</tr>
<tr>
<td>Sixth</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eighth</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ninth</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eleventh</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Twelfth</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethnicity</td>
<td>Must try on apparel in store to ensure fit</td>
<td>23</td>
<td>30.00</td>
<td>5</td>
<td>.00</td>
</tr>
<tr>
<td>White/European American</td>
<td></td>
<td>23</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White/European American &amp; African</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>American/Black</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>American/Latina</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>African</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>American/Black</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>African</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>American/Black</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indian/ Native</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI Percentile</td>
<td>Does not feel as fashionable as peers</td>
<td>17</td>
<td>12.61</td>
<td>5</td>
<td>.02</td>
</tr>
<tr>
<td>&gt; 95</td>
<td></td>
<td>17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>93</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>86</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. $p < .05$; Only significant findings reported in table.
Findings by Research Questions

In this section, each research question is discussed separately integrating the findings from both the quantitative and qualitative data. Quotes from interviews are included and referenced by the participant number assigned during the research appointment. When a participant is quoted, it is designated by [P followed by her participant number]; when a mother is quoted it is designated by [M followed by the participant’s number]; when a grandmother is quoted it is designated by [G followed by the participant’s number]; when a father is quoted it is designated by [F followed by the participant’s number]. When a word is added within a quote for clarification, it is designated as [clarifying word].

Unpublished research data (Unpublished research data) when referenced in this section refers to participant characteristic data collected from the Interview Instrument (see Appendix J) and is specific to a participant. Participant body weight, height, age, ethnicity, and grade in school are not disclosed in this dissertation. This information was only used in connection to group statistics to further protect the identity of the participant and does not compromise the findings in this chapter. However, in certain instances it was necessary to disclose a particular characteristic of a participant to clarify research findings. Referencing (Unpublished research data) informs the reader that the participant specific characteristic used in the discussion does not appear on a table or figure within the dissertation.

Research Question 1: Do the anthropometric measurements of plus-size female teens aged 12-17 years participating in this study fit into any of the current standardized sizes published by ASTM?

Research question 1 was answered by examining (1) the participant’s individual differential measurements in combination with interview data and (2) the average differential measurements for all participants. All participants were assigned to an ASTM apparel
category and size based upon their key measurements of bust, waist, and full hip measurement (see Table 2); however, individual deviations from the ASTM standardized measurements occurred at various locations for all participants (see Table 3). Participants’ 20 and 3 had individual measurements with the greatest deviation from ASTM standardized sizes in circumference and length measurements, respectively. A deviation of 11.17 inches was observed in the waist circumference measurement of P20 for the ASTM apparel category and size that most closely aligned to her other measurements. This indicated that apparel for the upper body in the standardized size would fit her at most locations but, the waist would be 11.17 inches too small. P3 had an arm length deviation of 8.55 inches from her ASTM standardized size indicating that when she purchased apparel for her upper body the arms would be 8.55 inches too long. A difference of 8.55 inches in arm length seemed excessive to the researcher so the original scans were checked for accuracy. All three of the participant’s scans recorded an excessive deviation from the ASTM standardized arm length for her category and size. Visual inspection of her data cloud shown in Figure 9 does not reveal an excessively short arm length. However, the participant does have full rounded sloped shoulders and the body scanner may have experienced difficulty locating shoulder landmarks and recorded an inaccurate measurement as it has been reported with plus-sizes (Han et al., 2010; Leong et al., 2007).

In 80% of the interviews, participants reported garments fitting at one location and not at another as their number one fit issue (see Table 4). While discussing the difficulty a 14 year old has experienced finding tops that fit well, both she and her mother identified apparel proportions as the root cause:
With a bigger stomach it is hard to find clothes because things are tighter and they don't fit right and so if you go up a size it will be too big and it won't lay right. [P16]

It becomes too big in the bust line but it fits in the waist. Or it's too long and then it's out of proportion. Or it's too big in the shoulders... and that means if she gets one that fits her in certain places then it doesn't fit elsewhere. And if she goes up a size it fits where it was snug but it's too big elsewhere. [M16]

P16 had key measurements which placed her in the ASTM category of Women’s size 22 (see Table 3). This size, although being the closest fit for her waist and full hip, has a differential bust measurement of 7.3 inches indicating the apparel was designed for someone with a bust circumference measurement approximately 7 inches larger than hers. Additionally, the Women’s category is specified for the adult female plus-size figure type which is assumed to be a fully developed adult requiring a larger bust circumference (Keiser & Garner, 2008). P16’s bust circumference measurement aligned to the Juniors category size 17; however, both her waist and full hip circumferences were 6 inches larger than a Juniors 17. A solution that P16 found to address her fitting issues with tops, a strategy not previously reported in the literature, was disclosed by her mother:

Girls who have a large abdomen will actually go into the maternity section to find T-shirts or pants because they fit better. They have the stretch, they have the flexibility, they are cut differently to accommodate that. Teenagers shouldn't have to do that. [M16]

While maternity tops may accommodate a larger waist without greatly increasing the upper chest area, this is not the optimal solution for a 14 year old. P16 was among the group of girls who wore Women’s size 22 (see Figure 10). The girls within this category and size reported different fit issues related to their varying body shapes. A visual examination of
P16 data clouds in Figure 10 show her abdomen protruding more than P9 and P6 who reported different fitting issues with the same category and size of apparel.

Unlike P16, P9 reported that she experienced her primary fitting issues in the bust and upper chest area. Regarding body shape and the issue of apparel fitting in one area and not another, the mother of P9 had the following comment:

*Clothing seems to be in a straight line, very narrow, there is no give and take for any kind of shape. So you might find something where the neckline is great and in the bust it's way too tight, or vice versa, the bust might work and then is so tight around the middle it shows everything and you're not comfortable wearing that.* [M9]

P9, whose measurements placed her in a Women’s 22 shown in Table 3, had a neck base measurement that was 1.8 inches smaller than the standard neck base for a Women’s 22. However, her bust circumference was .88 inches and waist circumference 2.73 inches larger than the standard measurement. This accounts for her difficulty in finding tops fitting in the neck and upper chest while accommodating a larger bust and waist.

Another girl who wore Women’s 22 is P6 shown in Figure 10. She experienced difficulty with tops being long enough in the torso. Her mother commented:

*She’s so long waisted, to cover the bust area she has to go a size or two bigger to make sure it's long enough and wide enough across the bust area. God forbid that we would have to find a button-down shirt because she would swim in it.* [M6]

P6 had a center back waist length 2.26 inches longer than the ASTM standardized length for Women’s 22; however, her bust circumference only differs by .57 inch (see Table 3). Therefore, as she has found from experience, when the current standardized measurements are used to design tops, she will experience an acceptable fit in the bust and upper chest but the top will be too short.
Fitting issues related to individual differential measurements and body shapes are not restricted to tops. Pants appear to account for many of the differential fit issues experienced, with 77% of participants specifically mentioning jeans during interviews (see Table 4). The mother of P7, another girl who wore Women’s 22, observed, “It's hard to find clothes for her because she's so particular to fit in because the way her body shape” [M7]. P7 cited length measurements to be an issue, “If I get bigger pants, they're longer, so I have to roll them up because I'm short” [P7]. Her mother added, “Petite is too short and average is too long” [M7]. P7 had a differential waist height measurement of 2.40 inches shown in Table 3) indicating the pants which she purchases to accommodate her circumference measurements are designed to fit a person over 2 inches taller than her. A similar comment was made by the father of P12:

*The biggest challenge is pants like the other day we went to shop at JC Penney’s. If she can't find anything in the preteen size or the larger kid’s size we have to go to the women's section and if we are lucky enough to find something in short then that's the trade-off. The waist size doesn't match up between the kid's dimensions and the adult dimensions… We actually did buy her a pair of adult pants that fit her, but the trade-off was the length because the adult ones were probably 2 inches taller than the kid’s size but they fit her comfortably in the waist.* [F12]

P12 was a 12 year old (Unpublished research data) who the apparel industry assumes will wear an apparel size within the Juniors category (Keiser & Garner, 2008). Her key measurements, however, placed her in the Misses 18 apparel size. Her differential waist height measurement was 5.17 inches shown in Table 3, indicating the pants were designed to fit a person approximately 5 inches taller than her.

Within a given apparel category and size, body shape was found to affect the participant’s experience with apparel fit, comfort, and satisfaction with apparel. A visual
inspection of the 3D data clouds of the six participants who wore Women’s 22 shows a sample of the various body sizes and shapes which can exist within a given category and size (see Figure 10). Although not evident from viewing the 3D data clouds, these girls ranged in stature from 65.75-69.00 inches tall. This height difference of 3.25 inches was reflected in P6 and P7 experiencing opposite fitting issues related to length. Bust circumferences of the girls in this group ranged from 40.20-48.38 inches, with waist measurements of 39.30-46.18 inches, and full hips circumferences ranging from 46.43-49.44 inches. This 8.18 inch difference in bust, 6.88 inch difference in waist, and 3.01 inch difference at the full hip between girls who wear the same category and size of apparel reflects the size and shape variation which can exist within a given ASTM standardized apparel category and size and confirms the findings of previous research (Connell et al., 2006; Deckert, 1999; Devarajan, & Isto, 2004; Faust et al., 2006; Mpampa et al., 2010).

An examination of participants’ average differential measurements reveals that, as a group, participants have both circumference and length measurements that deviate from the ASTM standardized measurements (see Figures 6 and 7). On average, 11 circumference measurements shown in Figure 6 and three length measurements shown in Figure 7 deviated from ASTM standard measurements by 1 inch or greater.

The finding of this study concludes that the anthropometric measurements of plus-size female teens aged 12-17 years participating in this study does not fit into any of the current standardized sizes published by ASTM. Both the quantitative and qualitative data support a misalignment of anthropometric measurements between the plus-size female teens aged 12-17 years participating in this study and ASTM standardized measurement for apparel.
Research Question 2: Are plus-size female teens aged 12-17 years satisfied with the fit of apparel available to them?

Female teens generally enjoy shopping for apparel, especially with friends (Meyer & Anderson, 2000), and participants in this study expressed positive emotions towards shopping despite the trouble they experienced finding apparel that fit. When asked what they liked about apparel shopping, participants commented: “Everything, I like being around clothes” [P17]. “I like clothes shopping. You get new clothes and get to try on a lot of things” [P13]. Chen-Yu and Seock (2002) concluded that recreation and social interaction were strong motivations for apparel shopping among female teens. This conclusion was echoed by P8 when she described her apparel shopping experiences:

*I like clothes shopping. It's fun. I don't like that sometimes it's hard because you can't find stuff that you need, clothing that you need. But, I like clothes shopping. I think my favorite part about it is you get to go usually with family or friends and be together, however long, a few hours in a day. It's a pleasant experience.* [P8]

However, not all participants expressed positive emotions towards their apparel shopping experiences, with 37% of participants mentioning negative emotions related to apparel shopping (see Table 4). Plus-size teens expressed frustration in locating apparel that fit and 33% of participants reported they did not make a purchase because they were unable to find something that fit (see Table 4). P30, who wore a Misses size 20 shown in Table 3 stated, “Sometimes [I] just go home with no clothes because you can't find something that fits your size” [P30]. P29 whose measurements place her in ASTM Women’s size 30 had this to say about her apparel shopping experiences:

*I don't like clothes shopping because I feel like nothing ever fits. I feel like I always see things that are like really cute and something I'd like to wear but like they don't have it in my size. So, I've never liked clothes shopping.* [P29]
P22 and her mother made these comments regarding the difficulty experienced when shopping for apparel that fits, “I usually just give up and say that I don't need anything” [P22]. Her mother added “I would be happy to take her out shopping but it is a very frustrating day” [M22]. P22 was among the 47% of participants shown in Table 2 whose measurements require her to wear apparel in the Women’s category (see Table 3).

Another participant, whose measurements required she wear apparel in the Women’s category shown in Table 3, explained why she did not enjoy apparel shopping, “It's disappointing, you set your hopes on this [garment] would look so good and then you put it on and it doesn't fit right…I usually either don't get it or compromise” [P16]. The fit and experience a teen has with the apparel available to her may be related to her apparel category and size. Both P8 and P17 who expressed positive emotions towards apparel shopping were among the 19% whose measurements permitted them to wear apparel in the Juniors category (see Tables 2 and 3). In contrast, P22 and P16 who reported negative experiences had measurements that required them to wear apparel in the Women’s category shown in Table 3.

The inability to find apparel with a satisfactory fit can lead to clothing deprivation the feeling of not having enough clothing to be satisfied (Francis, 1990). In this study, 47% of participants had measurements that required them to wear apparel in the Women’s category (see Table 2). Several of these participants identified fit related issues as the cause of their clothing deprivation. The reason P5 gave for why she felt deprived of apparel was: “I don't really have a big wardrobe because I can't find anything that fits me perfectly so I don't do anything” P23 made a similar comment: “Jeans I like, I don't fit into and then it kind of upsets me but I deal with it” [P23]. Previously unreported in the literature, 13% of participants confided that they had to purchase their apparel at resale stores or borrow needed
items because they were not able to find new apparel in the store that fit. P9, wears a Women’s size 22 shown in Table 3 explained that although she would prefer to purchase new apparel from the store, “Sometimes we will get really lucky, like we went to Goodwill and we each got five shirts… I don't particularly like Goodwill” [P9]. P21 wore a Misses size 20 (see Table 3) and experienced fit issues related to her body shape. Her mother related, “A lot of times she just wears hand-me-downs. For Christmas, she wanted longer pink shorts and we had to special order” [M21].

Clothing deprivation has also been defined as discontent with clothing in relation to peers (Francis, 1990). Discontent with the fit and brands available to plus-size teens in the Women’s category shown in Table 3 was expressed by both participants and family members. Plus-size teens can experience apparel deprivation with regards to the fit of desired brands:

*There are kids that wear the Miss Me jeans and they are specifically made for smaller people, so then it's kind of unfair. And then there are different stores that just don’t have sizes for bigger teenagers. Like, I went to Aeropostale yesterday, and everything was either medium or small. And then it was like, okay, I really don’t fit in here.* [P4]

P29 related several fit issues she has encountered and disclosed how her negative experience with apparel fit has resulted in her no longer trying to obtain the apparel similar to peers that she desired:

*I feel like if I was to follow most people's fashion it would be the brand Miss Me jeans and things. I don't think they carry them in the size that I would be able to wear at all. I don't know because I've never looked, but I'm pretty sure if I had to follow, try to find things that most people own in my grade, it wouldn't work out at all. I don't think they have sizes like that.* [P29]
Family members also expressed concern that their teen suffered clothing deprivation due to fitting requirements. The mother and grandmother of P7 expressed their dissatisfaction with the fit and styles of apparel available to plus-size teens. Her grandmother who explained that she often shopped for apparel with the participant commented, “I just wish they would make clothes that would be decent for everybody all the way around. Plus-sizes are just hard to find” [G7]. The participant’s mother added, “she has been in plus-sizes since she was in elementary school. There were no jeans that fit her, none, she was always in stretch pants” [M7].

The relationship between a plus-size female teen’s satisfaction with the fit of apparel available to her may be related to her BMI and apparel category. As the teen’s BMI increases, she becomes less aligned with the ASTM standards for the Juniors apparel category, which is designed and fit for an immature female body, and must move into either the Misses or Women’s category (Keiser & Garner, 2008). Additionally, a teen’s body is not proportioned the same as an adult (Connell & Ulrich, 2005).

