Design Functions in Transformable Garments for Sustainability

A DISSERTATION
SUBMITTED TO THE FACULTY OF THE GRADUATE SCHOOL
OF THE UNIVERSITY OF MINNESOTA
BY

Helen Koo

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

Dr. Elizabeth Bye and Dr. Lucy Dunne
Advisers

AUGUST 2012

Acknowledgements

I would like to express my sincerest gratitude to my advisers, Dr. Elizabeth Bye and Dr. Lucy Dunne, who were abundantly helpful and offered consistent encouragement, support, and inspiration throughout my graduate life at the University of Minnesota. Without their persistent support and guidance from the beginning to the completion of the research, this dissertation would not have been possible.

In addition, my deepest appreciation goes to my committee members, Dr. Marilyn DeLong and Dr. Brad Hokanson, for the encouragement and insight they have shared. They gave endless inspirations and suggestions on this research.

I would like to convey thanks to Dr. Karen LaBat. I had a great time working in her classes and creativity research projects. Interacting with her was a great opportunity to learn about teaching and becoming a creative professor. In addition, I am grateful to the Department of Design, Housing, and Apparel for the funding that enabled me to start and finish the journey of this research.

Above all, I am heartily thankful to my family for their understanding and endless love through the duration of my studies. I offer special thanks to all my friends who have always been there for me.

Abstract

This study was designed as a bottom-up approach to understand what kind of changeable functions people desire in transformable garments by analyzing a wardrobe database, participants' perceptions of garment varieties, and their values related to transformable garments.

The wardrobe database (2009–2011) was analyzed using data quantification and descriptive analysis. Seven style-conscious professional working women, between the ages of 20 and 40 were interviewed focusing on their perceptions and values related to tops. Versatility was the most important reason for preferring specific changeable design functions. Participants had three expectations for transformable garments: functional, hedonic, and social. Functional expectations included ease of matching, ease of layering, comfort, usability, ease of care, and durability. Among functional expectations, usability, care, and durability, were requirements for frequent and long-term use of transformable garments. Participants wanted to have fun and be able to experiment with various styles in hedonic expectations. Social expectations were context aptness, and modesty. In this study, several models regarding transformable garments and criteria for evaluating transformable garment design were suggested. Among candidates for changeable design functions, the most preferred functions were transforming colors/patterns and sleeve lengths.

Transformable garments have the potential to lead consumers' natural engagement with sustainable acts by satisfying their various needs and wants. In an effort to motivate consumers to care more about the sustainability of their clothing, many

researchers have suggested educating consumers. However, transformable garments are expected to influence consumers to wear these pieces over longer periods of time and more frequently due to their ability to serve multiple needs. Even though consumers may lack knowledge or indicate little concern about sustainability, transformable garments have the potential to encourage them to engage in sustainable behavior without their awareness. Designers can support this behavior by encouraging consumers to naturally consider versatile, transformable fashion while still satisfying their needs and wants.

Table of Contents

List of Tables

List of Figures

CHAPTER ONE: INTRODUCTION

Justification

Consumers purchase, wear, and dispose of diverse garments throughout their entire lives. Although individual wardrobes can be large and many garments are added each year, a relatively small percentage of the wardrobe is regularly worn (Banim, & Guy, 2003; Dunne, Zhang, Danzl, Koo, & Terveen, 2011; Woodward, 2007). Woodward (2007) found that about only 38% of clothing for women is work-related. Moreover, Dunne et al. (2011) reported that women subjects wore an average of only about 6% of their working wardrobe once per month in 3-month study.

Consumers often buy new garments to satisfy their changing needs and wants. Consumer preferences for appearance and expression through clothing changes frequently (Hethorn, 2008). The major movement of "fast fashion" has enabled overconsumption, and consequently the fashion industry's negative influences on the environment, the economy, and society have increased. Today, a number of apparel designers typically seek to enhance sustainability through making more sustainable choices within the existing practice of garment design; this approach addresses symptoms, but without altering the paradigm of the fashion system. Environment, Community, and Local Government (1998, 2004) suggested that the preferable way to manage waste is prevention and minimization in the waste management methods. If a garment can continue to satisfy changing consumer needs and wants while consumers are using and wearing the garment, this may extend the lifespan and frequency of use of an individual garment, reducing the overall garment consumption rate.

Transformable garments, which allow their aesthetics and functionality to be converted into multiple looks and functions to satisfy various consumer needs and wants, could offer a potential paradigm shift (Farrer, 2011; Dombek-Keith & Loker, 2011; Loker, 2008). For example, a garment that can change its color could replace a large number of different colored garments. A transformable garment is hypothesized to be worn for a longer period of time by adapting to changing consumer needs and wants, to prevent and minimize waste in the product lifecycle, and to reduce the amount of materials in the fashion ecosystem.

Fabrics are one of the top ten disposed material wastes (paper, glass, metals, plastics, wood, yard trimmings, food scraps, and others) of the municipal solid waste (MSW) generation in the United States. MSW keeps increasing about 3% per year, from 243 million tons in 2000 to 250 million tons in 2010, and waste clothing and footwear have increased about 38%, from 6470 thousand tons in 2000 to 8950 thousand tons in 2009, which is an 85% increase from 1960 to 2010 (U.S. Environmental Protection Agency, 2010). The EPA cites the increase of clothing and footwear waste as the most among non-durable goods, from 2.7% in 2000 to 3.6% in 2010. Only 14% of total waste of clothing and footwear were recovered in 2010.

Fast fashion, marked by low prices and quickly-updated new items, and disposable fashion, purposely designed to have a short lifespan, have become central trends influencing this increase in waste; they encourage consumers toward overconsumption (Fletcher, 2008; Hawley, 2008; Hethorn & Ulasewicz, 2008). Wasteful overconsumption causes an increase of resources in the fashion system's flow and has negative influences on the environment, economy, and society.

2

Sustainability and fashion might not be considered highly related to each other, but fashion can reduce its negative influence on the world by reducing materials in the fashion ecosystem, encouraging people to wear garments in a more sustainable way, and expanding clothing lifecycles. Clothing is an observable medium that can be used to encourage others to think about sustainability (Hethorn & Ulasewicz, 2008). Also, garments can be a communication medium between consumers and designers. Apparel designers have the power to influence consumers' behavior and have the responsibility to enhance sustainability in fashion (Black, 2008; Bye, 2010; Fletcher, 2008; Gwilt, 2011; Renfrew & Renfrew, 2009). Apparel designers interact with many industries and roles in the garment development process and they can make important decisions to adopt sustainable practices in design and production, and to communicate and encourage sustainable consumption. Designers can create numerous opportunities to be involved in increasing sustainability in people's everyday lives, such as influencing consumers' behavior through designed garments.

Consumers have changing and varying preferences about their appearance, and a desire to generate new ways of expressing themselves through clothing (Hethorn, 2008). If a garment can keep satisfying changing consumer needs and wants while consumers are using and wearing the garment, this may extend the lifespan and frequency of use of an individual garment and reduce the overall garment consumption rate.

Dombek-Keith and Loker (2011) state that most sustainable design focuses on manufacture rather than garment use, which is considered to be the consumers' responsibility. However, fashion designers can seek design strategies to influence and lead consumers to engage in sustainability more actively, for example, by wearing fewer

garments for a longer time (Dombek-Keith & Loker, 2011; Gwilt & Rissanen, 2011).

Among various ways to prevent and minimize waste generation, Farrer (2011) asserts

that garments that can change or evolve can deepen the relationship between garments

and consumers, and reduce the need to buy more garments. Transformable garments are

expected to increase the wear frequency rate, postpone disposal, and ultimately expand

the garment lifecycle as consumers transform their garments repeatedly. Figure 1

illustrates the existing garment lifecycle as described by Alwood, Laursen, Rodriguez,

and Bocken (2006) on the left, while the right side depicts the paradigm-shifting

influence of changing use behavior rather than production or manufacture. Transformable

garment design has the potential to impact the whole paradigm of consumer behavior and

direct the clothing lifecycle to become more sustainable.
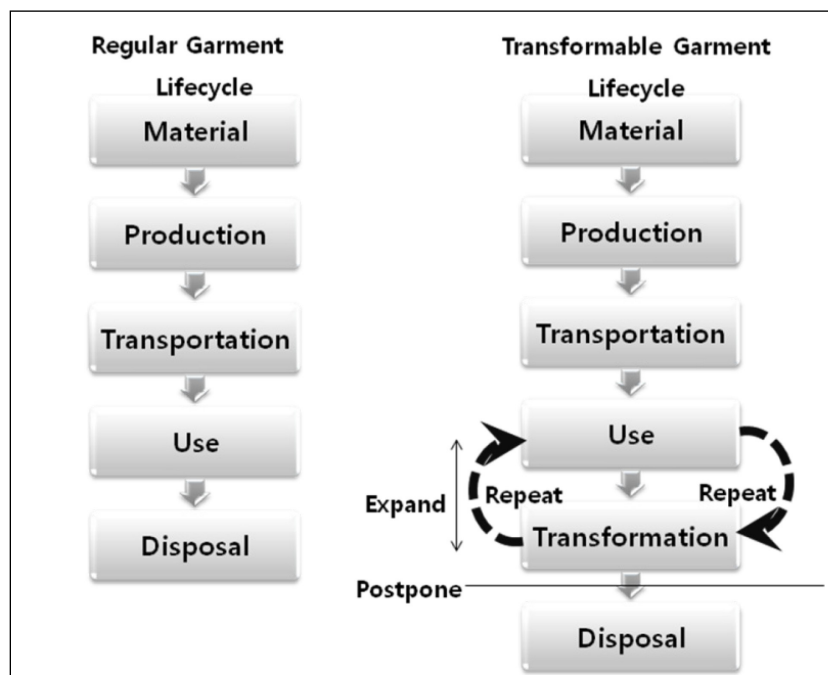
Figure 1. Regular garment lifecycle (Alwood, Laursen, Rodriguez, & Bocken, 2006) and the transformable garment lifecycle.

However, even though transformable garment design offers possibilities for changing the whole paradigm of fashion flow to be more sustainable, there is a lack of understanding about what consumers' value regarding variety in their garments and what design functions need to be changed in their garments. Thus, this research seeks to discover which garment design functions are good candidates for changeable design functions in transformable garments. What changeable design functions should a commercially successful transformable garment have?

Purpose of Research

The purpose of this study is to understand what kind of changeable functions people desire in transformable garments, and how these desires relate to sustainable consumption and use behaviors. Thus, this research was designed with a bottom-up approach by identifying varieties of garment design functions in people's wardrobes, and the varieties of garment design functions people value in their garments. It was also intended to give apparel designers ideas on what changeable design functions are worthy of being included in transformable garments to meet consumer needs and wants.

In addition, the specific objectives were: (a) to analyze the variation that people have among their garments and the differences among such variations in garment types in their wardrobes.; (b) to explore people's perceptions of variability in their wardrobes and the actual differences in their wardrobe; (c) to understand what types of variability people value in transformable garments.

Research Questions

The main research question was as follows: "What kind of changeable design functions do people desire in transformable garments?" The sub-research questions were outlined below.

1. What varieties do people have within each type of garment, and how do those varieties differ among garment types in their wardrobe?

2. What are the differences between the existing variety in garment design functions and the wearer's perceptions of variety of such functions?

3. What varieties and changeable design functions do people value and prefer to have in their transformable garments?

Contributions

The long-term goals of this research seek to identify consumers' values and desires regarding sustainable consumption, and variety and transformability in garments. The motivation for this research is the hypothesis that transformable garments could potentially modify consumers' behavior by encouraging them to wear garments longer and more frequently, to own fewer garments, and to extend clothing lifecycles. The results will help apparel designers develop garments that naturally lead consumers to adopt sustainable behaviors by transforming their garments to increase wear frequency rate.

Analyzed differences between the variety measured in consumers' actual wardrobes, their perceptions of this variety, and their preferences of garment designs will suggest a new way of viewing consumers' behavior in purchasing, storing, and wearing

their garments. This will guide apparel designers in developing transformable garments regarding consumers' preferences and expectations.