In this study, participants who expressed positive experiences and emotions towards shopping for apparel items providing an acceptable fit had BMI percentiles lower than those who expressed negative experiences and emotions about the apparel shopping process. The participants with lower BMI’s were able to wear apparel in the Juniors category and, therefore, may experience less fit issues, as this apparel category is proportioned for an immature body. The Juniors category also contains the brands and styles targeted to that peer group (Keiser & Garner, 2008) which may explain the more positive attitude towards apparel shopping. However, the plus-size teens who were able to fit into the Juniors category still encountered difficulty locating apparel with an acceptable fit, as indicated by P8’s earlier
comment when she said, “…sometimes it's hard because you can't find stuff that you need, clothing that you need…” [P8].

Market World Research concluded that online shopping lacked the social aspects female teens desire and this is why they shop online less than boys (Teens slowly increase, 2011). This may not be the reason plus-size teen girls prefer to shop for apparel in stores. Ninety-seven percent of participants said they must try on a garment to ensure it has satisfactory fit and 80% gave this as the reason they do not shop online or from catalogs (see Table 4). The participant’s age was found to be related to her not shopping for apparel online or in catalogs, with the majority of participants being 14 -17 years of age (see Table 5). P1, who wore a Women’s 22 shown in Table 3, explained how difficult it was for her to find jeans that fit. Her mother estimated the number of pairs she must try on to find an acceptable fit, “usually a 10 to 15 process to just get a couple” [M1]. The mother of P9 who wore a Women’s 22 shown in Table 3 explained why they did not shop online for her daughter’s apparel, “To me, it's a waste of time not to go to the store, buy something online, have it sent to you, and 9 out of 10 times it's not going to fit right” [M9].

Currently, in the U.S. there is no legal requirement that apparel sizes correspond to specific anthropometric measurements (Keiser & Garner, 2008; Park et al., 2009). Size discrepancy between brands can cause additional shopping issues for plus-size female teens, as it may not be easy to discern what size will fit, and 97% of participants said they must try on garments in the store to ensure fit. The need to try on multiple garments, or go to multiple stores to find apparel that fits, was mentioned by 57% of participants. Finding the correct size while in the store was described as a process of elimination:
Well this one might not fit so we would take another one too, and then we would just try them on in order ‘til we found the one that fit. Cause sometimes even by brand it varies. A large in one brand is not necessarily a large in another brand. [M15]

Shopping for a plus-size teen can be just as frustrating for family members as for the teen herself. The mother of P5, a girl whose measurements placed her in the ASTM Women’s apparel category size 26 shown in Table 3, explained why she could not shop for her daughter without being present:

Like, Rider jeans and Lee jeans, both size 16, there is no way we would fit into a 16 on the Riders, but on the Lees they would. Old Navy, no way... you've got, this is size 15 in this brand in this is size 15 in this brand, and there is a 10 inch difference. [M5]

The grandmother of P12, a girl whose measurements placed her in the ASTM Misses 18 (see Table 3), related her difficulty purchasing apparel as a gift for her granddaughter and identified store and brand size discrepancies as the cause, “Different sizes in different stores, like maybe a 16 might fit in JC Penney's, but you would have to have an 18 at Maurice's” [G12].

Findings of this study suggest that the degree of satisfaction with apparel fit may be related to the teens BMI and apparel category. Participants whose anthropometric measurements permitted them to wear apparel in the Juniors category conveyed a more positive attitude towards shopping for apparel that provided a satisfactory fit. However, participants in both the Junior and Women’s apparel categories expressed varying degrees of dissatisfaction with the fit of apparel available to them. Part of this dissatisfaction may be related to the uncertainty of apparel sizing and the need to find the best fit through a process of elimination. Therefore, based upon these findings, research question 2: Are plus-size
female teens aged 12-17 years satisfied with the fit of apparel available to them? appears to be no.

Research Question 3: Does the ready-to-wear apparel available to plus-size female teens aged 12-17 years satisfy their functional, expressive, and aesthetic wants and needs?

This research question was answered by examining functional, expressive, and aesthetic wants and needs separately. A conclusion was made as to whether the participants were satisfied with individual aspects (i.e. functional, expressive, aesthetic) of the apparel available to them. A conclusion was then made as to whether, in general, participants are satisfied with the functional, expressive, and aesthetic attributes of the apparel available to them.

Functional Aspects of Apparel. Lamb and Kallal’s (1992) Functional, Expressive, and Aesthetics (FEA) Consumer Need Model defines the functional aspects of apparel as garment fit, comfort, range of available motion, ease of dressing and undressing, and the protection it offers. The protection apparel offers can include physical protection from the elements, and psychological protection which permits the wearer to adorn her body, ensure a degree of modesty (Marshall et al., 2004). Both physical and psychological protections provide comfort to the wearer (Francis, 1990). This section discusses participants’ experiences regarding functional aspects of their apparel. It also contains insight into why plus-size female teens prefer certain types of apparel and discloses information not previously found in the literature.

Comfort is a functional aspect of apparel that has been shown to be related to self-esteem and an important factor in apparel satisfaction for plus-sizes (Daters, 1990; Francis, 1990). In this study, 53% of participants mentioned apparel comfort as a primary concern
Although the word ‘comfort’ often appears in the literature when describing apparel, no studies were found that investigated how plus-size teens define ‘apparel comfort’ or what apparel comfort means to them.

To gain insight into how plus-size teens define comfort in relation to apparel during the interview participants were asked: What does “comfortable clothing” mean to you? The comments made by P18 and P27 summarized the information gathered in this study. Connecting comfort to physical and psychological protection, P18 commented, “Comfortable clothing is something that I can move around in and be free instead of having to worry is my shirt too low, is my back showing, is the skirt too short” [P18]. P27 mentioned the tactile sensation of comfortable apparel and related this to the range of motion it provides when she gave her three definitions of apparel comfort, “One, not itchy, two, not ridiculously tight so it's cutting off all circulation and then three, sweatpants in general, can't we wear sweatpants and be considered attractive? Why can't we have the best of both worlds?” [P27]. Similar definitions of comfort were used by other participants throughout the study with regards to functional attributes of their apparel.

Included in participant’s description of comfort were “not ridiculously tight” [P27] and “move around in” [P18]. From an apparel industry viewpoint, this is referring to the garment providing adequate wearing ease, which facilitates range of motion (Beazley, 1999; Gill, 2011). As shown in Table 4, adequate range of motion was cited by 37% of participants as interfering with the comfort of a garment and 33% also described it as a fitting issue. Apparel fitting too tightly was also mentioned by 70% of participants. The participant’s grade in school was associated with comments that her apparel was too tight at the upper chest and armscye (see Table 5). In the U.S., persons of the same age are generally in the
same grade in school, however, apparel fitting too tight at the upper chest and armseye was not associated with age. Additionally, the small sample size of this study does not permit any conclusions to be drawn concerning a relationship between grade level and this fitting issue.

Not previously discussed in the literature, interviews uncovered that plus-size female teens often must wear boys or men’s apparel for functional reasons. Forty percent of participants disclosed that apparel in the women’s department did not provide adequate ease and range of motion and they needed to purchase at least some of their apparel in boys or men’s department out of necessity, not by choice (see Table 4). The need to wear male apparel to obtain the necessary garment ease may lead to misconceptions about the plus-size teen’s interest in fashion and her appearance. Rutherford-Black et al. (2000) found that college students regarded overweight students as being less concerned with fashion and designer labels. Cornette (2011) reported that high school teachers viewed their plus-size students as unkempt. This perception may in part be based upon the apparel available to plus-size female teens that accommodate their functional needs as related by one participant:

*The only way to get it bigger is if you get the boys shirt. I don't want the boy's shirt, I want a girl's shirt, but bigger...There's a difference between a man's T-shirt and the girls T-shirt. You can tell when you look them. Say you went to a store and were looking for sports shirts. You can see that there is a more feminine shirt and more masculine sport shirts and I would go towards the masculine because they're not as form fitting.* [P14]

P14’s measurements placed her in the ASTM Women’s category size 30 (see Table 3). Her comment of desiring feminine and fashionable apparel refutes the assumption made by the participants in Rutherford-Black et al. (2000) study that plus-size girls are not interested in fashion. It should be noted that ASTM Women’s 30 is next to the largest size available in female apparel and, therefore, her choice of male apparel, as she stated, is not based on
personal style, but out of necessity. Another participant who wore Women’s size 30 shown in Table 3 also found she needed to wear men’s apparel out of necessity rather than by choice, “I can't buy the girls T-shirt, I have to buy the guys. And I have to buy the guys pants from there because the girl’s sizes don't go any bigger” [P29].

The need to wear boy’s or men’s apparel to obtain the needed ease and facilitate range of motion is not restricted to persons in the upper end of the Women’s sizing chart. Body shape and weight distribution may be a factor in the increased comfort found in the cut of male apparel. Even plus-size teens whose measurements permit them to wear apparel in the Juniors category (see Table 3) can experience difficulty with certain types of female apparel and find it necessary to wear men’s:

I can't really wear girl’s or women's [socks] because they have smaller ankles usually, too narrow, so I wear men's socks. It doesn't bother me that much. Sometimes you want fun colored socks and men have white socks. Men’s are white and black. [P8]

Apparel fit in the upper arm and bust were mentioned as restricting range of motion in 50% of interviews (see Table 4). A participant whose upper arm circumference was 1.02 inches larger than the standardized size (see Table 3) made this comment about why she wore men’s shirts, “They fit better than the girls because with the girls [unless] you have teeny tiny arms they don't fit” [P6].

Apparel, appearance, and peer approval are of particular concern to young women during their teen years (MacGillivray & Wilson, 1997). One mother made this comment concerning her daughter’s need to wear men’s apparel for functional reasons:

It seems like you can buy men's clothes for a while to fit because they fit better, but kids get made fun of at school if they're not wearing the garments of a girl. When you're younger it's one thing but as you get older it's really important that you have clothes that fit. [M20]
Fashionable apparel permits teens to manage their appearance (Kidd, 2006) and change peer group associations (Eicher et al., 1995). In addition to wearing boys or men’s apparel, participants found they needed to wear t-shirts and sweatpants to achieve the necessary comfort and range of motion. P7, whose measurements placed her in a Woman’s 22, (see Table 3) was asked how she would describe comfortable apparel. She said, “Sweatpants, because I really can't find any other comfortable clothes” [P7]. Participants related that wearing T-shirts and sweatpants was not always their desire, nor did it create the public image they wanted. Wearing T-shirts and sweatpants were often a compromise between what they wanted and what fit, as participant 14, who wore Women’s size 30 (see Table 3) explained:

> My peers wear more fashionable clothing...If I'm looking for typical clothing that girls my age would wear, if I don't find anything, then I'm just like, okay I wouldn't wear it anyways, and then I go to someplace that just sells T-shirts and sweatpants and I just get that...It's not the most fashionable thing. [P14]

The mother of P1, a girl who wore Women’s size 22 (see Table 3), was concerned that her daughter was unable to wear apparel as stylish as her peers. She identified fitting issues as the reason her daughter often wore t-shirts and sweatshirts:

> Because of the fit issue she finds comfort in T-shirts and sweatshirts. Of course her parents would like to see her wear not so many of, but that's a comfort factor and I'm sure could she find stylish tops that perhaps her peers are wearing that fit her well and flattered her, she would probably wear those. [M1]

Functional fitting issues related to apparel ease and range of motion appear to be a primary reason why 33% of participants mentioned sweats and T’s when describing comfortable apparel. Although comfortable, these apparel items do not always present the
public image the teen desires, as P27 has discovered, “A woman just cannot go to school in sweatpants and just look amazing. It's impossible, I've tried” [P27].

Adequate coverage is another way plus-size teens defined apparel comfort. Descriptions, like not having to “worry is my shirt too low, is my back showing, is the skirt too short” [P18], or that apparel “should hold you in more” [P29], were used to describe the functional aspect of adequate coverage. Apparel that provides adequate coverage is a type of psychological protection, as it affords the wearer a degree of modesty (Marshall et al., 2004). Adequate coverage was mentioned by 33% of participants as being related to the comfort of apparel (see Table 4). The participant age was found to be related to two of the sub-themes dealing with adequate coverage (see Table 5). Participants using terms such as ‘spillage, flow over, or muffin tops’ to describe how their apparel fit were 15-16 years of age (see Table 5). Participants who specifically mentioned ‘too short in bodice exposing skin’ ranged in age from 13-16 years (see Table 5).

When participants were asked what was most important to them about the apparel they wore to school, 74% related that they wanted their apparel to fit and cover their body (see Table 4). Comments included “If I don't have to worry about pulling my pants up every 5 seconds” [P7] and “It fits, because everybody always want a slimmer look and if pieces of your body are hanging out it's not attractive. So you just kind of want to make sure that everything is contained” [P4].

Two mothers identified inadequate length of female shirts as the reason why their daughters needed to wear men’s shirts. Participant 6 had a back waist length 2.26 inches longer than the ASTM standard measurement for her apparel size (see Table 3) and her mother commented, “To find T-shirts she will get men's clothes because they're longer”
The mother of P27, who had a center front waist length 2.52 inches longer than the standard for her size shown in Table 3, related, “We buy a lot of guys T-shirts and sweatshirts…they’re longer” [M27]. In addition to plus-size teens and their parents being concerned about their apparel providing adequate coverage, one mother who was a teacher explained that adequate coverage for plus-sizes has become a school administration issue. She related her experience with the plus-size students and their parents in her third grade class:

I'm a teacher and even in school, we have to say to the kids over and over again, usually the plus-size ones, pull your shirt down…I teach third grade and we have a lot of girls that we have to remind all the time to pull their pants up or pull their shirts down. And in talking with parents, they have tried multiple different things to get coverage for the girls but they're running into problems as well, with plus-size girls finding pants that cover or shirts that are long enough to cover. So, we are constantly reminding them and talking to them about having to cover their rear…Last year I had a student that had notes [left on her desk] about her butt showing or, 'pull your pants up', or 'pull your shirt down', and so we had to have conversations with parents about that too. [M27]

School is not the only place plus-size teens experience difficulty finding apparel that fits and is similar to their peers. Participants and their families related functional issues which have arisen with apparel worn for extracurricular activities including sports teams, band, dance classes, and special events. Forty-seven percent of the participants were members of a sport team and 23% found that they had to order a special size uniform due to fit issues (see Table 4). The teens related embarrassing situations that occurred regarding the fit and procurement of team uniforms, including not being able to obtain a uniform that matched the rest of the team, or needing to wear a male uniform to accommodate their apparel fit requirements. The mother of P9, a girl whose measurements placed her in Women’s size 22 apparel (see Table 3), discussed how the special ordered uniform that
accommodated her daughters fitting requirements did not match her teammates, “the school
had to order a special size for her and for the volleyball uniform, they have the size that fit
her, but it did not match the rest of the girls” [M9]. P20, who wore a Women’s size 32 (see
Table 3), and her mother, described the experience they had trying to purchase a team jersey
for softball:

_We had ordered the size, and it came a size smaller, and I don't know what
kind of fabric it is but it's tight and doesn't stretch whatsoever._ [P20]

_Actually we compared a 3X to a large and it wasn't any bigger than the
large. It was like they just sewed a different tag in it and it didn't fit... We
complained to the softball league and I don't know if they complained
to the company or not, but we did get another shirt that was bigger, but
still wasn't comfortable. They were cut and it had a female cut to it, short
shoulders and dived way in and flared out the waist. Obviously, if you are
ordering a 3X it doesn't need to flare in. There's a reason you're ordering
a 3X. It was annoying._ [M20]

_I wore a jersey of the same color that we had found at a garage sale._
[P20]

Another female teen was faced with purchasing a garment from the boy’s department
for functional reasons. P21, whose high and full hip measurements were more than 2 inches
larger than the ASTM standard measurement for her size (see Table 3) related her experience
in the store when she went to purchase her team uniform, “They order the uniforms, the
practice shorts. I went to Scheel’s to get them and they had two options and then they said
you have to go to the boys section if you want wider shorts” [P21]. Fit issues with team
uniforms and the need to wear male apparel for ease and range of motion are not confined to
girls whose measurements place them in an adult female apparel category. Body shape and
apparel fit also appear to be an issue for plus-size girls who can wear apparel in the Juniors
category. P24, whose measurements permit her to wear apparel in the Juniors category (see
Table 3), and her mother, discussed the embarrassing and frustrating incident that took place in the school locker room when the team uniforms arrived and were distributed:

The shirt wouldn't fit over my boobs and the pants wouldn't fit over my butt...Everybody in my school is like twigs and stuff so they brought in smalls and mediums, and I'm like, I'm not going to fit in those. It was not a good day for me. I fit in one of the girl’s; it was a large or extra-large. I think it was a large shirt and extra-large pants, because I have a big butt apparently. [P24]

She had to get boys [uniform]. [M24]

There is a positive relationship between teens being comfortable and satisfied with their apparel and social participation, group membership, and engaging in activities (Francis, 1992; Kelley et al., 1974; Ryan, 1966). Apparel concerns can prevent a teen from engaging in a desired activity (Ryan, 1952, 1953) and 37% of participants said the uniform requirements for school related activities prevented them from seeking membership (see Table 3). P28 who was a cheerleader last year commented: “I wanted to do cheerleading this year, but like all of the girls at my school are really tiny, they usually don't have bigger sized things to wear” [P28]. P6, whose measurements placed her in a Women’s 22 (see Table 3) desired to play sports, but declined because she could not wear the same uniform as the rest of the team,

I want to play sports but all of the little skinny people are on the teams, I would feel really out of place if I had to wear basketball shorts and a T-shirt to the game when they are wearing short tank tops and shorts. [P6]

P4, who wore a Women’s 24 (see Table 3), also desired to play sports but declined because the team uniforms did not provide adequate coverage to make her feel comfortable in public. When asked if she would try out for the team if the uniforms offered more body coverage, replied “I think maybe” [P4].
The functional aspects of apparel include fit, comfort, range of motion, and protection. For a garment to provide satisfactory function, it must be sized, graded, and designed with an accurate understanding of the target customer (Connell & Ulrich, 2005; Deckert, 1999; Farmer & Gotwals, 1982). In this section, participants described apparel fit issues that interfere with their comfort, range of motion, and protection. Both participants’ anthropometric measurements (see Table 3) and their interview quotes indicate the plus-size female teens in this study are not having their functional needs met by the apparel available to them. Therefore, the answer to the functional section of research question 2 is no. The ready-to-wear apparel currently available to plus-size female teens aged 12-17 years does not satisfy their functional wants and needs.

**Expressive Aspects of Apparel.** The expressive aspects of apparel, as defined by the FEA model, are concerned with the wearer’s ability to express values, status, roles, and self-esteem through the apparel she wears (Lamb & Kallal, 1992). Apparel which permits self-expression and experimentation is an important part of adolescence, as it helps individuals to discover their interests and place in society (Engle et al., 1995; Farmer & Gotwals, 1982).

School has its own culture and social stratification which dictate acceptable apparel styles and behavior for many adolescents (Eicher et al., 1995; Horn, 1968). To fit in with a certain peer group, an adolescent will adopt the group’s values, behaviors, and apparel style preferences (Schiffman & Kanuk, 2004). Participant 5, who wore a Women’s 26 (see Table 3), and expressed frustration with the styles of apparel available in her size, described this phenomenon as:

*There are like popular people and whatever they like to wear is basically with they think everybody else should wear. It’s kind of like a thing where*
This need to conform to the group norm for apparel style and fashion was reiterated by others. P22 who wore a Women’s 22 (see Table 3) described the most important aspects of the apparel she wore to school as, “Style and comfort, because if you wear something that's not really ‘in’ other girls make fun of you. I don't really want to be made fun of so I worry about style and comfort most” [P22]. P25 wore a Misses 16 (see Table 3) and commented, “I base what I like and buy on what other people like because I can get made fun of for not wearing the right thing. There are certain groups of girls who expect people to wear certain brands of clothing” [P25].

Brand labels play an important role in the establishment of status and conveying one’s values to others in a school setting (Abercrombie, 2013; Stossel, 2012). However, many of the brand names that teens associate with status do not provide sizes large enough for plus-sizes. P16 who wore a Women’s 22 (see Table 3) said, “I would love to wear any of the jeans that they have at Hot-topic because they are so bright colored and they are so fun, but they're made for people who are like twigs” [P16]. P14, whose measurements required for her to wear a Women’s 30 (see Table 3), and her mother, discussed many of the brands that carry status value in her school and her disappointment with not being able to wear the same brand labels as her peers:

*I have really negative feelings about trying on clothing because there's been so many times where they haven't fit so I don't really like to go shopping... Aeropostale and Hollister, like a bunch of name brand clothes, hey, we run super small, don't come into our store.* [P14]

*They have all of the hot teen brands...In today's society I think they should run a 2X at every store like that. We have stores like Express and the Gap and all those places like that that don't even carry an extra-large;*
and even places like Victoria's Secret, the largest thing they have is a large, that is the biggest size. [M14]

*Dear Victoria's Secret, have the bigger shirts.* [P14]

Participants also discussed wearing apparel that was not flattering to their body or that did not fit, because they desired the brand and style of their peers. Participant 29, who wore a Woman’s 30 (see Table 3), and her mother, commented about other plus-size teens in her school:

*I've seen people that are heavier that go to my school that wear them [the desired brand label] and it doesn't look good.* [P29]

*It's obviously not the size for them. They want the brand so bad that they kind of wear them anyway.* [M29]

The mother of P1 a girl who wore a Women’s 22 (see Table 3), discussed her daughter’s desire to wear the brands and styles popular in her school:

*I think there have been definite times where she has insisted on what she wanted despite maybe it not being particularly flattering because it didn't fit well. So just because that's what she wanted, she wanted the look.* [M1]

Fifty percent of participants shown in Table 4 mentioned that youthful prints and embellishments such as graphic designs, sequins, and sparkles worn by their peers were lacking in apparel in their size. The mother of P27, a girl whose measurement technically permitted her to wear a Juniors 17 (see Table 3), explained the style compromise her daughter is now facing:

*The Juniors clothes we are finding don't fit, so we have to go to the women's clothes, and they are not always fun, so she wears a lot of solids, solid color T-shirts because that's what we can buy that fit.* [M27]

P23, whose measurements dictate she wore a Women’s 26 (see Table 3) was not able to express herself through her apparel style because as she explained, “Some clothes that I want
are not in my size and so I have to go with something that I wouldn't normally pick that would be in my size” [P23].

Adolescence is a time for experimenting with different social roles (Horn, 1968). Apparel can serve as a visual cue to others of the role one has assumed or aspires to assume in a society (Farmer & Gotwals, 1982). Schiffman and Kanuk (2004) found apparel was particularly important to female teens as it allowed them to confirm and publically demonstrate their self-image. Plus-size female teens, however, may find it difficult to establish their social roles through the use of apparel. Participants and their families related that the apparel that fit the girls did not always accurately represent their current or aspirational social roles. P14, whose measurements dictated her to wear a Women’s size 30 (see Table 3), described the public image her apparel created as one which did not agree with her self-image, “It's like office clothing. It all looks like teachers clothing to me. It's for plus-size but it's not for teens” [P14]. P2 shared a similar comment about the style of apparel available in her size Women’s 20 (see Table 3):

I don’t know how to describe it but when I see it, I think that looks old lady-ish. Some blouses that are for plus-size people, teenagers wouldn’t want to wear. They don’t make blouses for plus-size people [in Juniors], they think that if they're plus-size they want to dress like an old lady. [P2]

Apparel worn to school is an effective way to change peer groups (Eicher et al., 1995) and to communicate one’s role in school society (Schiffman & Kanuk, 2004). A teen whose anthropometric measurements dictate she purchases apparel in an adult female size may not be able to assume her aspirational role. The mother of P25, a young woman very interested in trendy teen fashions, described how her daughter who wore a Misses 16 (see Table 3) has been stifled by the styles of apparel available in her size:
She likes a lot of sparkle and bling on things and that's certainly geared more to Junior sizes then it is the Women's sizes...so then to someone at 15 years of age, how do you say there isn't anything with those sparkly jeans or the yoga pants from Victoria's Secret. We're going to have to look for a generic brand to fit your body, if that's what you still want to wear, as opposed to being a trendsetter. [M25]

Self-concept is the way one thinks and feels about herself (Horn, 1968). The closely related concept of self-esteem is ones overall opinion of herself including her feelings of general happiness and satisfaction (Manning, 2007). Kwon (1991) found that females use their apparel to boost self-esteem, and Moody et al. (2010) observed that apparel will affect ones behavior. Being inhibited from expressing their status, values, and social roles through their apparel appears to have negatively affected the self-esteem, self-concept, and behavior of some of the plus-size female teens in this study. Comments made by participants and family members disclosed the effect that not being able to have apparel comparable to peers had on the girls in this study. Sadly, P6, a girl who wore a Women’s 22 (see Table 3), remarked, “I don't really talk to short little skinny people, sometimes I feel like a monster next to them” [P6]. P22, who wore a Women’s 20 (see Table 3), described her apparel compared to her peers, “It's not really styles or colors that other girls at my school wear… because they're really skinny and they can get pretty much any clothes they want and I can't” [P22]. The mother of P9, a girl whose measurements placed her in a Women’s 22 (see Table 3), described how after years of needing plus-size apparel and being disappointed by the styles available to her daughter has accepted fashion defeat:

I think over time she is conditioned, she hates to go shopping because it so hard, to find things that fit and find what other kids are wearing, but she has grown up knowing that she’s just not going to have the same things that other kids have, and has come to realize that and is comfortable with that. I see that when we do go shopping, she will say oh I would love to
have that, but it's for skinny minis and I won't even try it, and just keeps on going. So it's almost like she is self-defeated before she even starts. [M9]

When asked if the apparel available in her size has affected the development of her personal style, P22, who wore a Women’s 20 (see Table 3), answered, “Yes, big time” [P22]. Her mother went on to explain how repeated disappointment with finding apparel in the styles her daughter desired has affected her interest in fashion:

Go back to a couple of years ago she all of a sudden decided she wanted to go shopping and she would get excited and like the fashions that were out there and I think she has kind of been burnt out in the last couple of years. You need to think about what you would like versus what you like now. You do just give up and go with the black and gray and something that I might have in my closet for a top versus something she would prefer to wear. You know that when you go to the store you do like the things you see and you visualize what you see yourself in and then you try it on and you get frustrated….She's just not looking like she wants to look. [M22]

P29, who wore a Women’s 30 (see Table 3), discussed how she is not happy with the apparel available in her size. When asked if she could design her own apparel and have it fit, what would she like to wear? “I would definitely have the cutesy top and the more unique kind of clothes than just the T-shirts and skinny jeans” [P29]. Her mother and grandmother discussed how her fitting issues have dictated her choice in apparel and development of her style:

She has her own style. She definitely has the T-shirt, skinny jean thing, but I really think if it came down to being able to pick other stuff that fit her, and she felt comfortable, I think personally her style would change a little bit. Even though, she says yeah, this is my style, what I like to wear, I think her style would change. [M29]

I think too, she settles a lot of times for something she doesn't really like because it will fit. It's not exactly what she would like to wear, but that's what's available. I think she goes more with what she can find that fits or that fits comfortably. And she has to watch too because she is big busted for her age, she kind of has to watch that. It's hard to find clothes too when you're having to go with adult size clothes. [G29]
The expressive aspects of apparel allow the apparel wearer to express her values, status, roles, and self-esteem through the apparel she wears (Lamb & Kallal, 1992). Participants related that their ability to express their values, status, and roles are hampered by the styles of apparel available in the sizes they require. Some participants and their families related how the girls’ self-esteem and development of personal style have been dictated by the apparel they could fit into rather than the styles they desired. Based on the information related by study participants, the findings conclude that the participants are not having their expressive wants and needs met by the apparel available to them.

**Aesthetic Aspects of Apparel.** The aesthetic aspects of apparel include art elements, design, the body to garment relationship, and its visual appeal to the wearer and others (Lamb & Kallal, 1992). Fashionable apparel is very important to teens (Koester & May, 1985) and teens judge each other based upon the apparel they wear (Eicher et al., 1995). To assess if the participants in this study were satisfied with the aesthetic appeal of the apparel available to them, participants were asked if they felt their apparel was as fashionable as their peers. Sixty-seven percent of participants shown in Table 4 did not think their apparel was as fashionable as their peers. The participants BMI was found to be associated with feeling less fashionable than their peers (see Table 5). Within the group of participants who stated their apparel was not as fashionable as their peers, 85% had BMI’s greater than the 95 percentile for girls of the same age and height. Participants gave five reasons for not feeling their apparel was as fashionable as their peers: (1) Brand logos worn by peers missing on their apparel; (2) stores popular with teens do not carry larger sizes; (3) color pallet limited in larger sizes; (4) fabric prints not youthful; and (5) apparel in the size that fits was too mature and did not present the youthful look they desired.
Many of the brands considered desirable by the teens in this study were not available in their size, with 60% of participants (see Table 4), mentioning this as a reason they did not feel as fashionable as their peers. One participant, who wore a Women’s 32 (see Table 3), explained, “Because they find things that you can't find in plus-sizes, like lots of people wear clothing that has logos on it like American Eagle, Hollister, and you can't find plus-sizes of those” [P20]. Even a participant whose measurements placed her in the Juniors category (see Table 3) experienced trouble fitting into the desired brand, “Miss Me jeans don't usually fit me because they're smaller. They’re junior size, and that's the only size they come in and those don't fit me. I like them, they're cute” [P8].