In addition, the identified changeable functions will provide insight to merchandisers and retail marketers in the fashion industry about motivations for selecting transformable garments.

CHAPTER TWO: LITERATURE REVIEW

Four aspects of the literature related to this research were reviewed:

1. The theoretical background for sustainability and sustainable apparel design strategies, to understand how apparel designers can increase sustainability in garment design.

2. The types of existing transformable garments and changeable aspects in garments, to discover what aspects are relevant and how they can be modified.

3. The assumptions and conceptual frameworks of sustainability, to reflect the objectives of this study.

4. Clothing selection criteria and design elements, to understand possible changeable design functions for transformable garments.

Sustainable Apparel Design Strategies in the Clothing Lifecycle

What does *sustainability* mean? Chouinard (2008) explained that a system is sustainable when the same amount of energy remains constant in a process, not exhausting resources or contaminating the environment. In addition, sustainability is concerned with not only looking at solutions that prevent exhausting environmental resources but also that protect social and economic resources (Gill, 2008; Hethorn & Ulasewicz, 2008).

Rodriguez, Roman, Sturhahn, and Terry (2002) suggested three spheres of influence in their sustainability model—social, economic, and environmental (Figure 2). If two of the three spheres are combined, they are environmental-social, environmental-

economic, or economic-social. Sustainable design needs to consider all three of these aspects. This model explains a basic view of sustainability and sustainable apparel design.
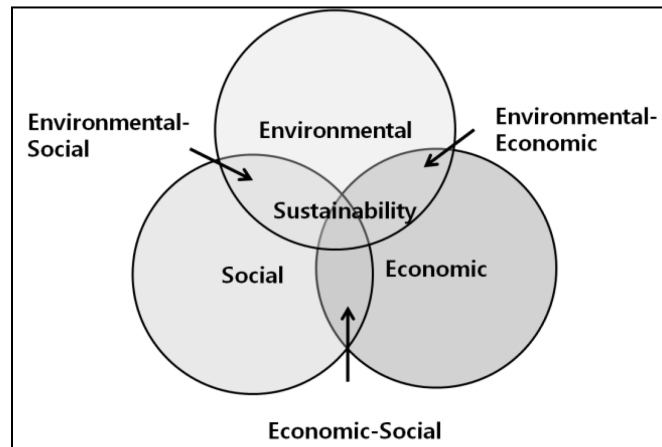
Figure 2. The three spheres of sustainability (Rodriguez, Roman, Sturhahn, & Terry, 2002)

There are various waste management hierarchy methods in practice. The model of the Environment, Community, and Local Government (1998, 2004), shown in Figure 3, will be reviewed here as it is firmly grounded in an internationally recognized hierarchy of waste management options. This model divides the management of solid wastes into six steps and explains the most favorable and least favorable methods: (a) prevention; (b) minimization; (c) reuse; (d) recycling; (e) energy recovery; and (f) disposal. Prevention or minimization is preferable over reuse or recycling (Figure 3).
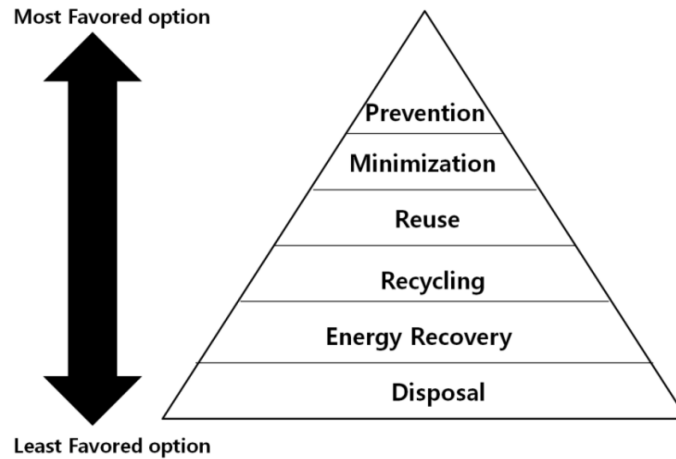
Figure 3. Waste management hierarchy (Environment, Community, and Local Government, 1998, 2004)

Loker (2008) described a sustainable fashion system created by technology. She viewed this type of sustainable fashion in two ways: (a) it increases efficiency by extending the product's lifespan and reducing both product and waste through technology aids for material choices, design processes, and production planning; and (b) it makes consumers more involved by recycling products and materials (Figure 4). Loker's model is a circular system with five phases that describe the circulation of energy and resources. She suggested examples of technologies for each phase of the garment lifecycle that designers can reference during the design process. Fewer garments and extended life spans are proposed as ways to increase sustainability related to consumer use, and transformable garments are expected to address these issues.

10
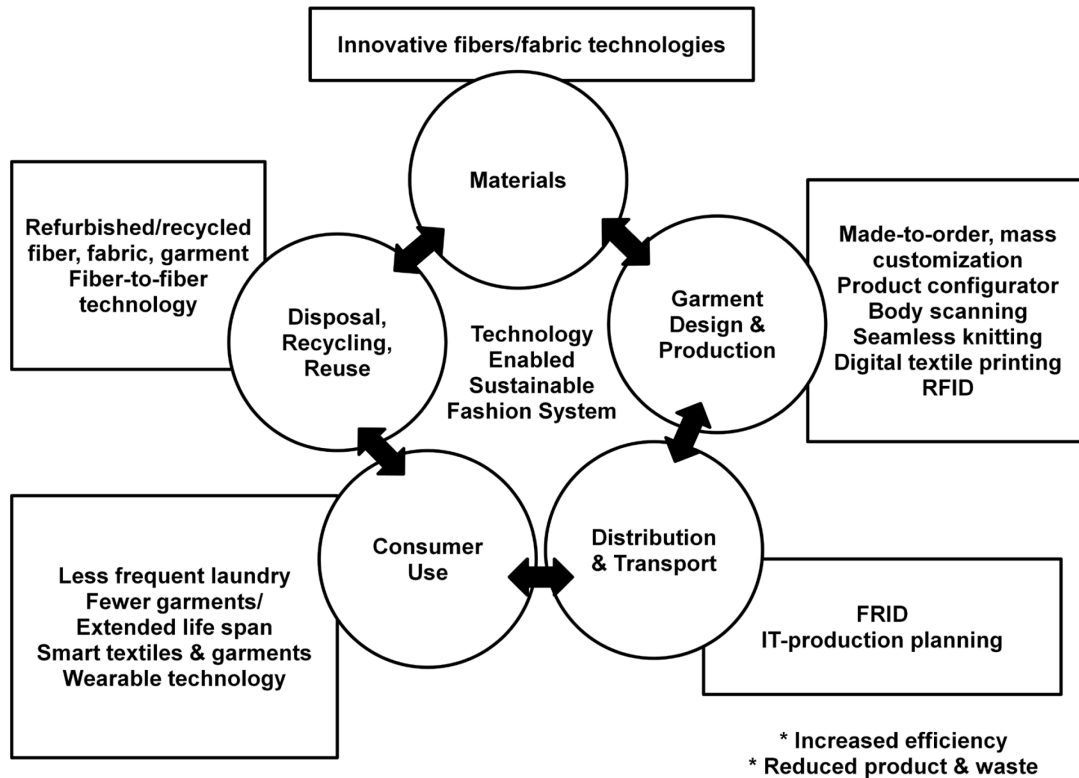
Figure 4. Technology enabled sustainable fashion system (Loker, 2008)

Sustainability can be increased when apparel designers consider the whole clothing lifecycle from material and production to end of life when they design, thereby expanding the whole clothing lifecycle and influencing consumers to be more sustainable (Alwood, Laursen, Rodriguez, & Bocken, 2006; Fletcher, 2008; Locker, 2008). To understand the common phases of the clothing lifecycle and what phases should be considered by apparel designers a clothing lifecycle consisting of five phases was extracted after reviewing the six major clothing lifecycles in the literature (Table 1). This is to create a meta-framework to synthesize existing frameworks of the clothing lifecycle and classify which apparel design strategies can increase sustainability after a literature review for each phase of the clothing lifecycle.

11

Table 1

Extracted New Clothing Lifecycle from Literatures

Clothing lifecycle	1	2	3	4	5
Fletcher's (2008) Product Lifecycle	Cultivation	Production Manufacturing	Distribution	Consumer laundering	Reuse/final disposal
Alwood et al.'s (2006) Lifecycle Phase	Material	Production	Transportation	Use	Disposal
Loker's (2008) Technology Enabled Sustainable Fashion System	Materials	Garment design, production	Distribution Transport	Consumer use	Disposal, recycling, reuse
World Watch Institute 's (2003) Lifecycle Assessment of a T-shirt	Raw materials	Processing Manufacturing	Packaging Transport	Use	Disposal
Rosselot & Allen's (2002) Product Lifecycle	Raw material acquisition	Material & Product manufacture	Transport	Use	Disposal
Graedel's (2008) Life Stage	Pre-manufacture	Product manufacture	Product delivery	Product use	Refurbish-ment Recycling Disposal
Extracted New Clothing Lifecycle	Material manufacture & selection	Garment design Manufacture	Packaging Distribution Transportation Retail	Consumer use	End of life

There are many ways to increase sustainability in apparel design in every phase of the clothing lifecycle. Literature focusing on sustainable apparel design strategies apparel was reviewed to give ideas to apparel designers to enhance sustainability in apparel design. Among the reviewed literature, those studies that suggest sustainable

apparel design strategies are classified according to every phase of the clothing lifecycle.

In the first phase of the clothing lifecycle, material manufacture and selection, many

researchers discussed sustainable design methods, such as using eco-friendly and high-

tech materials (Bye, 2010; Dombek-Keith & Loker, 2011; Farrer, 2011; Hawley, 2011;

Laursen & Hansen, 1997; Milmo, 2007; Oakers, 2009; O'Mahony, 2011; Orzada &

Moore, 2008; Schwartz & Laky, 2008; UNEP, 1993; Waite, 2009).

In the second phase, clothing manufacture, many introduced various ways,

including zero-waste patternmaking (Black, 2008; Bye, 2010; Farrer, 2011; Finney, 2006;

Fletcher, 2008; Gwilt, 2011; Gwilt & Rissanen, 2011; Hethorn, 2008; Lewis, 2008; Loker,

2008; Luke, 2008; Milmo, 2007; Oakers, 2009; O'Mahony, 2011; Orzada & Moore, 2008;

McQuillan, 2011; Rissanen, 2008; UNEP, 1993).

In the third phase of packaging, distribution, transportation, and retail, apparel

design is also inter-correlated to distribution, transportation, and retail methods, and

product design can impact and lead the methods of distribution, transportation, and retail

methods more sustainably (Bye, 2010; Dombek-Keith & Loker, 2011; Farrer, 2011;

Fletcher, 2008; Gwilt & Rissanen, 2011; Luke, 2008; Oakers, 2009; O'Mahony, 2011;

Ulasewicz, 2008; Welters, 2008).

In the consumer use phase, the fourth phase in the clothing lifecycle, consumers'

behavior concerning wearing and caring for clothes can be made more sustainable,

consciously and unconsciously, by apparel design that allows consumers to wear clothes

for longer and wash them less frequently (Allwood et al., 2006; Boradkar, 2010;

Dombek-Keith & Loker, 2011; Fletcher, 2008; Gwilt & Rissanen, 2011; Loker, 2008;

Oakers, 2009; O'Mahony, 2011; Rissanen, 2011; Sawa et al., 2003; Shove, 2003).

13

In the last phase, end of life, researchers suggested various ways to expand the clothing's end of life and to rebirth the clothing such as by reusing or recycling it (Allwood et al., 2006; Bye, 2010; Cupit, 1996; Fletcher, 2008; Gwilt & Rissanen, 2011; Hawley, 2011; McQuillan, 2011; O'Mahony, 2011; Palmer & Clark, 2005; Scott, 2008; Welters, 2008).

From the reviewed literature, detailed apparel designers' actions, including design strategies for sustainability, are classified according to the five phases of the clothing lifecycle and considered in all three spheres—social, economic, and environmental—as in Rodriguez et al. (2002) (Appendix A).