Even when the retail store where many of their peers shop does carry plus-sizes, participant’s experienced difficulty with the fit and measurements of the garments labeled plus-size. The mother of P9, related how her daughter who wore a Woman’s 22 (see Table 3), still did not fit into the plus-size apparel in teen targeted stores:

*Justice is a big store for girls their age, maybe a little bit younger, but growing up, everybody wears Justice, and they do have some plus-sizes, but even then we have a hard time finding anything in that store that would fit them. And growing up, it's very hard for you to go into that store and see everything that everybody else is wearing, and you wanted it, and it didn't fit. [M9]*

When asked if she felt as fashionable as her peers at school, a girl who was able to fit into apparel in the Juniors category (see Table 3), but is a plus-size, commented:

*No, anything but. You can see most girls in my grade going around in these Miss Me jeans …and you see them wearing all these cool shirts and their hair done up all nice and cool looking, and I'm like, I don't need that, I got sweatpants. [P27]*

In this study, 81% of participants had measurements that dictated they wear apparel in an adult female size (see Table 2). Apparel sized for the adult female is designed under the
assumption that the wearer will have a more mature, conservative, aesthetic taste (Keiser & Garner, 2008). Additionally, 40% of participants shown in Table 4 said they needed to purchase at least some of their apparel in the boy’s or men’s department. Both of these no doubt contribute to the 33% of participants who mentioned they desired bright colors and 50% who mentioned youthful floral prints among the embellishments they wanted in their apparel (see Table 4). Comments about the color pallet and fabric prints that are available in their size included “Why can't we just have rainbow neon color fun shirts” [P27]. P12, who wore a Misses size 18 (see Table 3) had this to say about the fabric prints available in her size, “I don't want to look like I'm from the 1990’s” [P12]. P12 was born in the 21st century and, as she related to the researcher, fabric prints from the 1990’s are ancient history and not what a trendy teen would wear today. A grandmother who often shops for apparel with her granddaughter P7, a girl who wore a Women’s 22 (see Table 3), gave her opinion of the styles available to plus-size teens, “It's like in the 60’s, it reminds me of my mother in a Mumu” [G7]. The mother of P20, a girl who wore a Women’s 32 (see Table 3), made a similar comment concerning the fabric prints available to her daughter:

I think a lot of the clothes we find are flowery prints. I think that's our biggest problem sometimes. It fits okay but the pattern is not age-appropriate. It would be fine for me but not so much for her to wear to school. It doesn't fit in with what the fashion is...I think it needs to match what's out there trendy for regular size kids. Fashion wise it needs to replicate what 60 or 80% of the kids wear. [M20]

P29, who wore a Women’s 30 (see Table 3), told the researcher she often had to purchase men’s apparel to accommodate her fitting needs, and described what she would like her apparel to look like if she could design it herself:

Right now, I have been seeing a lot of skinny jeans that are printed and floral. It's a lot of like vintage clothing. I think that looks really cute. I
would definitely mix some of those things together if I was to design my own clothes. A lot of sweaters, I like graphic T-shirts, that have pictures or sayings on them, or T-shirts that support things... But, if I'm shopping I can't buy the girls... because the girl's sizes don't go any bigger. [P29]

While discussing the esthetic appeal of the apparel offered in their size, 50% of participants commented that it was designed for older women not teens (see Table 4). P7 who wore a Woman’s 22 (see Table 3) complained, “It's not fair, they need to make cuter clothes for bigger people” [P7]. P1, who wore a Women’s 22 (see Table 3), had this to say about the majority of apparel she found in her size, “Usually it will be ugly clothes for older people” [P1].

Participants also mentioned various types of apparel, like footwear, and how the sizes that accommodated the larger calf were not aesthetically appealing to a teen. “When you find boots that fit they don't look like they are for a teen, they look like they are for someone who is older” [P16]. Mothers also expressed their concerns with the sizes the girls wore not offering colors, prints and styles appealing to a teen. The mother of P25, a girl who wore a Misses 18, discussed the need for youthful looking apparel in larger sizes for teens:

They have to give up the age appropriate for something that fits or wear something that is, as my daughter would say, old lady-ish because it fits. Unfortunately then those children stand out more. And as she has repeatedly said it's important that kids in her age group fit in, socially acceptable. The first thing they're judged on is the way they look. [M25]

The mother of P16 made this comment about the need to have apparel appealing to teens in the sizes girls like her daughter, who wore a Women’s 22 (see Table 3), need:

You know it's not appropriate when she goes to find her clothing and it's in the Women's section where I would shop and I'm 50 years old. So, what would look right on me for my age is definitely not what is right for her and vice versa... The other part of that is so many of the ones that are really cute or appealing are in the Juniors section and there aren't Junior plus-sizes. Or, if she goes into Misses section the style is different, the
graphics are different, it doesn’t appeal like on the teenage stuff available in the Juniors section. There is not a crossover area, a compromise area. [M16]

The aesthetic attributes of the apparel a teen wears can determine how she is viewed by both her peers and others (Eicher et al., 1995). Her apparel can send the wrong message to her peers causing them to place her in a social category not of her liking or which does not reflect her aspirations (Engle et al., 1995). The message that is conveyed by a teen’s apparel can have profound consequences for her present and future opportunities in life (Eicher et al., 1995; Cornette, 2011). The comments made by the participants and family members regarding the aesthetic appeal of the apparel available to plus-size female teens indicate that their aesthetic wants and needs are not being met by the ready-to-wear apparel available to them.

To answer research question 3, Does the ready-to-wear apparel available to plus-size female teens aged 12-17 years satisfy their functional, expressive, and aesthetic wants and needs? the functional, expressive, and aesthetic attributes of the apparel available to participants were analyzed separately. The findings of each attribute indicated that the current ready-to-wear apparel has not fully satisfied with their functional, expressive or aesthetic wants and needs. Based on these findings the answer to research question 3 is no.

Advice for the Apparel Industry

Participants and family members wanted to share with apparel industry professionals their thoughts for improving plus-size apparel for teens. As one mother said, “I think there should be more focus on larger teens, their beauty is just as important as other people” [M14].
Advice for the apparel industry fell into seven sub-themes shown in Table 4. Sixty percent of comments conveyed the message that plus-size female teens want styles similar to their peers and for plus-sizes to be readily available. It was suggested that designers try to adapt the styles they already are producing to plus-sizes, “If they make it in the Junior size, try to adapt it to a larger size” [M2]. Increased availability of plus-sizes was also suggested, “They need to make cuter, more of a selection, and they need to have them in all places” [P7]. A mother related that availability of suitable apparel was more important than the price, “If there was clothing that cost more but fit her better we would do that. She would have less clothing but better fitting clothing” [M16]. Increasing the aesthetic appeal of plus-size apparel for teens by including embellishments, prints, and logos found on average size apparel was suggested by 50% of participants and 30% said they wanted bright fun colors (see Table 4). P28 and her mother suggested how manufacturers could capture the plus-size teen market by using fabric prints they already have developed:

*It needs to be more trendy, more in fashion of today, because I find a lot of it is outdated, nobody wears it anymore.* [P28]

*If they could use the same fabrics or print of fabrics to make the plus-size clothes as they do the smaller ones because a lot of times when we go shopping will say oh, this is really cute, but it's not your size.* [M28]

Updating size charts to reflect the anthropometric measurements of today’s teens and designing apparel that accommodate different body shapes were suggested by 53% of participants (see Table 4). One teen suggested that the industry “Size teens and see what the average size is” [P2]. Mothers also stressed that body shape should be a consideration when designing apparel for plus-size teens “Many plus-size people have different body styles. They carry their weight differently. I think that they should modify things for that” [M14].
Grading related issues were also mentioned as something the industry needs to consider, “What I would say is that they make more of a variety of proportions so that when you need a bigger waist line that you don't necessarily need really long legs” [M10].

Eighty percent of participants said they did not purchase online due to fit issues and 57% needed to try on multiple garments or go to multiple stores to find a size that fit (see Table 4). To make the shopping process easier, consistency was suggested, “Like extra-large in one design means size 15, in another size extra-large is a size 19. Just some consistency there would be good. If she saw it online she would have a chance to figure something out” [M23].

The plus-size apparel market accounts for $47 billion a year in sales (Kids plus-size, 2011). A mother who had advice for manufacturers about effectively marketing to plus-size teens related:

*I don't think they should call it plus-size. They should never call those clothes plus-size, that's a bad word for it. For a preteen or teenager, they should never call it plus-size. They should just continue numbering them up without putting the word plus-size because think of this kid who is shopping and she can only go to plus-size and she's just picked her dress and her friend walks up. Because teenagers are mean and preteens are worse. They need to learn that plus-size is a bad word for teens.* [M13]

**Summary**

Results of this study indicate a discrepancy between individual participant measurements and the ASTM standardized sizes, with specific measurement points deviating on average as much as 11.17 inches from the standard measurement for the apparel category and size which most closely aligned to the participants’ measurements. Within the same apparel category and size, participants varied in body shape and experienced different fit issues. Participants, as well as family members, expressed concern over acquiring the
desired styles and related difficulties encountered during shopping for both personal apparel and team uniforms. They also related incidents where apparel needs had interfered with the girl’s relationship with her peers, development of her personal style, and her public self-image. Comments made by some participants indicated that apparel issues they experienced have negatively affected both their self-esteem and self-concept.

This research identified four insights into plus-size apparel for female teens which have not been discussed in the previous literature: (1) Some plus-size girls wear maternity tops to accommodate waist circumference needs; (2) some plus-size girls wear boys and men’s apparel to accommodate garment ease and range of motion requirements; (3) teens defined what comfort in apparel means to them; and (4) some plus-size teens need to purchase apparel at resale stores, borrow needed items, or wear hand me downs because they cannot find a garment that fits in the retail store.

Participants and their mothers provided advice to the apparel industry on developing and marketing apparel for plus-size teens and offered a wealth of information useful to creative designers, technical designers, and marketers interested in capturing the female plus-size teen apparel market. This study also uncovered areas where future research is needed. The implication of this study, its limitations, and suggestions for further research will be discussed in Chapter 5 Summary and Conclusions.
CHAPTER 5 SUMMARY AND CONCLUSIONS

This chapter summarizes the research conducted for this study and discusses the implications of the findings for both industry and academia. It discusses the study’s limitations, identifies areas of further research direction and ends with brief concluding comments.

Summary and Discussions

This research significantly contributes to the literature by providing insight into the little researched area of plus-size teen apparel. It is the first study to be conducted investigating the apparel fit issues experienced by plus-size female teens aged 12-17 years. Its holistic approach to the analysis of data collected through a mixed-methods research design uncovered previously unidentified issues surrounding plus-size teens and apparel, revealed numerous areas where future research is needed, and provided vital information for both apparel industry and academia.

Teens in the U.S. are projected to spend $80-120 billion on fashion related items in 2013 (Fox, 2013). Plus-sizes continue to be the fastest growing segment of apparel retail (Plunkett Research, Ltd., 2013) and this trend is expected to continue as the number of overweight and obese teens worldwide is increasing at an accelerated pace (World Health Organization, 2011). In 2013, an estimated 23.9 million children aged 2-19 years are currently overweight or obese (American Heart Association, 2013). Therefore, there is a current and future need for plus-size apparel for teens.

Niche markets often offer the best opportunity for an apparel brand to expand its market share and profits (Engle et al., 1995). However, the plus-size market is a niche where apparel fit issues is prevalent (Brock et al., 2010; Connell & Ulrich, 2005; Deckert, 1999;
Kang, 2004). Devarajan and Istook (2004) suggested that the American Society for Testing and Materials (ASTM) standardized apparel categories and sizes were outdated and contributed to the fit issues experienced by plus-sizes.

Few apparel research studies (Anderson & Meyer, 2000; Brock et al., 2010; Francis, 1990) have been conducted with minors individuals who are under the legal age for consent (National Institutes of Health, 2013). Additionally, no studies could be found investigating apparel issues experienced by plus-size female teens aged 12-17 years. This area merited further investigation as teens are influential consumers and plus-sizes are a growing niche market.

The overall purpose of this study was to investigate apparel fitting issues experienced by plus-size female teens aged 12-17 years in the context of Lamb & Kallal’s (1992) Functional Expressive and Aesthetic (FEA) Consumer Needs Model with a view to improving apparel fit within the plus-size female teen apparel market. The specific objectives of this study were to: (1) Examine whether current ASTM sizing categories meet the measurement needs of plus-size female teens aged 12-17 years; (2) identify specific areas of the body where plus-size female teens aged 12-17 years are not satisfied with the fit of their current ready-to-wear apparel; and (3) explore the current U.S. ready-to-wear apparel needs in terms of functional, expressive, and aesthetic aspects for plus-size female teens aged 12-17 years. The research questions developed to accomplish the study purpose and objectives were:

RQ1: Do the anthropometric measurements of plus-size female teens aged 12-17 years participating in this study fit into any of the current standardized sizes published by ASTM?

RQ2: Are plus-size female teens aged 12-17 years satisfied with the fit of apparel
RQ3: Does the ready-to-wear apparel available to plus-size female teens aged 12-17 years satisfy their functional, expressive, and aesthetic wants and needs?

A mixed-methods research design including 3D body scans, a survey of participant’s demographic characteristics, and in-depth interviews with them and their family members was used to gather quantitative and qualitative data of this study. Fifty-two potential participants expressed interest in this study. Twenty-two were disqualified from participation due to either not meeting inclusion criteria or deciding not to participate. A total of 30 useable participants and their family members traveled to the Iowa State University campus to engage in the study which took place in the body scanning lab.

Thirty females aged 12-17 years who wore plus-size apparel participated in this study. Participants represented six separate ethnic backgrounds such as White/European American, White/European American and African American/Black, White/European American and Hispanic American/Latina, African American/Black, African American/Black and American Indian/Native American, Hispanic American/Latino and Native Hawaiian/Other Pacific Islander. It included six through twelfth graders with 74% of participants having a Body Mass Index (BMI) above the 95th percentile for their age and height. 3D body scans were taken of participants while wearing a tight fitted scanning suit to ensure accuracy of the body shape and anthropometric measurements at 37 key locations (see Table 3).

Interviews with each teen participant and family members, including mothers, grandmothers, and fathers, lasted 12-45 minutes each and were digitally recorded.
Data analysis included assigning participants to the ASTM standardized apparel category and size based on their key measurements of bust, waist, and full hip. Each participant’s measurements at 37 key apparel fit locations were then compared to the measurements of the ASTM standardized size to calculate differential measurements, those being the difference between her measurement and the ASTM standardized size. Differential measurements for participants were then averaged to reveal key apparel fit areas where the study population differed from the standardized sizes and provided a basis for answering research question 1. Interviews were transcribed then coded by main theme and sub-theme using content analysis approach by three researchers resulting in inter-coder reliability of 99%. Interview statements were compared to individual measurements, body shape, apparel categories, and sizes derived from the 3D body scans to corroborate study findings. This provided a basis for answering research questions 2 and 3.

Individual measurements placed 81% of participants in an adult female apparel category of either Misses or Women’s with only 19% being able to fit into the Juniors category. Individually, participants differed from the ASTM standardized sizes as much as 11.19 inches in circumference and 8.55 inches in length in some key locations (i.e., waist circumference, arm length). As a group, participants deviated from the ASTM standardized measurements as much as 3.91 inches in circumference, 5.83 inches in length in some key locations (i.e., waist circumference and vertical trunk length). Specific fitting issues comprised the most frequently referenced theme with a total of 169 comments being made in the interviews. This agrees with Brock et al. (2010) findings that plus-size girls discussed fit related issues more than any other theme. In 80% of the interviews, participants described their apparel as fitting in one location but not another and 53% said different body shapes
should be considered when designing apparel. Findings indicate that the current ASTM standardized categories and sizes do not fully meet the functional fitting needs of the plus-size female teens in this study.

Findings also indicate that the expressive and aesthetic desires of the participants have not been met by the apparel currently available to them. Sixty-seven percent of the participants did not feel their apparel was as fashionable as their peers and 37% related that apparel concerns were the reason they did not engage in a desired extracurricular activity. Fifty percent described apparel as being designed for older women and 60% disclosed that the apparel brands they desire to buy are not available in their size. This also concurs with Brock et al. (2010) that the apparel which fits plus-size teens was designed for mature females and often does not appeal to younger consumers.

This study uncovered four new findings regarding plus-size female teens and apparel. These findings provide valuable insights into the apparel choices made by many plus-size female teens and provide topics for further research: (1) Some plus-size girls wear maternity tops to accommodate waist circumference needs; (2) some plus-size girls wear boys’ and men’s apparel to accommodate garment ease and range of motion requirements; (3) plus-size teens define what apparel comfort means to them; and (4) some plus-size teens need to purchase apparel at resale stores or wear hand me downs because they cannot find properly fitting apparel in a retail store. These new findings provide some insight into why many plus-size female teens choose certain style of apparel. It should also be noted that interviews revealed these selection strategies related by the participants were developed out of necessity and not by choice. Therefore, each of these findings requires further individual investigation to fully understand the role it plays in style selection, development of personal style, the
girl’s social interaction, its effect on her emotional and psychological health, and implications for the apparel industry.

**Implications of Research Findings**

The findings of this study have implications for both apparel industry and academia. Industry is focused on profits, market share, accurate target marketing, and producing a tangible product which will sell. In contrast, academia is focused on research, furthering our understanding of the world we live in, and educating students to meet the skill needs of industry. Due to their separate focus which will eventually mingle together, this section will discuss them individually and then discuss the need for, and benefits of, cooperation between industry and academia.

**Implications for Apparel Industry**

The goal of all apparel manufacturers and retailers is to maximize profits. Statistical data support the assumption that there is a current and future need for plus-size teen apparel worldwide (American Heart Association, 2013; U.S. Census Bureau, 2010; Center for Disease Control, 2011b; World Health Organization, 2007). As the plus-size market continues to be the fastest growing segment in apparel retailing, it is a crucial factor in brand profitability and growth. Apparel manufacturers cannot ignore this trend if they wish to remain competitive in the marketplace (Plunkett Research, Ltd., 2013).

Apparel is the top spending category for teens, with most of their disposable income spent on fashion-related items (Boris, 2013). This has significant consequences for manufacturers and retailers, as the U.S. teens have an estimated $200-300 billion of discretionary money per year (Fox, 2013), in addition to the estimated $208.7 billion that family members spend on purchases for teens (Teenage consumer spending, 2013). To
maximize profits, apparel manufacturers and retailers will need to address the needs and desires of this niche market.

This research identified areas where apparel manufacturers and retailers are losing potential business by not accommodating the functional, expressive, and aesthetic needs of plus-size female teens. Thirty-three percent of participants related that they often left a store without making a purchase because they could not find apparel that fit. Additionally, new apparel must compete with resale for the consumer’s business. However, 13% of participants related wanting to purchase new apparel, but were unable to find anything that fit and had to borrow an item or purchase it at a resale store. Apparel brands and retailers need to reevaluate the sizes they are offering or face possible loss of profits and market share due to not meeting the needs of the current and emerging marketplace.

Functional issues relating to apparel fit were the most frequently discussed topic, occurring 169 times during interviews with participants. Cross referencing participants’ comments with their 3D body scan data revealed that current apparel sizing and grading practices do not accommodate the size, shape, and ease requirements of the plus-size teens in this study. Collectively, participants’ measurements deviated from the ASTM standard sizes. Only 19% of participants were able to fit into apparel in the Juniors category designed for the immature teen body in styles that appeal to that age group. This indicates that the current ASTM standardized categories and sizes, as well as brand sizes, have not address the size and shape of the plus-size female teens in this research. Therefore, up-to-date anthropometric data reflecting the size and shape of today’s female teens is necessary for apparel manufacturers to improve apparel fit.
An apparel manufacturer wishing to enter the plus-size female teen market will need to conduct its own anthropometric study or commission a study to be conducted by industry consultants. This may be cost-prohibitive for many manufacturers, presenting a barrier to entry into the plus-size female teen market. A brand can incur large product development expenses gathering anthropometric data and developing new pattern blocks. However, 49% of participants reported they wore male apparel because it provided more ease and offered a better fit than female apparel. Block development costs can be minimized by modifying the styles created with male pattern blocks to address the expressive and aesthetic desires of the plus-size female teen market. Participants expressed their desire to have t-shirts and sweats that fit like male apparel, but with a feminine neckline, colors, and embellishments. Sportswear manufacturers may be able to contain product development costs by starting with existing male pattern blocks to develop more feminine styles.

Alternatively, a brand currently competing in an adult female apparel category may also find that entering the plus-size teen market requires minimum product development costs. Eighty-one percent of participants in this study had measurements which placed them in the misses or women’s apparel category. Modifying adult pattern blocks to reflect an immature teen’s body can be a cost effective way to address functional fit issues.

Apparel brands targeting teens should investigate the profitability of increasing the range of sizes offered to include plus-sizes. Sixty percent of participants said they wanted to wear the same styles and brands as their peers and 50% expressed a desire to have the graphics and embellishments found on teen targeted brands that only carry average sizes. Teen brands wanting to expand their customer base already have plus-size customers who want to purchase their product. With an estimated $200-300 billion of discretionary funds
available to teens (Fox, 2013), a brand may find that it could increase sales enough to offset the additional product development costs involved in expanding its size range while simultaneously increasing market share and profits.

Brands targeting teens also need to evaluate possible damage to the brands reputation by not offering apparel in plus-sizes. Teens interviewed in this study repeatedly mentioned certain brands such as Miss Me jeans, Aeropostale, Justice, and H&M with 60% of participants indicating they desired to wear these popular teen brands. These brands, however, do not carry larger sizes. The recent controversy surrounding Abercrombie and Zara deliberately refusing to accommodate larger sizes indicate there may be long term consequences for a brands image and profitability if they do not accommodate plus-sizes (Abercrombie, 2013; Chang, 2012).

Likewise, manufacturers producing athletic apparel for teen sport teams need to examine their sizing in light of the plus-size trend. Producing larger sizes may be essential to maintaining market share, as 47% of participants played on one or more school sport teams. Both teen athletes and overweight teens require wider girth measurements and additional ease in their uniforms. The standard sizes offered by a brand may not reflect the current marketplace, since 23% of participants had to special order a team uniform to obtain a size that fit. Additionally, participants and their mothers related incidents where they were unable to purchase the official team uniform from the designated manufacturer due to size constraints and had to find a similar uniform from another manufacturer. This represents not only lost profits, but poor customer relations. With the continuous increase in number of plus-size teen market, an apparel manufacturer not offering larger sizes may lose school contracts.
Functional apparel issues with plus-size female teens present a challenge to online and catalog retailers, as 80% of participants said they did not purchase online or from catalogs due to fit concerns. Online and catalog retailers need to carefully review their sizing information and return policies if targeting plus-sizes. Even those retailers currently targeting plus-sizes may be losing a significant amount of potential sales by not presenting detailed measurement charts, using models that reflect various plus-size shapes and sizes, and not offering liberal return policies.

The female plus-size teen market offers great potential for apparel manufacturers and retailers to expand their market share and increase profits. Although functional issues related to apparel fit need to be addressed, it is important to note the teens desire to have styles similar to their peers. This matter was mentioned by 60% of participants and 67% said they did not feel as fashionable as their peers in school. Participants suggested that their expressive and aesthetic desires could be met by having apparel that matched the styles, colors, prints, and embellishments of their average-size peers. To avoid the ‘old lady look’ it was suggested that using the same fabric prints for plus-sizes and average sizes would ensure that teens were on trend with their average size peers. In addition to satisfying the plus-size teens expressive and aesthetic desires, the use of the same fabric, colors, prints, and embellishments on plus-size and average size teen apparel would lower the per unit fabric and print development costs for the manufacturer. Brands and retailers currently catering to the female teen apparel market may find the additional costs involved in developing new apparel sizes are outweighed by increased sales and market share.

Merchandising of plus-size apparel for teens should be a particular concern for retailers. Shopping is a favorite pastime for female teens and affords retailers frequent access
to customers. Fifty-seven percent of participants mentioned needing to try on multiple items and one mother related that her daughter usually had to try on numerous pairs of jeans before finding a pair that fit properly. Plus-size friendly dressing rooms should be comfortable, have adequate space, facilitate the hanging of multiple garments, and be private.

Store layout, size designation, and inventory should also be examined when targeting plus-size teens. Seventeen percent of participants said retailers need to carry more stock in larger sizes and not just one or two items in a plus-size. A mother commented that plus-size apparel should not be placed in a separate section, or designated as plus-size, but included among the average size apparel to minimize customer embarrassment when shopping with friends. Since shopping with friends is a favorite pastime for female teens and teens who shop with friends make more purchases (Mangleburg et al., 2004; Meyer & Anderson, 2000) retailers making their stores plus-size friendly may find increased profits and market share.

Various implications for apparel industry were addressed above. Some of these can be easily and cost effectively addressed by apparel manufacturers and retailers such as modifying styles, fabrics and embellishment offered on plus-size apparel and the location of items on the sales floor. Other implications such as modifying blocks or conducting anthropometric studies may be outside of the apparel manufacturer’s expertise or resources and will require assistance from industry consultants or academia.

**Implications for Academia**

This research has implications for both the research and teaching sectors of academia. Little academic research could be found which investigated apparel issues faced by teens. This study identified four previously unknown issues and revealed there is much that is still unknown about the plus-size teen market. The fact that this amount of unknown information
was uncovered indicates there has been a lack of exploratory research surrounding apparel fit issues, with plus-size teens conducted in academia. It also may indicate that in academia exploratory research has been neglected in favor of hypothesis testing of previously identified phenomena. Additionally, the lack of academic apparel research conducted with minors, those less than 18 years, and plus-sizes that could be located in the literature may indicate academic researchers favor an easily accessible study population over ground breaking research with less accessible participants. This may also indicate supervisory faculty have discouraged students from applying for IRB approval to investigate issues surrounding vulnerable populations directing them instead towards easily accessed study populations. Research with vulnerable populations could delay the student’s graduation date and understandably may not be an option for some students. Although additional time and effort is required to conduct research with minors and niche markets, the opportunity to contribute unique and significant findings to the body of literature should not be overlooked or discouraged. Academic researchers, therefore, should consider increasing the amount of exploratory research they are conducting and look to niche markets where little research has been conducted. Research conducted with minors and niche markets can advance the knowledge within the apparel discipline and provide unique findings for future research. The findings of exploratory research conducted with less accessible study populations may also be more useful to industry and increase the university’s industry relationships.

The teaching segment of academia can also benefit from the findings of this research. Areas were identified where advanced and different skills are required to address the unique needs of the plus-size female teen market. New and additional skills may need to be incorporated into the apparel design curriculum. As most U.S. apparel design programs use
standardized sizes to teach pattern drafting and draping, these basic skills need to be expanded to non-standard sizes. Faculty accustomed to teaching design, drafting and draping skills on standardized sizes may need to be enhanced and update their skills to teach and oversee student projects using non-standard sizes. Faculty, therefore, must be continually working on improving and updating their technical skills through specialized classes offered at conferences, or from industry sponsored seminars in order to keep pace with changes in the marketplace.

Both creative and technical apparel design students will be seeking employment in an industry with an increasing need to cater to niche markets. As the plus-size market is becoming an increasingly larger niche market, students need to be trained in the creation and fit of apparel for a variety of consumer’s body types. Fitting issues were discussed 169 times in interviews. Eighty percent of participants related that their apparel fit in one location and not another with 53% telling the apparel industry it needs to design for different body shapes and sizes. Revision of academic curriculum may be needed in order to provide students the opportunity to practice appropriate drafting, draping, and fit for plus-sizes. Consideration should be given to incorporating fitting on live models with non-standard sizes and shapes into the curriculums of existing classes. This may require both students and faculty to serve as fitting models to provide a range of sizes and body shapes. Individuals not possessing drafting, draping, and fit skills with non-standard sizes may find it difficult or impossible to secure employment in the industry.

Design students also need to gain experience in modifying style lines, apparel proportions, and scaling textile prints to flatter non-standard body sizes and shapes. With the plus-size female apparel market generating over $100 billion in sales annually (Meng, 2007)
and the most successful retail chains being those that focus on niche markets (Plunkett Research, Ltd., 2013), the ability to design for plus-sizes will be an increasingly important part in the ready-to-wear industry. Thirteen percent of participants’ mothers expressed concerns over their daughters being teased about apparel. In addition to technical training, apparel design students and faculty may need to receive sensitivity training to expand their viewpoints and combat the negative stereotype of plus-size individuals which is often portrayed in the media. This may lead to being more receptive to designing apparel for plus-sizes and acquiring an increased understanding of this niche market. Apparel design programs preparing students to design for a variety of body sizes and shapes will send better qualified designers, product developers, manufacturers, retailers, and merchandisers into the workforce thus strengthening industry relationships.

Implications of Industry and Academia Collaboration

Many of the implications of this study point to the need for further research. Apparel brands and manufacturers may lack the expertise, budget, and time needed to conduct research on new product design and development. Academia, on the other hand, has the expertise and time, but often lacks the funds and access to resources needed to conduct research useful for industry. Close collaboration between these areas can be beneficial for both.

Industry can benefit from collaborating with academia in several ways: (1) Helping to ensure future employees enter the job market with the skills necessary for employment; (2) receiving information about the marketplace and target customers; and (3) using apparel design programs as an extension of their product development division. Collaborating with academia can insure that a pool of potential employees with the unique skills needed by the
manufacturer is available and trained to begin work. Students familiar with the companies’ particular needs can be directly hired and assume their job duties with minimal additional training. Academia can serve to keep industry updated on the latest technology and changes in the marketplace. By funding the required research through grants to the university, manufacturers can have access to a team of qualified researchers working to solve their product development issues while receiving tax benefits for educational grants.

Academia would also benefit from this cooperative relationship by: (1) Remaining current on industry needs; (2) expanding the focus of research; and (3) maintaining a realistic viewpoint of the marketplace. Input from industry could help faculty to remain current on industry needs while using the research projects to enhance student learning thus better preparing them for entry into the workforce. Directly working with industry can expand the focus of faculty research ensuring it is relevant to the marketplace, and provide a means of acquiring funding. As many academics are not directly involved in industry working as designers or business owners, collaboration with industry can help them remain in touch with the realities of the ever changing marketplace.

**Limitations**

Some limitations were present in this research: (1) Generalization of the study; sample size, and data analysis; (2) recruitment of minors as participants; (3) monetary resources to conduct the study; and (4) cross-sectional data. Examining these limitations will provide clear guidance for future research.

**Generalization of the Study, Sample Size, and Data Analysis**

Participants had to meet the strict study inclusion criteria of being a female aged 12-17 years, require plus-size apparel, and currently live in the state of Iowa. This severely
narrowed the potential sample pool resulting in only 30 qualified participants completing the study. The minimum number of participants needed for a mixed-methods study is 21, when the participants are chosen based on a unique characteristic, such as being plus-size (Onwuegbuzie & Collins, 2007). This study exceeded that amount with 30 participants, however, the small sample size limited the statistical analysis and generalizability of the findings.