The sustainable apparel strategies shown in Appendix A are visually presented as an apparel designers' sustainable action model (Figure 5). This model synthesizes three models previously discussed: (a) Rodriguez et al.'s (2002) three spheres of sustainability: environmental, social, and economic; (b) waste management hierarchy models (Environment, Community, and Local Government, 1998, 2004) to guide the goal of prevention and minimization of wastes; and (c) Loker's (2008) model, presenting examples in the clothing lifecycle. The shaded regions (clothing manufacture and consumer use) represent the focus of this study, which is framed within the larger problem scope.

Material Manufacture & Selection (1)

Choosing fair vendors
Local manufacture
Recycled materials
Reuse materials
Hybrid materials
Eco-friendly fibers
Eco-friendly spinning, weaving and knitting
Closed-cycle for toxic chemical free
Eco-friendly textile bleaching:
Eco-friendly textile coloration
Standard sequence of effluent treatment

Eco-friendly accessories
Smart textiles
Nanotechnology
Assessment tools

Clothing Manufacture (2)

Choosing fair vendors
Welfare for workers
Local manufacturer
Product plan codes
Collaboration with researchers
Sharing knowledge
Laser cutting
Minimalism
Digital textile printing
Computer-aided design
Flexible production system

Minimized process
Upcycling design
Free from trends/ slow fashion
Consumer analysis
Technology-aid sizing system
Zero-waste patterning
Seamless knitting/ whole garment
Co-design
Transformable design
Modular design
Smart Clothing
DIY design
Biomimicry design
Lightweight
Higher quality and longer lasting design
Invisible sustainability design
Clean production system
Assessment tools

Packaging / Distribution / Transportation / Retail (3)

Use green suppliers, Welfare for workers,
Consumer's choice, Minimized packages,
Boat or rail than air, Eco-stores,
Eco-friendly packaging materials, Eco-label,
Reusable packages, Sustainable care labels,

Consumer Use (4)

Educate consumers
Motivate moral responsibilities
Clean environment to reduce pollution
Use moisture absorber
Organized wardrobe
Smart wardrobe
Fewer garments and longer use
Less water and energy usage
Efficient washing machine
Shower-able garment
Alterable design
Multi-lives garment design
Anti-stain/odor/bacterial finish
Design requiring less washing
Less detergent or eco-friendly detergent
Anti-wrinkle finish

End of Life (5)

Secondhand Cloth
Donation
Prevention, Minimization, and Reuse
Recycle materials and clothing
Redesign
Waste management strategies
Vintage style

Apparel Designer

Prevention / Minimization

Figure 5. Apparel designers' sustainable action model based on literature

Designers must consider all phases when they design clothing (Fletcher, 2008; Gwilt & Rissanen, 2011; Loker, 2008). During phases such as clothing manufacture, designers can make direct decisions but they also have indirect influence on consumer behavior. Apparel designers are located at the center of our clothing lifecycle; therefore, designers need to consider every phase, from the material to end of life. Priority goals for apparel design should follow prevention and minimization in the waste management hierarchy. The model is a circular system, so that each phase is connected to the others, highlighting the designer's major role in the lifecycle. The model explains and classifies sustainable actions with detailed design strategies that apparel designers can use during every phase of the process.

Designers play a major role in (a) establishing who should be involved in the development of garments; (b) managing selection of material and garment manufacture; (c) influencing packaging, distribution, transportation, and retail; (d) directing consumer use; and (e) even determining garments' end of life. According to Gwilt and Rissanen (2011), designers can provide sustainable knowledge to maximize positive influence throughout the clothing lifecycle and the whole paradigm of fashion system.

However, Dombek-Keith and Loker (2011) asserted that many sustainable designs focus on sustainable manufacture rather than on garment use; garment use is considered the consumers' responsibility, though the highest impact phase in the clothing lifecycle is frequently attributed to use (Fletcher, 2008). Apparel designers can provide a bridge between the manufacture phase and the need to seek new design concepts to impact and lead consumer use behaviors toward sustainability such as enabling extended use with fewer garments (Dombek-Keith & Loker, 2011; Gwilt & Rissanen, 2011).

16

Thus, apparel designers need to consider consumers' use behavior in order to successfully encourage—through garment design—the natural involvement of consumers in sustainability.

Consumers tend to purchase more garments when the garments fail to satisfy their needs and wants. Fletcher (2008) explained that consumers' unfulfilled emotional and physical needs and wants instigate more consumption with short-term thinking; consumers purchase after looking at one little difference in a silhouette, hemline, or color for a new experience—and more purchases generate waste. Ehrenfeld (2004) and Fletcher (2008) suggested that apparel design should give long-lasting human satisfaction through more flexible and intelligent design.

Transformable Garments

Among the various ways to design garments for sustainability as shown in Figure 5, the transformable garment has the potential to satisfy changing consumer needs and wants with its flexibility in use.

According to Farrer (2011), if apparel designers develop a garment that can transform, then consumers can be involved in sustainability. Dombek-Keith and Loker (2011) state that designers should offer various options for consumers, such as smaller, high-quality wardrobes that are more versatile, garments that can be worn longer and are more useful, and garments that have multiple lives with potential reincarnations.

Therefore, garments that can change, adapt, or evolve may encourage a relationship between wearer and garment that is much deeper than can be achieved through typical fashion solutions. These garments can be worn for longer periods of times and on various occasions, thus minimizing waste generation in two ways by reducing the

17

consumer's need to purchase additional garments, and by decreasing materials flow in the fashion industry.

The various types of transformable garments and changeable aspects of garments will be reviewed to understand which aspects were made changeable in response to consumer needs and wants. The transformable garments were classified into four types: (a) reversible and folded/tying designs; (b) modular designs; (c) smart clothing; and (d) do-it-yourself (DIY) and multi-lives designs.

Reversible and Folded/Tying Designs

Reversible and folded/tying types of clothing have been around for more than a millennium. Reversible garments consist of inner surfaces that can be also outer surfaces of the garment. "Caress dress" is part of the Five Ways research project, and can be worn with two reversible colors of black and orange (Fletcher, 2008). Folded or tying garments can be changed in different ways by folding or tying the whole or part of the garments. The Indian sari is a long rectangular-shaped cloth that can be folded and tied in many ways (g-moda, 2011). Similar to the sari, a Hawaiian pareo can be worn tied in a variety of ways such as dress wrap, halter, toga, long or short skirt, or sarong tie, depending on what the wearer chooses. In the 2000s, Ximena Valero designed the OMG garment, which can be changed into different types of garments and is similar to Eliza and Ethan's multi-wrap dress and Magic Wrap Skirts, whereby one skirt can be changed and worn in 100 different ways. These garments do not need high technology, but can be changed into various style and types of garments.

Modular Design

Modular designs feature smaller components that can be work independently, detach, or be replaced with other components. Fletcher (2008), Gwilt and Rissanen (2011), and McQuillan (2011) explained that these modular designs can create an infinite number of items and combinations.

Designers such as Rei Kawakubo at Commes des Garcons and Jun Takahashi of the 2003 paper dolls collection for the Undercover brand developed modular-design garments that can change details like a paper doll's garments using components such as hook-and-loop fasteners (Fletcher, 2008). Dombek-Keith's Suit Yourself designs (2009) can be modified to reflect new fashion trends, altered to fit the wearer's body changes, or repaired by replacing components of jacket collars, cuffs, skirts, and pants using zippers. After purchasing these types of garments, consumers are encouraged to modify them to increase their wearable lives.

Dombek-Keith's Suit Yourself designs (2009) were primarily based on traditional types of garments, but some transformable fashions change the entire structure of the garments. These designs can change size, silhouette, garment type, or design details by using one pattern of repeating parts that can be connected with each other. The examples in this area are Arial Bishop and Fortune Cookies, which can create an infinite number of possible garment designs with repeating components (Fletcher, 2008; McQuillan, 2011).

On the minus side, durability and flexibility can be compromised when multiple connecting parts need to be detached easily at the same time. According to Fletcher (2008), Bishop uses an interlocking fastening system that joins the repeating hexagonal components along the edges, which are made of felt. McQuillan (2011) explained that

Fortune Cookies use hook-and-loop fasteners to interconnect each module, but the reconfigured garments are stiff and potentially uncomfortable.

Smart Clothing

Smart clothing that incorporates technologies into garment design creates new benefits to consumers. Smart clothing can have changeable functions and can be used for longer periods (Black, 2008; Bye, 2010). For example, if garments can be developed allowing downloads of new images, colors, or even different garment shapes they can seem to be new and different garments (Randerson, 2007). Black (2008) explains that if a garment can change colors and patterns, consumers will not feel the need for so many different garments, and they will try to wear garments more often and for a longer time.

Smart clothing can promote longer consumer use cycles through embedded technology in apparel by following the five sustainable design strategies: (a) versatile functionality; (b) detachable devices; (c) low-power and/or renewable power sources (e.g., solar-cells or kinetically chargeable batteries); (d) modular hardware; and (e) modular/upgradable software (Koo, 2011). With versatile functionality, wearers can use smart clothing in various ways by satisfying their changing needs and wants. For example, a garment can be worn as a normal garment by turning off or detaching the electronic devices or a garment can sense various vital signals. Smart clothing garments and hardware can be modularized to change their function and design. With respect to software, if the smart clothing software is upgradable, the devices in garments can be personalized and allow for longer garment and hardware use.

Color/pattern changeable smart clothing. With respect to the aesthetic transformation of garments, light-emitting diodes (LEDs), electro luminescence (EL),

optical fibers and fabrics, organic light emitting diodes (OLEDs), or other display aids

such as Liquid Crystal Display (LCD) monitors or projector beams can be integrated into

garments to change the colors or patterns of the garment.

As one of the early LED prototypes, Orth, Post, and Cooper (1998) developed the

Firefly Dress that can dynamically change its color using LEDs integrated onto fuzzy

conductive pads. This change can be made by connecting power to the LEDs when the

wearer is moving or a necklace brushes the dress. They also developed a dress with flash

LEDs that are changed by the wearer touching flower sensors to turn them on or off.

Dunne (2002) used EL to develop a smart garment prototype for athletes in cold

temperatures that reacts to light with light sensors and retro-reflective trim.

As a project of Technology Development of Smartwear for Future Daily Life,

researchers at Yonsei University (2009) developed a color-changing dress that interacts

with sound and a dress that changes the color of its LEDs with a color sensor. Jennifer

Shellard integrated textiles with computer-animated light to change color stripes (Gwilt

& Rissanen, 2011). Color-changing dress II (Koo, 2011) can be changed into 83 different

modes with seven colors using LED wires controlled by a radio frequency (RF) remote

controller.

In addition to LEDs and ELs, optical fibers and fabrics are integrated into the

garments. Luminex, an Italian company, and Lumigram, a French company, made new

fiber optics and presented several prototypes, such as dresses that change colors. France

Telecom developed a T-shirt that integrates optical-fiber threads to display images

downloaded from computer databases (Deflin, Weill, & Koncar, 2002). Berzowska and

Laflamme (2011) developed PLEET, a light-emitting dress that changes the fiber colors

with light-emitting optical fibers woven with cotton and silk on a computer-controlled electronic Jacquard loom.

As display technologies are becoming more flexible and non-planar and can be folded like paper or change into three-dimensional shapes, OLED can be integrated with Organic User Interfaces (OUIs) to interact with devices activated by users' multitouch or bimanual gestures (Holman & Vertegaal, 2008). E-ink is used with SURF and other displays that are thin and flexible enough to be rolled up (Eaton, 2011). These displays have flexible properties that are similar to traditional garments, and therefore can be considered more "wearable" than traditional rigid display technologies. The images of E-ink displays can be easily changed in real time by using a computer. Steckl, You, and Kim (2011) examined the application of flexible electrowetting technology on flexible materials such as paper or polyethylene terephthalate (PET) to make thinner, more flexible, and lower-power displays than existing LCD monitors. These technologies can expand the possibilities for the adaption on apparel products and the transformation of apparel designs such as colors, patterns, silhouettes, and other details.

Projection technology has been used for garments to display images or messages on dresses, and a dress can display the surrounding environment in real-time through the dress's connected camera (Koo, 2010).