The quantitative data analysis was further limited by: (1) Demographic characteristics of the study participants and (2) availability of human body shape identification software. Participants being limited to those currently residing in the state of Iowa skewed the demographic characteristics of the sample, with 78% of participants reporting their ethnicity as White/European Americans. This is not representative of the ethnic and cultural diversity present in the U.S (U.S. Census Bureau, 2010). Body shapes and sizes are genetically determined (Marshall et al., 2004) and 74% of participant’s had a Body Mass Index (BMI) above the 95th percentile. Therefore the data collected is skewed in favor of one ethnic group and the upper end of the BMI chart and therefore does not represent the various shapes and sizes in the U.S. plus-size population. The skewed demographics may have affected the findings of research question 1: Do the anthropometric measurements of plus-size female teens aged 12-17 years participating in this study fit into any of the current standardized sizes published by ASTM? A sample reflecting the variety of BMI percentiles that exist within plus-sizes may result in a different answer to this question.

Neither the university nor the researcher had access to the advanced body shape identification software. This software would have made it possible to mathematically identify differences between participants’ body shapes. This would have permitted an in-
depth examination of the relationship of an individual’s body shape and satisfaction with apparel. However, answering research question 2: Are plus-size female teens aged 12-17 years satisfied with the fit of apparel available to them? was restricted to a visual analysis of the 3D data clouds in connection with participant statements, rather than an in-depth quantitative analysis.

Likewise, qualitative data may not be generalizable to all plus-size female teens in the U.S. The sample came from only one state in the Midwest although diverse regional and ethnic cultures are present in the U.S. As culture influences lifestyle, perceptions, and attitudes, participant’s interview responses may not represent the experiences, attitudes, and perceptions of all plus-size female teens in the U.S. In order to participate, the girls had to self-identify as being plus-size and be willing to discuss their personal apparel issues in a laboratory setting with a researcher who may be considered stranger to them. This had the potential to be emotionally and psychologically stressful. The girls who volunteered to participate knew and understood the study requirements in advance and were still willing to participate in the study. Therefore, the interview data used to answer research question 3: Does the ready-to-wear apparel available to plus-size female teens aged 12-17 years satisfy their functional, expressive, and aesthetic want and needs? may not represent the perceptions and opinions of all plus-size female teens in the U.S.

To eliminate or lessen these limitations, future research should attempt to obtain a larger sample of participants representing the ethnic diversity present in the U.S. Additionally, the study inclusion criteria could be broadened to include both male and female teens of average and plus-sizes. This may be accomplished by collaborating with universities located in different regions of the U.S. as well as other countries. This would provide a pool
of potential participants with a more diverse demographic. Collaborating with a university which has access to body shape identification software will also facilitate a detailed examination of the relationship of an individual’s body shape to apparel fit.

**Recruitment of Minors as Participants**

This study recruited minors, individuals who are under the legal age of consent, as participants. Access to potential participants was restricted due to the age group under investigation. This made recruitment for the study extremely difficult. No school district within a 50 mile radius of the Iowa State University campus would permit the distribution of advertising concerning the study within their schools, newsletters to parents, or on their websites. The request to make recruitment materials available was also denied by the adolescent weight loss clinics at McFarland Clinic in Ames and Mercy Hospital in Des Moines in the state of Iowa. Therefore, a broad, rather than targeted approach, to recruitment advertising was necessary.

Participants needed to have the consent of their legal representative to engage in the research and to be escorted to the campus by an adult. This required that the researcher obtain verbal consent of both the participant and her legal representative prior to scheduling a research appointment. Additionally, both the participant and legal representative needed to be present during the research and had to coordinate their schedules with open lab appointment times. This was not possible for all potential participants and two interested parties who met study inclusion criteria had to decline participation.

Many of these same limitations will be present in future research investigating apparel issues with minors. However, limitations may be lessened by collaborating with other university departments or government agencies that have greater access to teens.
Alternatively, collecting data with the use of a portable body scanner installed in booth at a mall, state fair or other location where potential participants are expected to gather would allow for simultaneous advertising and recruitment of participants.

**Monetary Resources of the Study**

Due to budget restrictions it was challenged to relocate [TC]$^2$ NX-16 3D body scanner used for this study in a public area such as a mall or at the state fair. If this resource was available, this would have eliminated the need for participants to travel to the body scanning lab as well as making it possible to recruit more participants and conduct the research simultaneously. The budget also did not allow for the purchase of human body shape identification software, which led to limit the data analysis conducted. To eliminate these limitations for future research sufficient preparation time should be taken to secure the needed funds through grants or collaborating with industry partners.

**Cross-Sectional Data**

The cross-sectional data obtained in this study reflects the size, shape, attitudes, opinions, and apparel fit issues of the participants at one point in time. One’s physical body as well as emotional and psychological development change significantly throughout adolescence. A longitudinal study conducted with a group of plus-size female teens would provide data on how their bodies shape changes with growth in addition to changes in attitudes and opinions surrounding their apparel.

This study explored an area of apparel research with an age group which had not been previously investigated. The limitations listed above provide some guidance for others who plan to conduct similar research. A more elaborative explanation of minimizing some of these limitations will be provided under the future research direction section of this chapter.
Future Research Direction

Several areas were uncovered where further research is needed to either determine the impact of the phenomena or to progress towards its resolution. The following provide more details of each uncovered area: (1) Updated anthropometric data and new ASTM apparel categories and sizes creation; (2) apparel issues and male plus-size teens; (3) body shape and apparel fit for teens; (4) development of methodologies for pattern grading; (5) modifying existing pattern blocks to fit plus-sizes; (6) plus-size concerns with purchasing apparel online; (7) socio-psychological effects of female plus-size teens wearing male, maternity, or resale apparel for fit; and (8) average-size and plus-size teens and their definition of apparel comfort.

Update Anthropometric Data and New ASTM Apparel Categories and Sizes Creation

Participant measurements were found to deviate from standardized sizing both individually and as a group. As a group, participants’ measurements deviated from ASTM standardized sizes at 37 key measurement locations. Currently, little anthropometric data of female teens exists. Although this study only included 30 female participants the fact that none of them conformed to the ASTM standardized sizes is compelling evidence of the needs for further research. Large scale anthropometric studies need to be conducted to obtain current size and body shape data of U.S. teens for both males and females. Large scale studies reflecting the ethnic diversity in the U.S. would provide the data needed to create new sizing charts reflecting the size and shape of today’s teens. These data then need to be used to modify current apparel categories and sizes and to create new categories and sizes, if required, to reflect the needs of the current teen population. A study of this size may require government oversight, sponsorship and funding. Therefore, collaboration with other
university departments such as Nutrition, or the School of Medicine could increase the potential for grants and provide data useful to each of the disciplines.

**Apparel Issues and Male Plus-Size Teens**

This study only investigated issues experienced by female plus-size teens. No studies could be found investigating apparel fit issues experienced by male plus-size teens aged 12-17 years. Therefore, exploratory research investigating apparel issues faced by male plus-size teens and whether the current ASTM standardized sizes for males address their fit needs will add significantly to the apparel literature. This research could be conducted alone or as part of a study investigating apparel fit issues experienced by both male and female teens of both average and plus-sizes.

**Body Shape and Apparel Fit for Teens**

Six participants who wore the same standardized size reported completely opposite fitting issues based on their body shape. This sample size is too small to arrive at any conclusions regarding how a female teen's body shape relates to her satisfaction with fit, however, it does point to the need for additional research. An investigation of the relationship between body shape and customer satisfaction with the fit of standardized sizes would give insight into which areas of pattern blocks could be altered to produce a better fit for a variety of body shapes. It would also provide data on body shape and fit, which is needed to progress towards mass customization of apparel for plus-size teens. To collect the needed data, groups of participants segregated by apparel size representing a cross section of ethnicities and ages will need to be enlisted. These participants will then need to have 3D body scans performed in connection with in-depth interviews or detailed surveys that permit participant commenting. This will help to uncover similarities and differences that exist
within each group with regard to body shape and fit satisfaction. Providing garments for participants to try on and discuss their satisfaction with fit may prove useful in uncovering similarities and differences among body shapes of the same standardized apparel size.

**Development of Methodologies for Pattern Grading**

Eighty percent of participants related that a garment would fit in one location but not another. Research needs to be conducted on how pattern grading for plus-sizes of various body shapes must differ from standard grading practices in order to provide an acceptable fit. It is crucial to develop methodologies for these new grading practices, which will eventually facilitate apparel mass customization and provide apparel industry direction on block modification when entering the plus-size market. A quantitative research design with a large sample would permit the comparison of plus-size teens to average size teens and reveal areas where body measurements differ. Dividing teens into groups based on height, with a cross-section of ethnicities, ages, and BMI’s represented in each group, could provide insight into how length and circumference measurements change with growth between average and plus-sizes.

**Modifying Existing Pattern Blocks to Fit Plus-Sizes**

Eighty-one percent of participants wore apparel in an adult female category, 40% wore male apparel for fit, and 53% addressed the needs of apparel companies to design apparel for different body shapes. Future research needs to be conducted to determine: (1) Why adult women and male pattern blocks provide a better fit for plus-size teens; (2) if these can be used to create an apparel line of female plus-sizes; or (3) if modifications are needed to address the needs of an immature female body. Such a study should include a participant pool comprised of plus-size teens of varying ages, sizes, and shapes. Muslins taken from
various blocks should be examined for fit with and extensive participant feedback. This will aid in determining if certain body shapes or sizes receive a better fit from an adult woman or male pattern block and what, if any, modifications are needed to existing blocks to achieve an acceptable fit. Development of methodologies for the use or modification of adult women and male pattern blocks for the female plus-size teen market would be useful to apparel manufacturers wanting to expand their lines to include plus-sizes while minimizing product development costs.

**Plus-Size Concerns with Purchasing Apparel Online**

Ninety-seven percent of participants said they needed to try on apparel to ensure fit and 80% gave this as the reason they did not shop online or from catalogs. Further research needs to be conducted investigating the type of information plus-size apparel customers require to be comfortable making an apparel purchase without physically trying on the garment. This research could be conducted using an online survey targeted to the plus-size market. Sample websites providing sizing information and a virtual try-on could be created for participants to view and rate the information provided. The online survey should allow for extensive participant feedback and suggestions for improvement. This would provide valuable information for retailers desiring to capture part of the online or catalog plus-size apparel market.

**Socio-psychological Effects of Female Plus-Size Teens Wearing Male, Maternity, or Resale Apparel for Fit**

Forty percent of participants related they needed to wear male apparel, 13% had to purchase resale items or borrow from a friend, and one mother explained that teens with larger stomachs often needed to purchase in the maternity department to find apparel that fit.
Additionally, the mother of P27, an elementary school teacher, related issues that have arisen in her classroom regarding the apparel worn by plus-size girls. All participants related that these were strategies they had developed out of necessity and not by choice. A study investigating female teens who wear male, maternity or used apparel to accommodate apparel fit needs and the relationship it has to self-image, self-confidence, and peer relationships would provide valuable information for professionals in the apparel field, child education, psychology, and sociology. Insight into why female plus-size teens choose one attribute (functional, expressive, or aesthetic) over another when making an apparel purchase could uncover underlying reasons for certain style choices. An exploratory qualitative study utilizing in-depth interviews, field studies, or survey with open ended questions conducted with several plus-size teens would be useful to collect this data.

**Average-Size and Plus-Size Teens and Their Definition of Apparel Comfort**

Comfort has been identified as an important functional attribute of apparel for teens, however, how teens define comfort has not been well investigated. Apparel that reflects the latest teen fashion trend may appear uncomfortable to adults, yet teens praise its comfort. Examples of this can be seen in the hip-hop style of pants fashionable in the late 1990’s which had an excessively low crotch level that restricted range of motion, or the currently popular platform shoes. Seventy percent of the plus-size teens in this study defined comfort as being “not too tight” and 37% related comfort to range of motion. None of the participants related comfort to the latest fashion. As this study was concerned with apparel fit, it is unclear as to whether participants restricted their definitions of comfort to functional fit related issues or if these take precedence over style for plus-size teens. Additionally, the small sample size makes it impossible to draw any conclusions as to how plus-size teens
define apparel comfort. As comfort is often related to apparel satisfaction and how teens define comfort has not been well explored, this area needs further research investigation. Both average and plus-size teens are needed to determine, in general, how teens define apparel comfort and if a difference exists based on body size and shape. This exploratory research could be conducted single sample or longitudinal with data gathered by a variety of methods including in-depth interviews or an online survey. The sample should contain an equal number of participants reflecting regular and plus-sizes. Determining how teens define comfort in apparel will aid apparel manufacturers in the design of garments which will meet this aspect of the customer’s functional needs. Table 6 summarizes the future research direction identified in this section.

**Determination of outlier values for differential body measurements**

In this research ≥2 inches was used to designate an extreme outlier for differential body measurements. Although ≥2 inches is a reasonable value for many circumference measurements it is too large for some body measurements including shoulder length, and apex to apex. Future research is needed to determine reasonable values for outliers at each of the 37 measurement points used by the ASTM for apparel sizing. These outliers will be useful for developing non-standard grading methodologies and identifying similarities and differences among body shapes and sizes. Determining outlier values will also facilitate a better quantification of data and enhance the validity and reliability of statistical analysis results. This research should include testing the hypothesized values on both live participants and dress forms of various sizes and shapes.
Table 6. Summary of future research direction.

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<td>Update anthropometric data and new ASTM apparel categories and sizes creation</td>
<td>Quantitative to collect anthropometric data</td>
</tr>
<tr>
<td>Apparel issues and male plus-size teens</td>
<td>Mixed methods to collect anthropometric data in conjunction with in-depth face-to-face interviews or detailed survey</td>
</tr>
<tr>
<td>Body shape and apparel fit for teens</td>
<td>Mixed methods to collect anthropometric data in conjunction with in-depth interviews or detailed survey</td>
</tr>
<tr>
<td>Development of methodologies for pattern grading</td>
<td>Quantitative to analyze anthropometric data</td>
</tr>
<tr>
<td>Modification of existing pattern blocks to fit plus-sizes</td>
<td>Mixed methods to fit muslins constructed from various size pattern blocks in conjunction with detailed participant feedback</td>
</tr>
<tr>
<td>Plus-size concerns with online apparel purchase</td>
<td>Quantitative to conduct survey</td>
</tr>
<tr>
<td>Socio-psychological effects of female plus-size teens wearing male, maternity or resale apparel for fit</td>
<td>Qualitative to conduct in-depth interviews, field studies, or detailed survey</td>
</tr>
<tr>
<td>Average-Size and Plus-Size Teens and Their Definition of Apparel Comfort</td>
<td>Quantitative to conduct survey or mixed methods to collect survey data in conjunction with in-depth interviews</td>
</tr>
<tr>
<td>Determination of outlier values for differential body measurements</td>
<td>Quantitative to test hypothesized values for outliers using live participants and dress forms of various shapes and sizes</td>
</tr>
</tbody>
</table>

In sum, the findings of this study provide various future research directions to enhance the field of apparel, merchandising, and design. This study contributes significantly to the discipline’s knowledge of apparel issues faced by plus-size female teens. It confirmed findings of some previous studies and refuted assumptions made by others. It reported previously unknown issues surrounding plus-size female teens and revealed reasons for many of their style choices. These findings are useful to both industry and academia.

This study investigated in-depth apparel issues experienced by a previously unstudied niche market, the plus-size female teen aged 12-17 years. In doing so, it laid the groundwork
for future research by identifying areas where little or no information is currently known and revealing limitations which may be minimized in future research.

It is my hope that the finding of this study will encourage other researchers to further investigate apparel issues surrounding plus-size teens. Further research is needed to progress towards resolving the various issues that prevent their functional, expressive, and aesthetic wants and needs from being satisfied.
APPENDIX A
Human Subjects Research Approval
Date: 9/20/2012
To: Laurel Romeo
4610 Toronto St
Ames, IA 50014

From: Office for Responsible Research

Title: Exploration of the U.S. Plus-Size Female Teens’ Apparel Fit and Sizing

IRB ID: 12-405

Approval Date: 9/18/2012
Date for Continuing Review: 9/17/2013
Submission Type: New

The project referenced above has received approval from the Institutional Review Board (IRB) at Iowa State University according to the dates shown above. Please refer to the IRB ID number shown above in all correspondence regarding this study.

To ensure compliance with federal regulations (45 CFR 46 & 21 CFR 50), please be sure to:

- Use only the approved study materials in your research, including the recruitment materials and informed consent documents that have the IRB approval stamp.
- Retain signed informed consent documents for 3 years after the close of the study, when documented consent is required.
- Obtain IRB approval prior to implementing any changes to the study by submitting a Modification Form for Non-Exempt Research or Amendment for Personnel Changes form, as necessary.
- Immediately inform the IRB of (1) all serious and/or unexpected adverse experiences involving risks to subjects or others; and (2) any other unanticipated problems involving risks to subjects or others.
- Stop all research activity if IRB approval lapses, unless continuation is necessary to prevent harm to research participants. Research activity can resume once IRB approval is reestablished.
- Complete a new continuing review form at least three to four weeks prior to the date for continuing review as noted above to provide sufficient time for the IRB to review and approve continuation of the study. We will send a courtesy reminder as this date approaches.

Please be aware that IRB approval means that you have met the requirements of federal regulations and ISU policies governing human subjects research. Approval from other entities may also be needed. For example, access to data from private records (e.g., student, medical, or employment records, etc.) that are protected by FERPA, HIPAA, or other confidentiality policies requires permission from the holders of those records. Similarly, for research conducted in institutions other than ISU (e.g., schools, other colleges or universities, medical facilities, companies, etc.), investigators must obtain permission from the institution(s) as required by their policies. IRB approval in no way implies or guarantees that permission from these other entities will be granted.

Upon completion of the project, please submit a Project Closure Form to the Office for Responsible Research, 1138 Pearson Hall, to officially close the project.

Please don’t hesitate to contact us if you have questions or concerns at 515-294-4566 or irb@iastate.edu.
The project referenced above has received approval from the Institutional Review Board (IRB) at Iowa State University according to the dates shown above. Please refer to the IRB ID number shown above in all correspondence regarding this study.

To ensure compliance with federal regulations (45 CFR 46 & 21 CFR 56), please be sure to:

- Use only the approved study materials in your research, including the recruitment materials and Informed consent documents that have the IRB approval stamp.
- Retain signed Informed consent documents for 3 years after the close of the study, when documented consent is required.
- Obtain IRB approval prior to implementing any changes to the study by submitting a Modification Form for Non-Exempt Research or Amendment for Personnel Changes form, as necessary.
- Immediately inform the IRB of (1) all serious and/or unexpected adverse experiences involving risks to subjects or others; and (2) any other unanticipated problems involving risks to subjects or others.
- Stop all research activity if IRB approval lapses, unless continuation is necessary to prevent harm to research participants. Research activity can resume once IRB approval is reestablished.
- Complete a new continuing review form at least three to four weeks prior to the date for continuing review as noted above to provide sufficient time for the IRB to review and approve continuation of the study. We will send a courtesy reminder as this date approaches.

Please be aware that IRB approval means that you have met the requirements of federal regulations and ISU policies governing human subjects research. Approval from other entities may also be needed. For example, access to data from private records (e.g., student, medical, or employment records, etc.) that are protected by FERPA, HIPAA, or other confidentiality policies requires permission from the holders of those records. Similarly, for research conducted in institutions other than ISU (e.g., schools, other colleges or universities, medical facilities, companies, etc.), investigators must obtain permission from the institution(s) as required by their policies. IRB approval in no way implies or guarantees that permission from these other entities will be granted.

Upon completion of the project, please submit a Project Closure Form to the Office for Responsible Research, 1138 Pearson Hall, to officially close the project.

Please don't hesitate to contact us if you have questions or concerns at 515-294-4566 or IRB@iastate.edu.
APPENDIX B
Recruitment Letter
Invitation to Participate in Apparel Research at Iowa State University

A research study investigating clothing fitting issues experienced by plus-size females between the ages of 12-17 years is being conducted in Apparel, Merchandising, and Design program at Iowa State University. The purpose of this research is to gather sizing information about plus-size teens and investigate issues experienced with the fit of the clothing currently available on the market.

Your participation in this study is completely voluntary. The identity of participants will remain confidential and no data collected will be attached to the participant’s name, or name of the Parent/Guardian or Legally Authorized Representative. Each person who participates will receive $25.00, and if you request, a complete list of your measurements will be provided at the time they are taken, you may also enroll in a drawing for an iPod, and take a guided tour of the Apparel Merchandising and Design department.

If you choose to participate in this study, you will be asked to:
1. Discuss with the researcher your opinion of the plus-size clothing currently on the market, any fitting issues your experience and provide suggestions for future changes.
2. Have your weight taken.
3. Have a full body scan while wearing a scanning suit. The full body scanner represents the latest technology and permits a comprehensive set of 3D body measurements to be taken in seconds without touching the body. The 3D body scanner utilizes cameras to digitally record body contours and create a computer avatar.

Approximately 1.5 hours of your time will be required and you must travel to the Iowa State University Campus one time to engage in this research.

To qualify for participation in this research you must:
1. Be a female between the ages of 12 – 17 years.
2. Wear plus-size clothing.
3. Be able to stand for the body scan.
4. Have a Parent/Guardian or Legally Authorized Representative’s read a sign a Consent to Participate in Research form written in English. If Parent/Guardian or Legally Authorized Representative will not be accompanying the participant to the research appointment the Parent/Guardian or Legally Authorized Representative must sign the form and the participant must give it to the researcher at the time of the appointment.
5. You should not participate if you are prone to seizures, as the 3D body scan uses flashing light to digitally capture your measurements.

To enroll in this study, please email Laurel Romeo at: ldromeo@iastate.edu
If you have any questions concerning the rights of research participants or research-related injury, please contact the Iowa State University Institutional Review Board Administrator at (515) 294-4566, IRB@iastate.edu, or Director, Office of Research Assurances, (515) 294-3115, 1138 Pearson Hall, Ames, IA 50011.

We thank you for your participation in this study.
Laurel Romeo: Iowa State University Department of Apparel, Events, and Hospitality Management, 31 MacKay Hall, Ames, IA 50011
Young-A Lee: Iowa State University Department of Apparel, Events, and Hospitality Management, 1073 LeBaron Hall, Ames, IA, 50011
APPENDIX C
Recruitment Flier
Teen Girls Interested in Fashion

If you are a girl age 12-17 and have trouble finding plus-size clothing in the styles you want that fits ... help us solve your problem.

A research investigating clothing fitting issues experienced by females between the ages of 12-17 years who wear plus-size clothing is being conducted in Apparel, Merchandising, and Design program at Iowa State University. The purpose of this research is to gather sizing information about females that wear plus-sizes and investigate issues they are experiencing with the fit of the clothing currently on the market.

Study participants will be asked to:
1. Fill out a brief survey.
2. Discuss with a researcher your opinion of the clothing currently on the market including any fitting issues you experience, and provide suggestions for future changes to apparel for plus-size teen girls.
3. Have your weight taken and have a full body scan while wearing a tight-fitted white lycra outfit. The full body scanner represents the latest technology and permits a comprehensive set of 3D body measurements to be taken in 10-15 seconds without touching the body. The 3D body scanner utilizes white-light cameras to digitally record body contours and create a computer-generated 3D body model.

Approximately 1.5 hours of your time will be required and you must travel to the Iowa State University Campus one time to participate.

To qualify for participation in this research you must:
1. Be a female between the ages of 12-17 years.
2. Wear plus-size clothing.
3. Be able to stand for the body scan.
4. Have a Parent/Guardian or Legally Authorized Representative read and sign a Consent to Participate in Research form written in English. Parent/Guardian or Legally Authorized Representative are not required to accompany you to the campus.
5. You should not participate if you are prone to seizures, as the 3D body scan uses flashing light to digitally capture your measurements.

Each person who participates will receive $25.00 and can enter a drawing for an iPod.

Additionally, if you request, a complete list of your measurements will be provided at the time they are taken and you may take a guided tour of the Apparel Merchandising and Design department.

To sign up for a session, please take the contact info below and e-mail your interest to the research investigator.
APPENDIX D
Newspaper Advertisement
Seeking Girls Age 12-17 for Clothing Fit Research

Research is being conducted in the Apparel, Merchandising, and Design Program at Iowa State University to improve plus-size teen clothing

You will come to the ISU Campus, fill out a brief survey, discuss fitting issues you experience, and provide suggestions for improving plus-size teen clothing.

• The interview session will also include a state of the art 3D body scan in order to digitally record body contours and measurements.

• The interview and 3D body scan will take approximately 1 ½ hours. Parent or legal guardian must give written consent.

• Participants will receive compensation of $25.00 and may enter a drawing for an iPod.

For complete information, eligibility, and to enroll in this study contact:
Laurel Romeo at LDROME@iastate.edu
Please provide: Name, Phone number, and best time to contact you.
APPENDIX E
Public Service Announcement
This is a public service announcement about plus-size clothing research at Iowa State University

A research study is being conducted at Iowa State University to investigate clothing fit issues experienced by young women who wear plus-size clothing. Are you a female between the ages of 12-17? Do you have trouble finding clothing that fits in the styles you like? You may be eligible to participate in this study. To participate, you will travel to the Iowa State University campus in Ames one time to discuss clothing fit issues with a researcher, and have a 3D body scan taken. Approximately 1 and ½ hours of your time will be needed and you will compensated $25.00 and have the opportunity to enter a drawing for an iPod. You must have written permission from a parent or legal guardian to participate. For additional information, eligibility, and to enroll in this study contact: LDRomeo@iastate.edu. Provide your name, phone number and best time to call. All participants’ identities will remain confidential.
APPENDIX F
Phone Script
PHONE SCRIPT TO SCHEDULE RESEARCH APPOINTMENT

My name is Laurel Romeo, I am calling from the Apparel, Merchandising, and Design program at Iowa State University. I received an email from (NAME) expressing interest in a research study I am conducting at the university. Is (NAME) available? Is (NAME) the person interested in participating in the study or her parent or guardian? If the potential participant or her parent/guardian are not available I will ask if there is a time when they can be contacted. No information concerning the nature of the research will be discussed with anyone other than individuals indicating she is the potential participant or her parent or guardian. If asked the nature of the study I will say: Due to confidentiality rules governing research, I am unable to discuss the nature of the research study with anyone other than (NAME) or her parent or guardian.

If I am speaking to the minor interested in the research:

(NAME) thank you for contacting me about the research I am conducting. I will need to have your Parent/Guardian or Legally Authorized Representative read and sign a Consent to Participate in Research form written in English, which we will provide, in order for you to participate in the study. What is the name of your Parent/Guardian or Legally Authorized Representative who would be signing the form? Is (Parent/Guardian or Legally Authorized Representative NAME) available to talk on the phone at this time? Is there a time when I can speak with him/her? How did you find out about the study?

If you decide to participate in the study you will be asked to: Fill out a demographic survey about your age and race/ethnicity; Take part in a brief recorded discussion about the clothing choices available to you, fitting issues you experience, and what designers and clothing manufacturers can do to meet your wants and needs; Have your weight taken and full body scanned with the [TC]² NX-16 white-light 3D body scanner while wearing a tight-fitted scanning suit. These activities will all take place on one day and require approximately one and half hours of your time. You should not participate if you are prone to seizures, as the 3D body scan uses flashing light to digitally capture your measurements.

You will receive $25.00 for participating and you may enter your name in a drawing for an iPod which will take place at the end of the research study. If you request you will also be provided a copy of your body scan measurements and given a guided facility tour of the Apparel, Merchandising, and Design program.

Do you have any questions concerning the study?

I need to confirm you meet the study inclusion criteria.

1. Are you a female between the ages of 12-17 years?
2. Do you wear a plus-size?
3. Will you be able to stand for the body scan?
4. Will your Parent/Guardian or Legally Authorized Representative’s provide written consent for you to participate in this research? This can be signed at the time of the
research appointment or if you would like to read it ahead of time or your Parent/Guardian or Legally Authorized Representative will not be accompanying you to the campus I can email you a copy of the Consent to Participate in Research form. Would you like me to send a copy to you? If your Parent/Guardian or Legally Authorized Representative will not be accompanying you to the appointment you must bring the signed form with you in order to participate in the research.

Would you like to set an appointment date and time for your research appointment? I would like to confirm the email address where the confirmation form will be sent. The confirmation form has your date, time, and location on campus where you will need to come and a link to campus maps. Would you like a guided tour of the Apparel Merchandising and Design department after your appointment? Confirm date, time, location and thank her for agreeing to participate.

If you have any additional questions or need to cancel your appointment please contact me at ldromeo@iastate.edu

**If I am speaking to the parent or guardian:**

(NAME) my name is Laurel Romeo, I received an email from (NAME) expressing interest in a research study. I am conducting aimed at improving the fit of apparel for girls aged 12-17 years who wear plus-size clothing. This research will take place on Iowa State University’s campus in the LeBaron building where the Apparel, Merchandising, and Design program is located. If (NAME) decides to participate in the study she will be asked to: Fill out a demographic survey about her age and race/ethnicity; Take part in a brief recorded discussion about the clothing choices available to her, fitting issues she experiences, and what designers and clothing manufacturers can do to meet her wants and needs; Have her weight taken and full body scanned with the [TC]² NX-16 white-light 3D body scanner while wearing a tight-fitted scanning suit. These activities will all take place on one day and require approximately one and half hours of her time. She should not participate if she is prone to seizures, as the 3D body scan uses flashing light to digitally capture her measurements.

To qualify for participation in this research she must:

1. Be a female between the ages of 12-17 years.
2. Wear plus-size clothing.
3. Be able to stand for the body scan.
4. Have a Parent/Guardian or Legally Authorized Representative read and sign a Consent to Participate in Research document written in English which we will provide in order for (PARTICIPANT’S NAME ) to participate in this research. This can be signed at the time of the research appointment or if you would like to read it ahead of time or will not be accompanying her to the campus I can email you a copy of the
Consent to Participate in Research form. Would you like me to send a copy to you? If you will not be accompanying (PARTICIPANT’S NAME) to the appointment she must bring the signed form with her in order to participate in the research.

These activities will all take place on one day and require approximately one and half hours of (PARTICIPANT’S NAME) time. She will receive $25.00 for participating in this study and she may enter her name in a drawing for an iPod which will take place at the end of the research study. If she requests she will also be provided a copy of your measurements and given a guided tour of the Apparel Merchandising and Design department.