Moreover, there are chromic materials such as photochromic (reacts to light), thermochromic (reacts to heat), electrochromic (reacts to electricity), piezorochromic (reacts to pressure), and solvatechromic (reacts to liquid or gas) (Tetrinno SmarTex, 2009). Thermochromic inks applied to textiles can changes colors according to temperature. Similarly, Amy Winters used hydrochromic (reacts to moisture) and

photochromic technology in her 2011 collection for dresses and swimsuits that change

colors, glow, or animate according to the sunlight, UV light, temperature, water, and

music (G-moda, 2011).

Silhouette, size, fit, and detailed design changeable smart clothing. In addition

to smart clothing that changes in color and pattern, there is smart clothing that changes

silhouette, size, fit, and detailed designs by using components such as motors or

mechanical controls, shape-memory alloy, or inflatable materials. Hussein Chalayan

presented the Airplane Dress in 2000 and 2006, which changes shapes. In 2000, he

showed a remote-control dress that changes shape by lifting its back (Black, 2009). Seven

years later, in 2007, he unveiled the Hour Glass Dress that transforms shapes by using a

pre-set microcontroller to lift the dress with linked metallic plates (The Metropolitan

Museum of Art, 2006). In the same year, he presented mechanical motion dresses, called

One Hundred and Eleven, with changing styles for various eras in his spring and summer

collection and his works gave inspiration to other apparel designers (Black, 2009).

Shape-changing garments can be developed by integrating a shape memory alloy,

Nitinol, which is also known as a memory metal or a muscle wire. It is made of nickel

and titanium and has ability to return to its original shape even after many changes.

Berzowska and Coelho (2005) developed two kinetic electronic dresses. The Vilkas

Dress changes its hemline when the Nitinol is heated by electronic stimuli and, after a

few minutes, the hemline falls due to gravity and the heavy fabric's weight. On the

Kukkia Dress, the flower decorations open and close (Berzowska & Coelho, 2005).

Dunne (2010) designed dynamic aesthetics and kinetic clothing by using actuators such

as vibrating motors, shape-memory alloys, and LED illumination that react to touch.

Webelow Wear used shape memory alloys (SMAs) to change the textile surface design, exposing and hiding fabric layers that react to the temperature of the environment (Webelow Wear, 2009).

Inflatable materials can also be used for changing the appearance of garments. XS Labs developed an inflatable hip dress and an inflatable breast dress to change shapes and provide comfort, safety, and social interaction (Berzowska & Coelho, 2005). Similarly, Almeida (2008) developed models for an urban mood collection with Space Dresses that the wearer can inflate, so that the bottom of the dress changes not only the aesthetic aspects but also protects and reduces anxiety in subways or other crowded situations.

New materials such as Ferro-fluids have the potential to be used to change the shape or details of garments. Ferro-fluids, which are also known as magnetic fluids or magnetic nanofluids, can be magnetically controlled (Odenbach, 2002). Ferro-fluids have been used for displays and multi-touch interfaces such as Kodama and Takeno's (2001) sound-responsive magnetic fluid display.

Do-It- Yourself (DIY) Design and Multi-lives Designs

When consumers use do-it-yourself (DIY) techniques, they will form stronger emotional attachments to their garments (Finney, 2006; Fletcher, 2011; Vartan, 2008). According to Vartan (2008), the best way to achieve sustainability is by modifying and repairing existing clothing, instead of continually buying more new garments. When consumers engage in DIY, they are actively involved in sustainability, and they give their own meanings to garments, increasing the garments' perceived value. Fletcher (2011) argued that sustainability needs to be connected to real experiences.

When consumers engage in DIY with their garments, the garments can have multi-lives whether they were intended to have multi-lives or not. The Five Ways research project was conducted by Becky Earley and Kate Fletcher in 2002 and 2003 (Fletcher, 2008); Earley and Fletcher preprogrammed nine lives for their garments, whose style could be changed by stitching into the skirts to produce a unique piece. They also invented an updatable T-shirt style that could be changed by consumers as part of the project. The purpose of the project was to encourage consumers to be involved in DIY.

In Chen and Lewis's (2005) research, the authors developed a sustainable garment titled "five lives of a piece of cloth." This garment is closer to a textile than to a garment compared to Fletcher's "nine lives" garments. At first, the "five lives of a piece of cloth" is in the form of a wrap made from one uncut piece of cloth, which can be changed into a multi-lives garment by cutting and sewing. In the end, the fabric is ground up for recycling or disposal. Similar to Chen and Lewis (2005), designer Issey Miyake introduced A Piece of Cloth (A-POC) in the late 1990s to create transformable garments that could be worn in various ways using fabrics that can be cut and sewn, can change fabric color and texture, and can stretch into various sizes.

The chronicles of fashion history contain innovative items such as fishermen's coats from Awaji Island (Dombek-Keith & Loker, 2011; Takeda & Robers, 2001). Fishermen's coats could be modified in appearance at will, by adding more pieces to the garments to replace worn-out components or to change the pattern of the fabric.

In addition, any garment purchased for a special occasion that is worn only a few times can be modified and refreshed to be worn on different occasions. For example, the dowry dress (2009) is a wedding dress that can be worn again for future special occasions,

such as parties, by modifying the skirt portion while keeping the garment meaningful to the wearer (Dombek-Keith & Loker, 2011).

Do-it-yourself and multi-lives designs are encouraging versatility, inventiveness, personalization, and consumers' participation (Fletcher, 2008). These types of garments offer new options for sustainability. Adding features that increase consumers' emotional attachment to their garments and satisfy their needs and wants can result in garments that can be worn more often and for a longer time, thus extending the clothing lifecycle.

<div align="center">

Assumptions and the CTGC Model

</div>

Assumptions

Based on the literature review in Chapter II, for the purposes of this study, the following assumptions were used. The first assumption was that a designer can influence consumers' behavior to be more sustainable through garment design. The second assumption was that people buy more garments and wear garments to satisfy their needs and wants. The last assumption was that transformable garments can increase sustainability by satisfying consumers' changing needs and wants, reducing the need for consumption, decreasing wardrobe size, and expanding the consumer use phase of the clothing lifecycle.

Consumers and Transformable Garment Circulation (CTGC) Model

According to these assumptions, a model is proposed here that indicates the interactions between the apparel designer and the consumer-based clothing lifecycle. Differing from other models of the clothing lifecycle, this consumer and transformable garment circulation (CTGC) model emphasizes the role of apparel designers and

consumers in the clothing lifecycle, within the interactions of garment design as a medium for sustainability (Figure 6).

Apparel designers collect and select materials and make garments through the design and manufacturing process. Consumers purchase the garments and use them. During this period, apparel designers communicate with consumers through the garments they have designed and produced. If consumers wear transformable garments, consumers can transform the garments and satisfy their changing needs and wants. This can be repeated by consumers transforming the garments according to different needs and wants. In this circulative interaction between consumer and garments through transformation, the garment is expected to be worn more frequently, and expand the clothing lifecycle by postponing the decision on the garment's end-of-life (Figure 6). Also, consumers give feedback to designers passively by purchasing the garments and actively by giving comments. Designers refer to this feedback for guidance in future design and production. After consumers decide not to use a garment, the garment can be reused, or recycled; the energy can be recovered, or it can be disposed of.
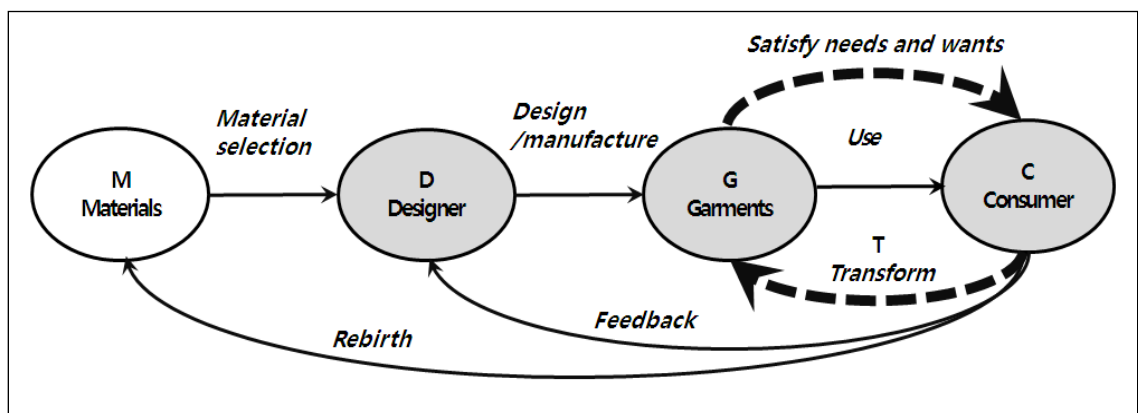
Figure 6. The consumer and transformable garment circulation (CTGC) model

Designers can influence consumers to behave more sustainably through garment design, potentially changing the whole garment lifecycle. Transformable garment designs are anticipated to expand the duration of use and number of times a garment is worn as well as to postpone decisions on the garment's end-of-life. This will help prevent and minimize waste and ultimately expand the garment lifecycle to increase sustainability.

<div align="center">

Conceptual Framework and Variables

</div>

To find candidate elements for changeable design functions in transformable garments, three areas were reviewed in the literature: (a) the Functional, Expressive, and Aesthetic (FEA) model, to understand the requirements necessary for garments to satisfy consumer needs and wants; (b) consumers' clothing selection criteria and design elements, to look for what people value and prefer to have when they buy new garments to add to their wardrobe; and (c) Wardrobe studies that indicate how garments can be categorized and differentiated to examine what kind of variety people have in their wardrobes.

Functional, Expressive, and Aesthetic (FEA) Model

Lamb and Kallal (1992) proposed the Functional, Expressive, and Aesthetic (FEA) model (Figure 7). Consumer needs can be met by determining their functional, expressive, and aesthetic requirements. The first element is function, such as fit, mobility, comfort, protection, donning, and doffing. The second element is expressive, which includes value, roles, statues, and self-esteem. The last element is aesthetic; it consists of art elements, design principles, and body-garment relationship.

Among the three aspects, aesthetic requirements are most directly modified by the physical characteristics of garment design itself. Thus, the proposed conceptual

framework focuses on aesthetic aspects that can be directly related to garment design

elements. The elements in the aesthetic category are applied to the developed conceptual

framework, but the specific elements are modified to fit a transformable garment. This

also enables an investigation of the changeable design elements of aesthetic function.
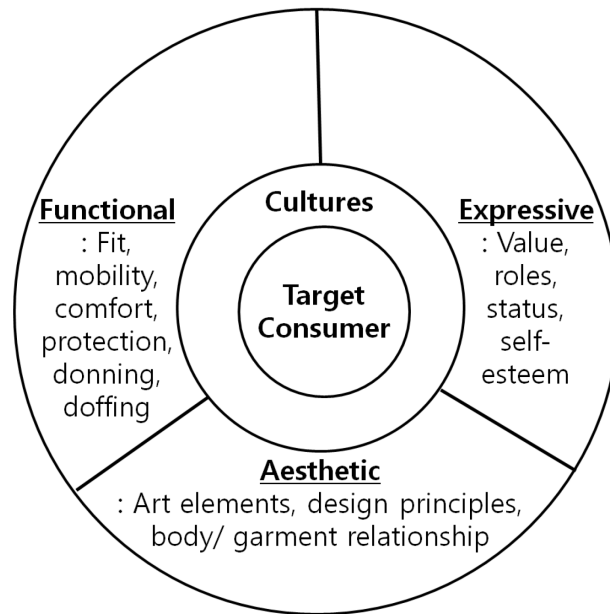
Figure 7. Lamb and Kallal's (1992) FEA Model

Clothing Selection Criteria and Design Elements

Clothing selection criteria were reviewed from previous research to understand

what people look for when they add more garments to their wardrobe. Eckman, Damhorst,

and Kadolph (1990) identified clothing evaluation criteria women use when purchasing

clothes in-store. They reviewed twenty-one studies about evaluative criteria for apparel

and divided the criteria into extrinsic and intrinsic criteria. Under the category of extrinsic

criteria are features such as price, brand, country of origin, store and store image,

coordination with wardrobe, sales person's evaluation, department in store, approval of

others, and warranty. The intrinsic criteria were (a) product composition (consists of style,

29

color, design, fabric, appearance, and fiber content); (b) product performance (consists of care, fit, sizing, durability, comfort, safety, and colorfastness); (c) quality of construction, workmanship, physical attributes, and fabric; and (d) sex-appropriateness. Among these criteria, the extrinsic qualities are not closely related to garment design; thus, this study mainly considered intrinsic criteria. This was also advantageous because intrinsic criteria are often more important than extrinsic criteria to consumers, according to Eckman, Damhorst, and Kadolph's (1990) study.

Forney, Pelton, Caton, and Rabolt (1999) studied the evaluative criteria by which women select apparel. They started from twelve intrinsic criteria (color, style, comfort, durability, fit, care, fiber, fabric quality, construction quality, trim/notion quality, product quality, and design originality) and nine extrinsic criteria (country of origin, label, store image, price, wardrobe coordination, attractiveness, prestigious image, suits my personality, and appropriateness for occasion), and then they reduced these into nineteen criteria after factor analysis by dividing into five multidimensional factors. The revised criteria were (a) quality (fiber, fabric, construction, trim/notion, and product); (b) cost (price, comfort, durability, and care); (c) appearance (style, fit, and attractiveness); (d) image (country of origin, label, store image); and (e) personal style (wardrobe coordination, suits my personality, appropriate for occasion, and design originality).

Crommentuijn-Marsh, Eckert, and Potter (2010) proposed a visual model for factors affecting the purchase of sustainable fashion items (Figure 8). The factors were divided into four spheres by implicit and explicit criteria for vertical columns, and by external (wearer in society) and internal (garment properties) criteria in horizontal columns. In this study, the candidate elements for changeable design function focused on

30

the garment itself, which is closely connected to the internal garment properties. Thus, the candidate elements for criteria included fit and color, as these are implicit factors of internal garment properties.

	Implicit	Explicit
External : Wearer in society	Image Brand image	Peer group pressure Must have items Occasion
Internal : Garment properties	Fit Color Style	Price Care Type of fibers

Figure 8. Factors affecting the sustainable fashion item purchased

(Crommentuijn-Marsh, Eckert, and Potter, 2010)

In addition, several studies focused specifically on jacket design elements and their interactions with consumers' evaluations of garments. Examining elements and their interactions with the combinations of elements is important to understanding what a consumer wants and needs (Holbrook & Dixon, 1985). Lamb and Kallal (1992) also suggested that one consider art elements and design principles to meet consumer needs in relation to apparel aesthetics.

Wagner, Anderson, and Ettenson (1990) found that the following factors affect consumers' judgments about aesthetic aspects of garments: jacket length, silhouette of bottom such as skirt or pants, pattern of bottom, pattern of jacket, silhouette of jacket, color, and jacket details. Eckman (1992) also found that the interaction of jacket silhouette with jacket pattern, color, and neckline shape was significant in consumers' aesthetic judgments about apparel. In Yoo's (2003) research, she studied working females' preferences in design by focusing on jacket design. Jacket design was modified

based on the five elements of jacket length, pattern, silhouette, neckline, drop, and collar style. All five jacket design elements were found to be significant in influencing consumers' evaluation of and preferences in garments. In addition, there were six significant interactions among the five design elements: jacket length and pattern, jacket length and collar style, jacket pattern and silhouette, jacket pattern and neckline drop, jacket silhouette and collar style, and jacket neckline drop and collar.

Baldt (1916) stated that color, form, line, and texture are major elements in women's apparel design. According to McJimsey (1963), color, shape/form/space, line, texture, and dark and light are important in clothing selection. Rasband (1996) proposed that color, shape, line, texture, and pattern are the most salient apparel design elements in wardrobe strategies for women. DeLong (1998) explained that form in space is created by visual parts of colors, textures, lines, and shapes that construct the look of apparel. The design elements of apparel are compared in Table 2. The three elements of color, line, and texture were all suggested in common, and shape, form, and space are suggested in similarity.

Table 2

Design Elements for Apparel Design

Baldt (1916)	McJimsey (1963)	DeLong (1998)	Rasband (1996)
Color	Color	Color	Color
Form	Shape/Form/Space	Shape	Shape
Line	Line	Line	Line
Texture	Texture	Texture	Texture
	Dark and light	Point	Pattern

Candidate Elements for Changeable Design Functions

Based on the literature reviews, the candidate elements for changeable design functions were focused on aesthetic aspects. In aesthetic function, the design elements were color/pattern, size/fit, silhouette, garment type, and design details.

These changeable design functions, as seen in Table 3, guided this study in wardrobe database analysis and interviews with participants by helping structure the conceptual framework.

Table 3

Changeable Design Functions Candidate Elements

	Changes in aesthetics: Aesthetic function
1	Color/Pattern
2	Size/Fit
3	Silhouette
4	Garment type
5	Design details

Aesthetic function. Aesthetic function consists of color/pattern, size/fit, silhouette, and design details as candidate elements that can be changed when consumers wear transformable garments. Aesthetic aspects of garments were the main influencing factors on consumers' behavior when buying apparel (Crommentuijn-Marsh et al., 2010; Eckman, Damhorst, & Kadolph, 1990; Forney, Pelton, Caton, & Rabolt, 1999; Sproles, 1979; Yoo, 2003).

Color/Pattern. Eckman et al. (1990) defined color/pattern as any reference to color, print, or visual pattern of knit or weave. Respondents placed more importance on color than fabric design; they referred to color 49 times and pattern or design only 5 times

33

during specific garment evaluations. Crommentuijn-Marsh et al. (2010) mentioned the importance of color to consumers considering the purchase of sustainable fashion items. Color was one of the implicit factors of garment properties. In addition, Wagner et al. (1990) and Eckman (1992) also considered color to be one of the significant elements for jacket design. Baldt (1916), McJimsey (1963), DeLong (1998), and Rasband (1996) explained that color is one of the major design elements for apparel.

Size/Fit. Size is one of important consideration factors when consumers select and wear garments (Chambers & Moulton,1969; Cho, & Grove,1978; Nicholson, 1999). Yoon and Jasper (1996) also discussed how the size of a garment influences the selection and purchase of garments and they found that the key dimensions of a consumer size-labeling system for women's ready-to-wear apparel are sleeve inseam length or sleeve outseam length for long-sleeve shirts, shoulder height or shoulder length for short-sleeve or sleeveless shirts, crotch height for calf- or ankle-length pants, and waist height for skirts.

Silhouette. According to Chambers and Moulton (1969), the silhouette of a garment affects a consumer's garment purchase and selection by reflecting an individual's tastes. Silhouette is one of the fashion design elements that creates shapes of a garment with other elements of line, decorative details and trimmings (Han & Kim, 2008; Kong & An, 2003). Wagner et al. (1990), Eckman (1992), and Yoo (2003) found that silhouette is a significant design element for the aesthetics of jacket design. Additional fullness beyond wearing ease can be integrated to create various silhouettes.

Garment type. Han and Kim (2008) divided garment types into skirts, pants, blouses, shirts, sweaters, jackets, coats, and dresses. The American women's apparel

category system was provided by the Office of Textiles and Apparel of the International Trade Administration (2012) which is the part of International Trade Administration of the U.S. Department of Commerce. Also, the U.S. Customs and Border Protection (2008) gave detailed definitions of women's apparel classifications based on the Harmonized Tariff Schedules of the United States (HTSUS).

Design details. According to Han and Kim (2008), garment details consist of constructive and decorative details. Constructive details are neckline, collar, sleeve, cuffs, and pockets, and decorative details are such as frill, ruffle, stitching, and trimming (Han & Kim, 2008; Kong & An, 2003).

Conceptual Framework for Transformable Garments

According to Miles and Huberman (1994), a conceptual framework identifies major roles of subjects, describes relationships, and provides the opportunity to generalize. For this study, the conceptual framework for a transformable garment was developed based on Lamb and Kallal's (1992) FEA model and literature reviews of candidate elements of changeable design elements. The framework focuses on changeable design elements as seen in Figure 9.

The identified candidate elements of changeable design functions are central factors that affect wardrobe size, garment wear frequency and periods, consumers' needs and wants, and consumers' purchase needs for new garments. According to the FEA model, the garment's changeable design functions are focused on aesthetic functions. The candidate elements for changeable design functions are color/pattern, size/fit, silhouette, garment type, and design details.

35
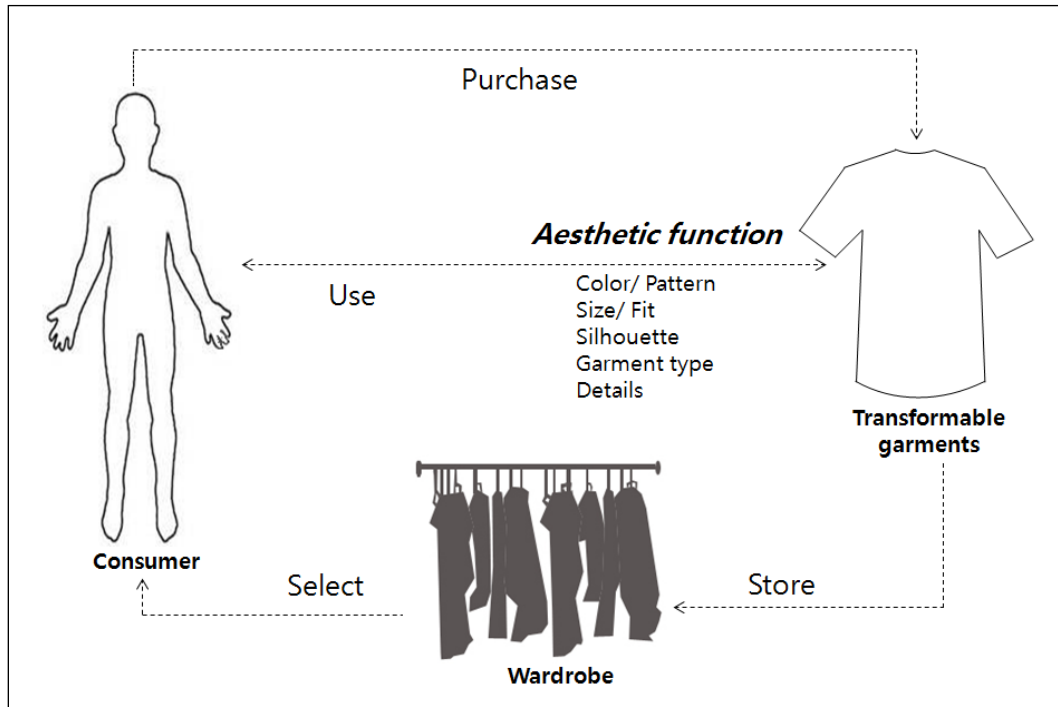
Figure 9. Conceptual framework for transformable garment

If the CTGC model (Figure 6) emphasizes the communication between the apparel designer and the consumer with garment design, this conceptual framework for transformable garments can be developed to understand the interaction between transformable garment design and consumers (Figure 9). In this proposed conceptual framework, there are four relationships:

1. Purchase (consumer and garment): According to Dombek-Keith and Loker (2011), and Loker (2008), transformable garments have great possibilities for being worn in various ways spanning the garment's lifecycle, reducing consumer needs for new garments, and reducing material flow. Farrer (2011) states that garments that can change or evolve can deepen the relationship between the garment and wearers and reduce over-consumption of clothing. If

consumers are satisfied with their various needs and wants, the projected

positive result is that they will decrease their need to buy many garments.

2. Store (garment and wardrobe): This transformable garment is expected to

     replace many items with one item and decrease consumers' wardrobe sizes.

3. Select (wardrobe and consumer): By selecting and wearing transformable

    garments, the consumer can engage in a sustainable act (Farrer, 2011). The

    transformable garments can be selected for more uses than ordinary garments

    in a wardrobe if that can satisfy various consumer needs and wants.

4. Use (garment and consumer): Hethorn (2008) stated that we can design

    successfully and enhance sustainability by satisfying consumer needs and

    wants in both aesthetics and function, and this can cause the garment to be used

    more frequently and for a longer period. A "transformable garment" is a

    garment that has changeable design functions. Consumers can rethink how to

    change their garments to meet their needs and wants, select one way to wear

    the garment among various choices, and modify the garment to wear as

    intended. Therefore, if the transformable garment is expected to meet

    consumers' various changing needs and wants, the garment is anticipated to be

    worn in high frequency rate and to expand the consumer use phase in the

    clothing lifecycle.

This conceptual framework suggests the importance of garment design to

impacting the whole paradigm of consumer behavior and the clothing lifecycle to be

more sustainable.

37

CHAPTER THREE: METHODS

This chapter is presented in two sections. The first section includes the methods for analyzing the wardrobe database from the Dunne and Terveen's research project of The Smart Wardrobe: Evaluating Garment Usage for Sustainable Apparel Consumption. In the second section, interviewing methods are presented.

Population and Research Procedures

Population

The wardrobe data analysis examined the variety of clothing that people have in their wardrobes to compare it with what variety people value in their wardrobes. This gives an understanding of what kind of changeable functions can be recommended in transformable garments in a bottom-up approach.

About 59.6% of women in the United States were in the labor force in 2009 and 58.5% women had jobs in 2010 (Bureau of Labor Statistics, 2010, 2011). Apparel designers and manufacturers consider the working woman as a major target consumer (Miley & Mack, 2008; Yoo, 2003). In 2008 and 2009, women ranked apparel and services among their top seven expenditures, along with entertainment, health care, utilities, food, transportation, and shelter. Style-conscious women accounted for about 70% of total spending on apparel, accessories, and beauty; professionals and women from 18 to their 40s are the main spenders for apparel in the United States (Bain & Company, 2010). Therefore, the population of this study was professional working and style-conscious women ages 20 to 40 years, who comprise almost 86% of all employed women in the United States (Figure 10).

38
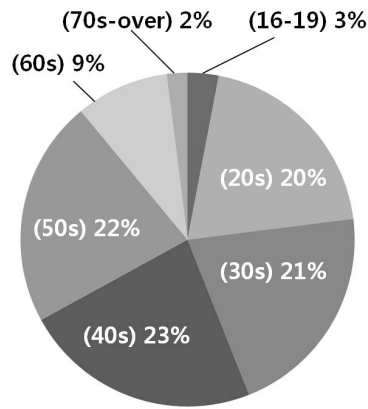
Figure 10. The percentage of U.S. employed women by age (Bureau of Labor Statistics, 2011)

Research Procedures

In order to accomplish the research objectives, multi-method approaches were used (Figure 11). First, this research followed the Institutional Review Board's (IRB) guidelines for assessing ethical issues and protecting participants. The information was collected after obtaining consent from participants. Participants' anonymity was maintained throughout the research, and participants had the right to withdraw from the research at any time.

After obtaining IRB approval, the second phase was analysis of the wardrobe database that was collected during 2009–2011 for the project called "The Smart Wardrobe: Evaluating Garment Usage for Sustainable Apparel Consumption." The visual images and described specifications of garments were collected from professional working women living in Minnesota. Among them, participants who had agreed to participate in future research were selected, and consent forms for interviews were distributed before the participants were interviewed.

39
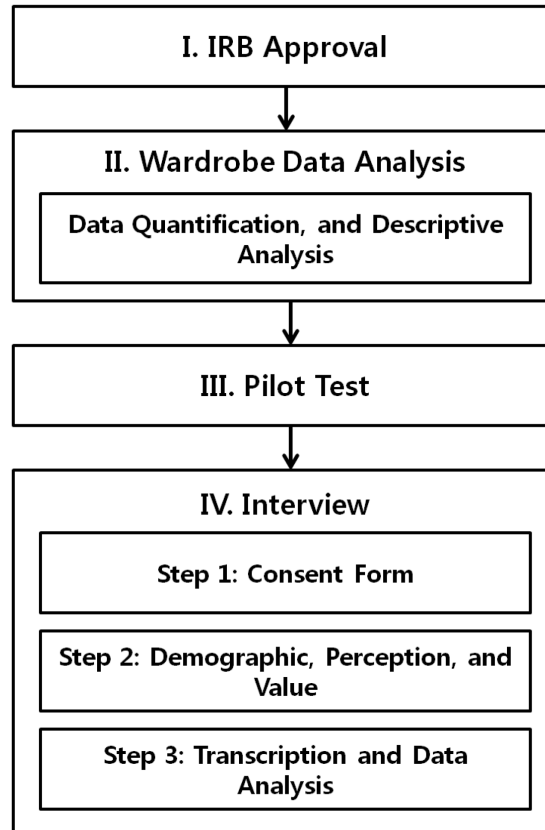
Figure 11. Research procedure

The collected data were analyzed using data quantification and descriptive analysis to identify garment design functions in people's wardrobes. The analysis was conducted in three layers: (a) the whole wardrobe; (b) selected garment type; and (c) different garments within a selected garment type. In the second phase, a pilot test was conducted to prepare and modify interview questions and procedures. In the third phase, after collecting consent forms with participants' signatures, follow-up interviews were conducted to gather qualitative data to compare participants' perceptions found in their wardrobe with the results of the wardrobe data analysis and to understand their values on transformable garments. The interview procedures were in three layers: (a) demographic, (b) perception, and (c) value.

Wardrobe Data Analysis

Data Collection and Participant Selection

Wardrobe data were collected during 2009-2011 for the project of The Smart Wardrobe: Evaluating Garment Usage for Sustainable Apparel Consumption directed by professors of Lucy E. Dunne and Loren Terveen and funded from the University of Minnesota Interdisciplinary Informatics Seed Grant.

Among 11 participants consisting of two males and nine females, wardrobes of nine professional women in the age range of their 20s to 40s were selected from the wardrobe database. Participants' intentions to attend further study activities, including interviews, were solicited and the data of those who agreed to join were chosen for this study. Participants in Minnesota were selected for close accessibility to their wardrobes and further personal interviews.

In the wardrobe database, in addition to demographic information, data were collected in two forms. The first types of data were photographs. Photographs of each garment were taken to confirm and compare the garments' specification data and to trace data whenever necessary, either for checking or to discuss with participants in future interviews. The second types of data were the specifications of garments: (a) layering, (b) garment type, (c) textile, (d) size, and (e) color. Detailed characteristics were documented in Excel files. The detailed item specifications were adapted from Takamura (1993), as seen in Table 4.

Table 4

Wardrobe Data Categories for Garment Specifications

Attributes	Values
Top, Cardigan, and Dress	
Color/Pattern	White, black, grey, red, green, blue, yellow, pink, purple, brown, beige, and print (floral, ethnic, modern, stripe, check, and animal)
Size	XS (2), S (4-6), M (8-10), L (12-14), XL (16-18), XXL (20-22), and Free
Silhouette	Hourglass, straight, full, other silhouettes
Collar	
Collar type	Bomber/tabbed, bow, convertible, cowl, frill, hood, knit-stand, mandarin, mock-T, peter pan, polo, ruffle, sailor, shawl, turtle, and wing
Collar size	Small, standard, large, and oversized
Neckline	
Neckline shape	Boat, crew, funnel, halter, henley, keyhole, off-shoulder, one-shoulder, round, scoop, square, strap/camisole, strapless, surplice, sweetheart, and v-neckline
Neckline depth	High, medium, low, and plunging
Sleeves	
Sleeve type	Bell, bishop, cap, cape/split, dolman, dropped shoulder, kimono, petal, puff, raglan, sleeveless (thick, medium, thin, and strapless) , and standard set-in
Sleeve fit	Fitted, tight, full/gathered, and loose
Sleeve length	Very short (above cap), short (bicep), elbow, three-quarter, long (to wrist), long, and extra long (to hand or finger)
Sleeve cuffs	Gathered to cuff, plain, and straight cuff
Jacket	
Jacket type	Cropped, double-breasted, elongated, mao, open, safari, single-breasted, mandarin, none, notched, peaked, rounded, and shawl
Lapel size	Small, standard, large, and oversized
Skirt, and Dress	
Skirt type	A-line, balloon/bubble, circle, dirndl, flared, gore, peg, pencil, pleated, ruffle, sheath, tiered, and trumpet/mermaid
Pants	
Pant type	Bell-bottom, cargo, flares, harem, jeans, jodhpurs, leggings, sailor, sweatpants, and trousers
Pant hem	Gathered to cuff, plain, and straight cuff

In addition to the detailed item specifications in the wardrobe database, color/pattern were originally recorded into hex color codes, and these were changed into 12 different color categories, including six prints based on frequent variability in color/pattern in participants' wardrobes. Sizes were categorized into letters and numbers by women's apparel sizes according to the wardrobe database. Sleeveless garments' strap types and pockets categories were added by viewing photographs of collected garments from the wardrobe database. Sleeveless garments' strap types were categorized into thick, medium, thin, and strapless types and pocket details were categorized into patch, set-in, seam pockets, and none by following of the studies by Han and Kim (2008) and Kong and An (2003).

Data Analysis

In this section, the recorded methods in the wardrobe data and the methods of analysis are discussed. The wardrobe database was analyzed based on the extracted candidate elements for changeable aesthetic design functions.

First, the wardrobe was categorized and indicated in a hierarchical chart according to the garment types and candidate elements for design function, in order to understand the ways in which participants' wardrobes consist of a variety of garments (Figure 12). This visualization using a hierarchical chart guided the organization of the data to find out whether there are specific garment types that are more frequently observed in the wardrobe, which offer more variety within a type, or which present unique patterns and characteristics. The wardrobe database analysis consisted of quantification and descriptive analysis methods to investigate what variability participants have in their wardrobe.
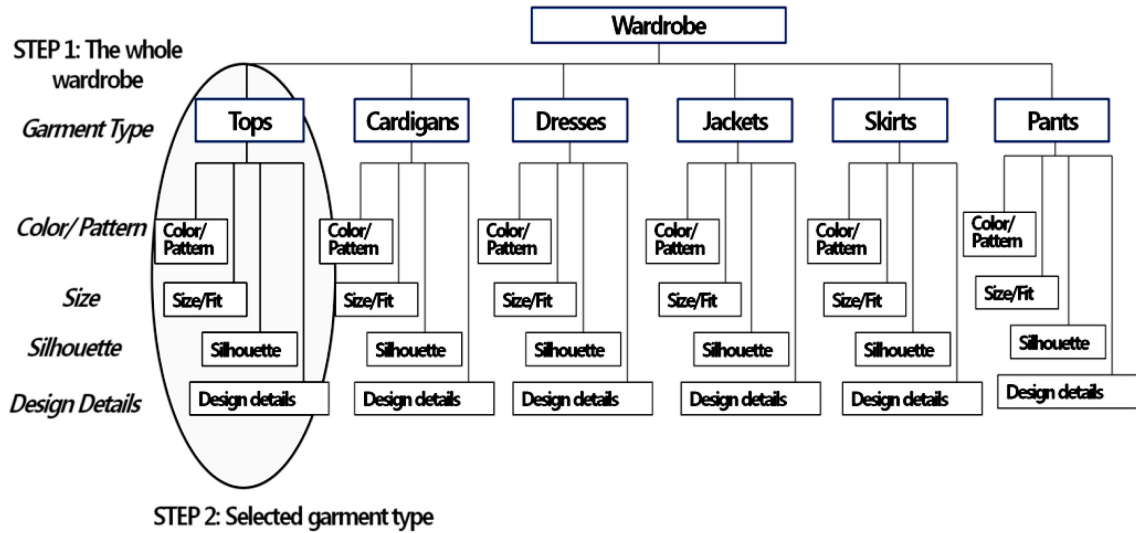
Figure 12. Wardrobe Data Analysis Plan

To select specific garment types, the wardrobe database was analyzed focusing on item frequency and this was compared among different garment types. The most frequent garment type was tops for all participants except one (participant: Linda) who had dresses as the most frequent item, as seen in Table 7. Among wardrobes, tops consist of tanks/camisoles, T-shirts, and shirts/blouses. As most participants (86%) indicated that tops occupied the highest portions in the wardrobe and presented the most varieties, thus top type was selected as the garment type for this research.

Step 1: Data quantification and descriptive analysis. Collected data were quantified for varieties of aesthetic functions (color/pattern, size/fit, silhouette, garment type, and design details) in the wardrobe. Table 5 presents the aesthetic function candidate elements that were extracted from the previous literature reviews and how they are defined in this study. Moreover, it explains how each aesthetic function is recorded in the wardrobe database and, finally, the methods of analysis.

44

Table 5

Summary of Wardrobe Database Analysis

Changeable Design Functions	Definitions	Measurements	Analysis Methods
Color/Pattern	"Color" is the color of the garment surface as perceived by humans' visual sensory system, which can be divided into overall colors that comprise the major portion of the garment, and detail colors that make a minor contribution to the garment. "Pattern" is a visual surface decoration of garment, such as figures or replicable images generating visual characteristics created by textile print, knit, weave, dye, or finish.	Hex color value Color categories	Data quantification, and descriptive, analysis
Size/Fit	"Size" considered as garment size in letter and number sizing systems. "Fit" is how people perceive and feel about the appropriateness of garments that suit a wearer's body size and body shape when people wear the garments.	Garment size: Letter and number sizing system	Data quantification, and descriptive, analysis
Silhouette	"Silhouette" is the overall visual outline of the garment that is created by the interactions among the design components of form, shape, space, and line.	Classifications by word: hour-glass, straight, full, and others (Han & Kim, 2008; Kong & An, 2003; Lee et al., 2002; Takamura 1993)	Data quantification, and descriptive, analysis
Garment type	"Garment type" is the item identification that categorizes the garment into a group.	Classifications by word: Tops, cardigans, dresses, jackets, skirts, or pants	Data quantification, and descriptive, analysis
Design details	"Design details" are individual parts of the whole garment that can impact the characteristics of the garment design as well as details of garments.	Apparel design classification (Han & Kim, 2008; Kong & An, 2003; Takamura, 1993)	Data quantification, and descriptive, analysis

In the wardrobe data, garment types were recorded in seven categories: skirts, pants, dresses, jackets, tanks, tops, and cardigans. To quantify the garment type, tanks and tops were combined into one category. Thus, the item categories were six: tops, cardigans, dresses, jackets, skirts, and pants. After analyzing the frequency analysis of garment types, this research focused on the top category which was most frequent item for the most of participants among the six categories.

In color and pattern, the wardrobe data were recorded using a hex color value, which was used to identify and classify colors numerically, indicating how much red, green, and blue was contained in a certain color. The collected data colors and patterns were quantified for color varieties in garment types. Varieties of garment size were also counted for each garment type: XSP (0), XS (2), S (4-6), M (8-10), L (12-14), XL (16-18), and XXL (20-22). Silhouette was classified in four levels according to Han and Kim (2008), Kong and An (2003), Lee et al. (2002), and Takamura (1993): (a) hour-glass (fit and tight, princess, crinoline, mermaid, bustle, and minaret); (b) straight (H type: straight, long torso, empire, sheath, shift, slim, tubular, and H-line; A type: tent line, trapeze, and triangular line); (c) full (cocoon, barrel-spindle line, and balloon-bubble line); and (d) other silhouettes (Y-line, T-line, and wineglass). The garment silhouette was categorized by analysis of photographed images from the wardrobes and quantified according to the four silhouette types. Design details were analyzed in the aspects of (a) collar type and size; (b) neckline shape and depth; (c) sleeve type, length, fit, and cuffs; (d) hem of pants; and (e) pockets.

Once the collected data were quantified, a descriptive analysis of frequencies, mean, range, standard deviation, and percentage distributions was calculated to select a

46

specific garment type that was more frequently observed, offered more variety within a type, or presented unique patterns and characteristics. After selecting a specific garment type, variation analysis using detailed descriptive analysis was conducted to compare and examine whether there were significant differences among varieties of aesthetic functions (color/pattern, size/fit, silhouette, and design details) in selected garment item categories. Moreover, selected garment item categories were further divided into different types to investigate how varieties are different among different types of garment.

Interview

Pilot Study

A pilot study was conducted with two female Ph.D. graduate students in Apparel Studies, age 28 and 29, who are conscious about style, and work as staff at the University. The purposes of the pilot study were to confirm whether procedures and questions were appropriate to satisfy the purpose the interview, to evaluate whether interview questions were understandable, and to revise interview questions and procedures according to the pilot study results. Their feedback indicated that the research plan was thoughtfully designed and the interview questions could answer the research questions.

However, they suggested that participants be asked whether there are differences among different types of a selected garment, and what core items they wear the most. In addition to the pilot tests, advisers' comments were incorporated into the questionnaires and interview procedures with actual participants.

Data Collection and Participant Selection

After wardrobe data analysis, follow-up personal interviews were conducted, and these focused on four categories of information.

47

The first was in-depth demographic data about the participants, in addition to the collected demographic data in the wardrobe database. The second was the participants' perceptions of varieties in their wardrobes in comparison to the actual varieties in their wardrobes. The third discussed the variety that people value in their wardrobes and in transformable garments. According to Frankfort-Nachmias and Nachmias (2008), personal interviews are beneficial because of their flexibility, the researcher's ability to control the interview situation, high response rate, and the collection of supplementary information, such as participants' reactions.

Participants who agreed to participate further in the study were contacted via email to introduce this new study, and to give information about it and contact information, and to set interview schedules if they were willing to participate. The invitation letter and the consent form presented the study's background information, procedures, confidentiality, risks, benefits of participation, and the researcher's contact information (Appendix B, C).

The interviews took place in the participants' home (three participants), office (three participants), or public place (one participant). The places were selected so that participants felt comfortable and safe to talk about themselves.

Multiple data source collection can increase a study's credibility (Baxter & Jack, 2008; Creswell, 2007; Patton, 1990; Yin, 2003). During the interviews, participants' responses were voice-recorded, and descriptive field notes and reflective notes were written about the participants, interview settings, conversations, observations, and emerging themes or patterns in order to ensure accurate data collection. The photographs of participants' garments in their wardrobes were shown on a portable LCD monitor and participants were asked to choose the core items and the item they wear the most

frequently. Participants were also asked about what garments were added to the wardrobe or thrown away after the wardrobe database had been collected, and if there was any other information that should be recorded. Appendix D presents detailed interview questions and interview scripts.

Step 1: Demographics. The demographic questions pertained to occupation, required attire at work, participants' own definitions of sustainability, and degrees of consciousness with regard to sustainability. These questions were asked in addition to demographic information (e.g., age, gender, working hours, innovativeness, and style consciousness) during collected as part of the wardrobe database.

Step 2: Perception. In step 2, the participants' perceptions of varieties in their wardrobes were compared with the wardrobe database for triangulation. The 17 open-ended questions consisted of six categories to satisfy the objective of exploring participants' perceptions of variability in their wardrobes and the actual differences in their wardrobes. The six categories were (a) frequent garment types; (b) core items; (c) varieties in a wardrobe; (d) frequent top types; (e) varieties in tops; and (f) perceptions about candidate elements for design functions. In question QP2, participants were asked to answer by looking at actual garments or images of garments in their wardrobe when they answered the question. For questions from QP6 to QP17, the definitions of candidate changeable design functions were explained. The specific interview questions are listed in the Appendix D.

Step 3: Value. In Step 3, the interviews focused on the participants' perceived value of clothing in understanding the types of variety people want to have in their wardrobes and in transformable garments. The 22 open-ended questions in five categories

were asked of participants regarding three categories as seen in Appendix D: (a) concerning aspects when purchasing and when wearing tops: selecting tops in a wardrobe, and purchasing and wearing transformable tops; (b) wardrobe change; (c) changeable design functions for tops, preferences in changeable design functions, and preferences in other changeable design functions; and (d) wear and purchase behavior; and (e) willingness to pay.

Data Analysis

The procedures of interview data analysis consisted of two methods: qualitative and quantitative analysis (Figure 11).

First, the recorded interviews were saved as digital recording files and transcribed into texts. The transcription texts were carefully read several times to identify key issues or themes. Second, important issues or themes were found for every participant. In this step, the transcript texts were rearranged by open-coding and color-coding techniques in Excel spreadsheets. Important sections from the text that described the themes of the study were extracted and copied into new Word files. Third, the analysis procedure of the second step was replicated across all of the participants to report common themes. By doing this, the possibility of introducing bias was reduced (Creswell, 2007).

In addition, transcription texts and related words for themes were quantified within participants and across participants by using descriptive analyses (a) to examine the presence of differences in among participants' demographic information; (b) to compare their perceptions of and their actual wardrobes; and (c) to evaluate differences in participants' values, perceptions, and the actual wardrobes. The collected interview data

were also compared within two layers: (a) the whole garment and details; and (b) changeable design functions in the selected garment item category.

Throughout the process, different types of data were compared with each other when analyzing, and voice-recorded files, reflective notes, and field notes were referred to when analyzing interview transcriptions to increase validity and trustworthiness (Bloomberg & Volpe, 2008; Creswell 2007; Lincoln & Guba, 1985).

Limitations

This study was designed to identify changeable design functions for transformable garments from a bottom-up approach, using quantitative and qualitative methods to understand people's wardrobe, perceptions, and values, with regard to the varieties in their wardrobes. There may have been some bias when interpreting the results with application to transformable garments.

The interview questions were designed with a sustainability perspective to encourage participants to offer their own definitions and values. This might have caused a priming effect when discussing the later parts of the interviews about regular and transformable garments.

In the process of interpreting the results of this study of transformable garments, the researcher's bias may become an issue and thus a disadvantage of the qualitative research method. To decrease the researcher's bias and enhance the reliability of the study, peer reviews and data triangulations are encouraged by qualitative researchers (Bloomberg & Volpe, 2008; Brantinger, Jimenez, Klingner, Pugach, & Richardson, 2005; Creswell, 2007; Lincoln, 1995; Merriam, 2002). Thus, when collecting and analyzing the collected data, efforts for enhancing the study's reliability and verify its results were

conducted by considering potential biases, engaging in self-reflection with journals, gathering multiple data sources, and analyzing the data in various ways for triangulation purposes, and reviews by expert advisers on conducting data collection and analysis procedures.

The participants in this study all live in Minnesota, and this specific location, and the small number of working women participants between the ages of 18-40s might introduce some bias. The study recruited only a small sample size, and this may limit the researcher's ability to discern meaningful patterns and other results from the sample.

CHAPTER FOUR: RESULTS

This chapter presents wardrobe database analysis results in three sections. The first discusses attributes of the whole wardrobe, focusing on tops, and different types of tops. The second presents an analysis of collected interview data, and the third discusses results in terms of the participants' perceptions of their wardrobe contents and varieties, and their preferences concerning transformable garments.

Wardrobe Database Analysis Results

To answer the first research question, 'what varieties do people have in their garments, and how do those varieties differ among garment types in their wardrobe?', the wardrobe database was quantified and compared in two levels: (a) among garment types; and (b) within a specific garment type for all participants and for each participant's wardrobe.

Demographic Characteristics of Wardrobe Database Participants

Table 6

Characteristics of Demographics

No.	Participant	Age	Gender	Location	Occupation
P1	Amy	30	Female	MN, USA	Planning Analyst
P2	Amanda	24	Female	MN, USA	Dietitian
P3	Monica	20s	Female	MN, USA	-
P4	Martha	26	Female	MN, USA	Supplier manager
P5	Angela	24	Female	MN, USA	Customer servicer
P6	Linda	26	Female	MN, USA	Textile designer
P7	Melisa	33	Female	MN, USA	Graphic designer
P8	Kate	24	Female	MN, USA	Religion staff
P9	Tiffany	29	Female	MN, USA	Dress sales

The study included wardrobe data from nine female participants. All were employed full-time in professional careers. They lived in Minnesota and ranged in age from 24 to 33 with a mean age of 27 (SD=3.34), except for Monica, who did not respond to demographic questions, as shown in the Table 6. Participants were assigned pseudonym to protect their anonymity.

Frequency of Garment Type in a Whole Wardrobe

Consumers classify the contents of their wardrobes based on garment type and usage (Skov, 2011). Investigating the composition of a wardrobe in terms of garment types can help in understanding what garment type people need and want to wear most frequently.

The wardrobe contents were categorized by garment type, and then the number of garments of each type was counted. The number of garments in participants' wardrobes ranged from 49 to 180, with a mean of 99 (SD=53.27) (Table 7). The number of wardrobe items ranged between 49 and 52 garments for 44% of the participants. A similar number of garments owned can also be seen in Woodward's (2007) research; an average of 98, with a range of 35-182.

The garment types were categorized into six: tops, cardigans, dresses, jackets, skirts, and pants. Outerwear, accessories, and other under wear were excluded. For all participants, except for Linda whose wardrobe contained more dresses than tops, the frequency of occurrence for tops was greater than for any other category (Figure 13). If a top has more versatility, then it might replace many tops and have a longer garment life. Therefore, tops were selected as a potential candidate for the set of transformable garments.

Table 7

Frequency of Garment Type

Garment type	Amy	Amanda	Monica	Martha	Angela	Linda	Melisa	Kate	Tiffany	Total
Top										
Q'ty	66	27	29	34	32	21	58	62	89	418
%	49	55	59	65	61	22	32	56	52	47
Ranking	1	1	1	1	1	2	1	1	1	1
Cardigan										
Q'ty	29	10	5	2	5	6	28	14	17	116
%	21	20	10	4	10	6	16	13	10	13
Ranking	2	2	3	4	3	4	3	3	4	4
Dress										
Q'ty	12	1	4	2	1	49	20	12	20	121
%	9	2	8	4	2	52	11	11	12	14
Ranking	4	5	4	4	5	1	5	4	3	3
Jacket										
Q'ty	5			3		2	27		10	47
%	4			6		2	15		6	5
Ranking	6			3		6	4		5	6
Skirt										
Q'ty	9	2	1	1	4	4	18	4	25	68
%	7	4	2	2	8	4	10	4	15	8
Ranking	5	4	5	5	4	5	6	5	2	5
Pant										
Q'ty	15	9	10	10	10	12	29	19	10	124
%	11	18	20	19	19	13	16	17	6	14
Ranking	3	3	2	2	2	3	2	2	5	2
Total	136	49	49	52	52	94	180	111	171	894

* All percentages are rounded off
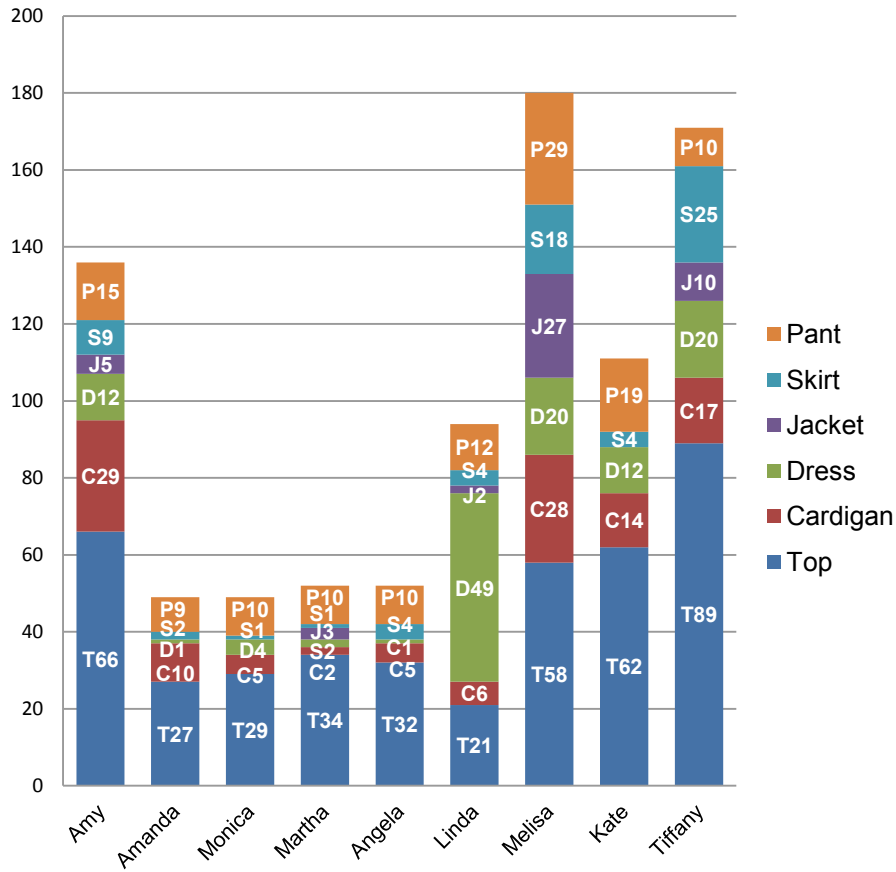
Figure 13. Frequency of garment types

Frequency of Top Type in a Whole Wardrobe

Figure 14 (along with Appendix E1) presents top type details. The most frequently occurring top type was a T-shirt, followed by the category of tanks/camisoles. Only Melisa presented different top type frequencies with tanks and camisoles, the highest (69%), followed by T-shirts (22%). Only Melisa and Tiffany had vests, which represented the least frequently occurring category.
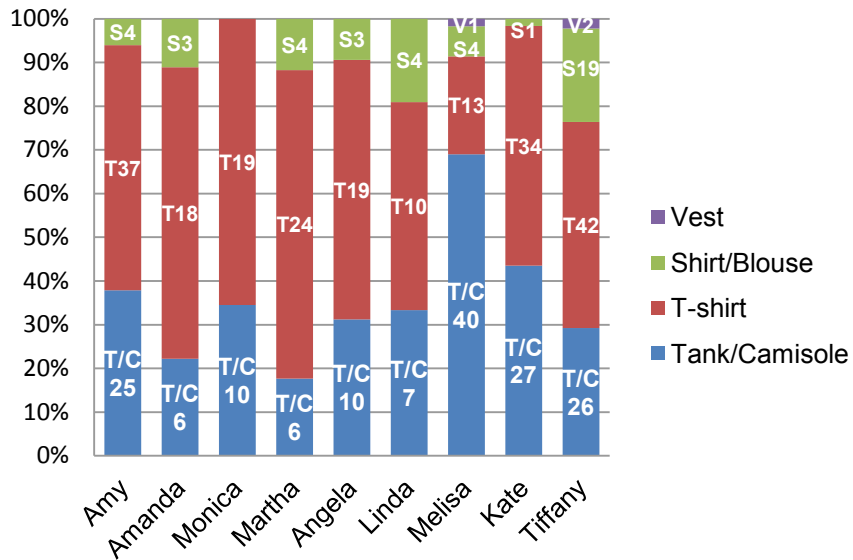
Figure 14. Frequency of top types

Frequency of Color/Pattern in Tops

Figure 15 shows that the most frequently appearing colors in the tops category were white (20%), print (18%), black (15%), grey (10%), red (9%), blue (7%), green and pink (5% respectively), brown and purple (3% respectively), and yellow and beige (2% respectively). The most frequent solid colors were the achromatic white, black, and grey, followed by red as the most frequent chromatic color. For 44% of the participants, white was the most frequently owned; 33% owned prints, and 11% owned red and black most frequently. Except for Amanda, all participants owned print garments (Appendix E2). The data labels in Figure 15 indicate the number of garments for each top type per participant.

Figure 15. Frequency of colors/patterns in tops for each participant
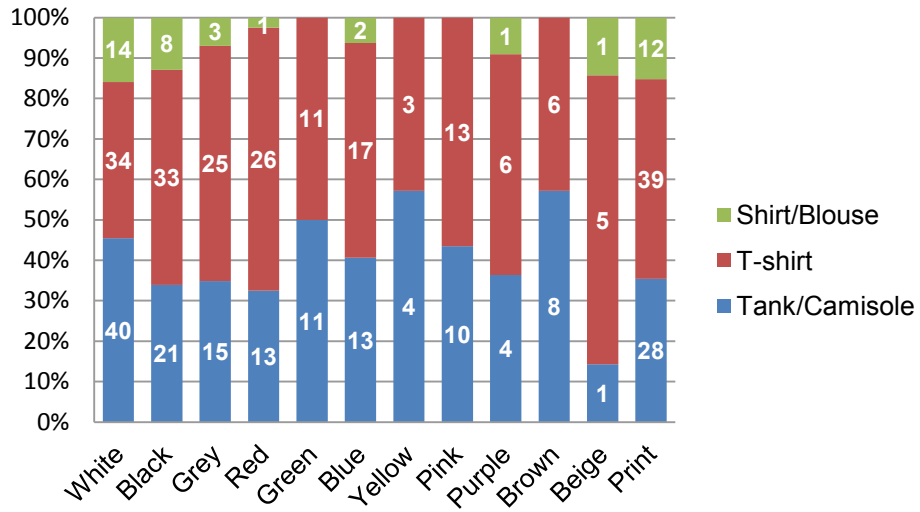
Figure 16. Frequency of colors/patterns in top types for all participants

In both the tanks/camisoles and the shirts/blouses categories, the most frequently occurring color/pattern was white, followed by print, black, and grey, which were identical. Within the T-shirt category, however, red was more frequent than for other top categories. In general, the most frequent colors/patterns were print and neutral colors such as white, black, and grey (Appendix E3, Figure 16).

The number colors/patterns varied among the top type categories. On average, participants had seven (SD=1.9) color/pattern varieties for tanks/camisoles, eight (SD=2.1) for T-shirts, three (SD=2.3) variations for shirts/blouses. There were more variations in colors and patterns for tanks/camisoles, and T-shirts than for shirts/blouses.
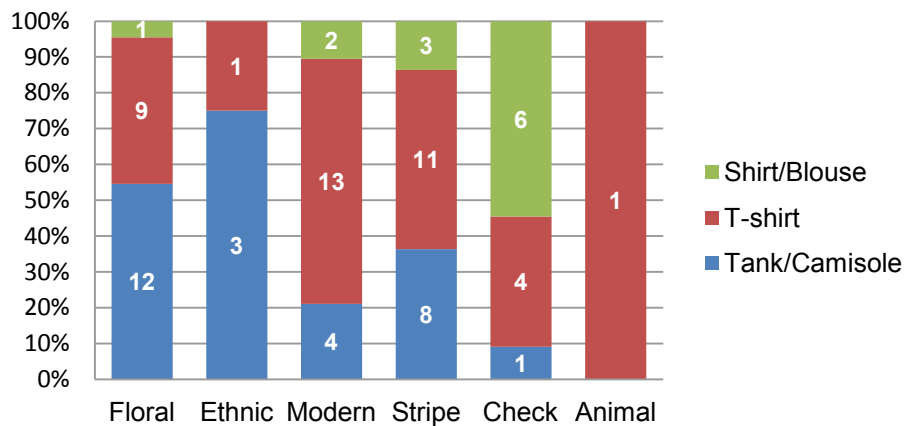
Figure 17. Frequency of print patterns in top types

Prints were analyzed to determine pattern variety for tops (Appendix E4). The most frequent prints in tops were floral and stripe (28% respectively), and the least frequent print was animal (1%). The other prints were modern (24%), check (14%), and ethnic (5%). As seen in Figure 16, the T-shirt type had the most variety in print types among tops. After T-shirts, tanks/camisoles had a wide variety of prints with five different print categories (Figure 17).

In the tanks/camisoles type, most participants had an average of two prints (M_{print}=1.6, SD=1.3), ranging from none to four. The top three prints – floral, stripe, and modern – were popular for both tanks/camisoles and T-shirt types. However, floral and modern prints were the two least frequently occurring prints in shirts/blouses.

Frequency of Sizes in Tops

Participants exhibited variation in sizes for tops ranging from three to four (M_{size}=3.56, SD=0.53) (Appendix E5). Over half, 56% of participants owned four variations in size and 44% had three variations of sizes in their wardrobes (