Do you have any questions about the study? What day of the week and time is best for you? Would you and (PARTICIPANTS NAME) like a guided tour of the Apparel, Merchandising, and Design program when your appointment is finished?

I will email you an appointment confirmation with a link to a map of the campus. Would you like to receive the Consent to Participate in Research document now so you can read it before the appointment? Thank you for your interest in this research I will see you (CONFIRM DATE, TIME AND LOCATION). If you have any additional questions or need to cancel your appointment please contact me at ldromeo@iastate.edu
APPENDIX G
Appointment Confirmation
Confirmation of Appointment to Participate in Research at Iowa State University’s Apparel, Merchandising, and Design Program

To:
Email:
Phone:

Thank you for your interest in participating in the research study titled “Exploring apparel fitting issues experienced by plus-size female teens”. A researcher will meet you in the lobby of the Human Nutritional Sciences Building and escort you to the lab located at 1057 LeBaron Hall. Your appointment time to meet the researcher is scheduled for:

Date:
Time:
Location: Human Nutritional Sciences Building lobby located at the corner of Osborn Drive and Morrill Road across from Parks Library.

Campus map: http://www.fpm.iastate.edu/maps/default.asp?zoom=2&xcenter=1796&ycenter=1933&background=map&layer=buildingnames&xshow=1796&yshow=1933

Written permission from a Parent/Guardian or Legally Authorized Representative is required for participation in this research. The Parent/Guardian or Legally Authorized Representative will be required to sign a document consenting to participation at the research appointment and should accompany the participant to the campus.

If you need to cancel your appointment for any reason, please contact Laurel Romeo at lromeo@iastate.edu; (515) 294-7474 or Young-A Lee at ylee@iastate.edu; (515) 294-7826.
APPENDIX H
Informed Consent Document
INFORMED CONSENT DOCUMENT

Title of Study: Exploring apparel fitting issues experienced by plus-size female teens

Investigators: Laurel Romeo, PhD candidate, Apparel, Merchandising, and Design Program
Young-A Lee, PhD, Apparel, Merchandising, and Design Program

This is a research study. Please take your time in deciding if you would like to participate. Please feel free to ask questions at any time.

INTRODUCTION

The purpose of this study is to identify apparel fitting issues experienced by plus-size female teens and to eventually create a new clothing size category that addresses the size and fit needs of today’s teens. You are being invited to participate in this study because you represent the size and shape of many young women in your age bracket. You should not participate if you: (a) do not have parental consent, if your Parent/Guardian or Legally Authorized Representative will not be accompanied you to the research appointment the Parent/Guardian or Legally Authorized Representative must signed this form and it must be given to the researcher at the time of the appointment, (b) are unable to stand to have your body scanned, (c) are younger than 12 years of age or older than 17 years of age, (d) do not want to participate in all the activities described in the procedures section of this form, or (e) are prone to seizures, as the 3D body scan uses flashing light to digitally capture your measurements.

DESCRIPTION OF PROCEDURES

If you agree to participate, you will be asked to participate in three activities:

- Fill out a short survey about your age, race/ethnicity, grade in school and clothing size.
- Take part in a brief recorded discussion about the clothing choices available to you, fitting issues you experience, and what designers and clothing manufacturers can do to meet your wants and needs. The interview will be tape recorded unless you request that a written record be taken instead.
- Have your weight taken and full body scanned with the [TC]² NX-16 white-light 3D body scanner while wearing a tight-fitted, light colored lycra suit of shorts and tank top provided by the data collector. The light colored outfit is required to give an accurate 3D scan of your body. The data collector/researcher will contact you via e-mail beforehand to schedule an appointment time and to get size information from you.

During the data collection session, only the data collector and an assistant running the body scanner will be present. These activities will all take place one day and require approximately 60-90 minutes of your time.
RISKS

There are no known risks for participating in this study. There is no reason to believe that participation in this research will result in any physical, social, legal, or economic risks greater than would be encountered in everyday life. It is possible that you may have some emotional reaction to the 3D scan views of your body, discomfort while wearing the snugly fitting scanning suit, and discomfort while discussing fitting issues you have experienced with your clothing. The researchers will not evaluate your physical shape or comment in any way about your body.

BENEFITS

If you decide to participate in this study, you may not receive any direct benefit from taking part in this study. However, the data will provide insight into developing a new apparel sizing category which addresses the fit and size needs of today’s teens. The findings will also benefit society by providing a foundation for a nationwide study aimed at updating body measurement data of teens. You may have a printout of your body scan measurements if you would like one.

COSTS AND COMPENSATION

You will not have any costs from participation in this study. Each person who participates will receive $25.00 and, you may enter your name in a drawing for an iPod which will take place at the end of the research. Approximately 50 research participants will be entered into the drawing. The winner will be randomly chosen by the drawing of an entry form from a container. If you win, you will be notified by email and the iPod will be delivered to you by the U.S. postal service. If you request you will also be provided a copy of your body scan measurements and given a guided facility tour of the Apparel, Merchandising, and Design program.

PARTICIPANT RIGHTS

Your participation in this study is completely voluntary and you may refuse to participate or leave the study at any time. If you decide to not participate in the study or leave the study early, it will not result in any penalty or loss of benefits to which you are otherwise entitled. In the brief discussion/interview on clothing fit issues, you can skip any questions that you do not wish to answer.

CONFIDENTIALITY

Data analysis and reports of research findings will focus on summary statistics, with no information reported that would enable detection of individual participating subjects. We will be bound by the confidentiality guarantee we have made. Thus, confidentiality will be protected in presentations and publications of research reports. Your identity will remain confidential in any report of the data.

Records identifying participants will be kept confidential to the extent permitted by applicable laws and regulations and will not be made publicly available. However, auditing departments of Iowa State University, and the Institutional Review Board (a
committee that reviews and approves human subject research studies) may inspect and/or copy your records for quality assurance and data analysis. These records may contain private information.

To ensure confidentiality to the extent permitted by law, the following measures will be taken: Your name or the name of your guardian will not be associated with any data collected. Each participant will be assigned an unique code that will be used on forms instead of her name, and the data will be stored in a password protected computer file. The consent form with your signature will not be given the code number. Interview recordings will be destroyed as soon as transcription is completed (or by July 31, 2013). The data file will be retained for three years after completion of the project and will be destroyed afterwards.

QUESTIONS OR PROBLEMS
You are encouraged to ask questions at any time during this study.

- For further information about the study contact Laurel Romeo at (515) 294-7474; ldromeo@iastate.edu or Young-A Lee at (515) 294-7826; ylee@iastate.edu.

If you have any questions about the rights of research subjects or research-related injury, please contact the IRB Administrator, (515) 294-4566, IRB@iastate.edu, or Director, (515) 294-3115, Office for Responsible Research, Iowa State University, Ames, Iowa 50011.

************************************************************************

PARTICIPANT SIGNATURE

Your signature indicates that you voluntarily agree to participate in this study, that the study has been explained to you, that you have been given the time to read the document, and that your questions have been satisfactorily answered. You will receive a copy of the written informed consent prior to your participation in the study.

Participant’s Name (printed) ____________________________________________

(Participant’s Signature) ____________________________________________________________________________ (Date)

(Signature of Parent/Guardian or Legally Authorized Representative) ____________________________________________________________________________ (Date)
APPENDIX I
Entry Form for Drawing of iPod
**Teen Clothing Fit Research Drawing Sheet**

Approximately 50 research participants will be entered into the drawing. One winner will be randomly chosen by the drawing of an entry form from a container. If you win, you will be notified by email and the iPod delivered by the U.S. postal service.

<table>
<thead>
<tr>
<th>Drawing for an iPod</th>
</tr>
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<tbody>
<tr>
<td>Name:</td>
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<tr>
<td>Phone:</td>
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<tr>
<td>Email:</td>
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<tr>
<td>Address:</td>
</tr>
</tbody>
</table>
APPENDIX J
Interview Instrument
FEMALE TEENS CLOTHING FIT RESEARCH

Participant number:_____________

Demographic Survey

Directions: The following questions will help us gain a better understanding of the people participating in this study. Please answer questions 1-4.

1. In what year were you born?___________

2. What ethnic group(s) do you consider yourself to be a member of? Please check all that apply.
   _____ White/European American
   _____ African American/Black
   _____ Native Hawaiian and Other Pacific Islander
   _____ Asian
   _____ American Indian/Alaska Native
   _____ Hispanic American or Latina
   _____ Other? (please specify)________________

3. What is your grade level in school?________________

4. What size clothing do you wear?__________________

The following section will be completed by researcher based upon data collected.

5. Participant’s height in feet and inches?______foot _______inch

6. Participant’s weight in pounds?___________

7. Participants ASTM apparel category and size? ___________________________

INTERVIEW QUESTIONS: APPAREL FIT ISSUES

Please think about your clothing shopping experiences.

1. Do you have difficulty finding clothing you like that fits properly?

2. What do you do when you cannot find clothing that you like that fits properly?

3. When you are deciding if a garment fits, what do you consider?
4. Please point to the numbered lines on these sketches where you have trouble with your clothing fitting. What is wrong with the way your clothing fits in that area?

**FRONT VIEWS**

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<thead>
<tr>
<th>Line</th>
<th>Description</th>
<th>Line</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Center neck point to waist</td>
<td>8.</td>
<td>Across upper chest between shoulder joints</td>
</tr>
<tr>
<td>2.</td>
<td>Side of neck to bust apex</td>
<td>9.</td>
<td>Across bust from side seam to side seam</td>
</tr>
<tr>
<td>3.</td>
<td>Center front waist to crotch</td>
<td>10.</td>
<td>Front waist from side seam to side seam</td>
</tr>
<tr>
<td>4.</td>
<td>Front waist to floor</td>
<td>11.</td>
<td>Front hips from side seam to side seam</td>
</tr>
<tr>
<td>5.</td>
<td>Shoulder point to elbow</td>
<td>12.</td>
<td>Thigh circumference</td>
</tr>
<tr>
<td>6.</td>
<td>Side neck to shoulder point</td>
<td>13.</td>
<td>Calf circumference</td>
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<td>7.</td>
<td>Bicep circumference</td>
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<td>Line</td>
<td>Description</td>
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<tr>
<td>14.</td>
<td>Back base of neck to waist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>Back waist to crotch</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td>Across upper back between shoulder joints</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17.</td>
<td>Across shoulder blades between shoulder joints</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18.</td>
<td>Across back waist from side seam to side seam</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.</td>
<td>Across back hips from side seam to side seam</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5. Do you try on garments in the store or just purchase according to size? Why?

6. Where do you usually purchase your clothing? For examples, in-store vs catalog vs online vs TV shopping. Why do you prefer those than others?

7. What do you like or not like about clothes shopping? Why?

8. What is the most important to you about the clothing you wear to school? Why?

9. Do you participate in sports or other activities in or outside of school where you need special clothing? For example soccer team, dance, gymnastics, band, exercise class.

10. Do you exercise on a regular basis? Do you wear other clothing for that activity or the clothing you wear to school? Why?

11. a. If participant is engaged in activity: Do you experience any problems obtaining the uniforms or special clothing needed?

b. If participant is not engaged in activity: Is clothing availability a factor in your participation in extracurricular activities? If clothing is not an issue which extracurricular activities would you like to engage in?

12. What does “comfortable clothing” mean to you?

13. What does “good fit” mean to you? How do you define the term “fit”?

14. Do you find your clothing comfortable to wear? If negative response: What makes you uncomfortable?

15. Are you more concerned about the style, cost, or comfort of clothing? Why?

16. Are you satisfied with the styles of clothing available to you? Do you feel like your clothing is as fashionable as your peers? If negative response, why do you feel less fashionable than your peers?

17. If you could design your own clothing, would it be different than what you currently own? How?

18. What advice would you give apparel industry professionals about designing clothing for plus-size teens?

19. Any other thoughts?
APPENDIX K
Participant’s Body Mass Index
Table K1. Each participant’s body mass index (BMI) (N=30).

<table>
<thead>
<tr>
<th>Age in Years</th>
<th>Height (Inches)</th>
<th>Weight (Pounds)</th>
<th>BMI</th>
<th>BMI Percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Twelve</td>
<td>65.75</td>
<td>213.6</td>
<td>34.5</td>
<td>&gt;95</td>
</tr>
<tr>
<td>Twelve</td>
<td>64.50</td>
<td>155.0</td>
<td>26.7</td>
<td>&gt;95</td>
</tr>
<tr>
<td>Twelve</td>
<td>62.00</td>
<td>171.2</td>
<td>31.4</td>
<td>&gt;95</td>
</tr>
<tr>
<td>Twelve</td>
<td>64.50</td>
<td>152.4</td>
<td>26.2</td>
<td>&gt;95</td>
</tr>
<tr>
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<td>65.50</td>
<td>118.8</td>
<td>19.8</td>
<td>71</td>
</tr>
<tr>
<td>Thirteen</td>
<td>66.50</td>
<td>187.2</td>
<td>30.3</td>
<td>&gt;95</td>
</tr>
<tr>
<td>Thirteen</td>
<td>67.00</td>
<td>187.2</td>
<td>29.4</td>
<td>&gt;95</td>
</tr>
<tr>
<td>Thirteen</td>
<td>63.50</td>
<td>181.4</td>
<td>32.2</td>
<td>&gt;95</td>
</tr>
<tr>
<td>Thirteen</td>
<td>64.00</td>
<td>175.8</td>
<td>30.1</td>
<td>95</td>
</tr>
<tr>
<td>Fourteen</td>
<td>66.00</td>
<td>204.6</td>
<td>33.1</td>
<td>&gt;95</td>
</tr>
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<td>Fourteen</td>
<td>62.25</td>
<td>142.0</td>
<td>26.0</td>
<td>93</td>
</tr>
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<td>205.0</td>
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</tr>
<tr>
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<td>350.0</td>
<td>50.3</td>
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<td>65.50</td>
<td>194.2</td>
<td>32.4</td>
<td>&gt;95</td>
</tr>
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<td>62.50</td>
<td>179.4</td>
<td>32.9</td>
<td>&gt;95</td>
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<tr>
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</tr>
<tr>
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<td>233.0</td>
<td>40.1</td>
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<td>253.8</td>
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<td>&gt;95</td>
</tr>
<tr>
<td>Seventeen</td>
<td>67.00</td>
<td>214.2</td>
<td>33.6</td>
<td>&gt;95</td>
</tr>
<tr>
<td>Seventeen</td>
<td>66.00</td>
<td>156.0</td>
<td>25.2</td>
<td>85</td>
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<tr>
<td>Seventeen</td>
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<td>95</td>
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<tr>
<td>Seventeen</td>
<td>63.00</td>
<td>144.0</td>
<td>25.6</td>
<td>86</td>
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</tbody>
</table>

*Note.* BMI percentile based on The Stature-for-Age and Weight-for-Age percentiles for girls 2 to 20 years chart, published in The Department of Health and Human Services Centers for Disease Control and Prevention 2000 CDC Growth Charts for the United States: Methods and Development Report (2000).
REFERENCES


NoteTab Light (Version 7.1) [Computer software]. Gruyère, Switzerland: Fookes Software, Ltd.


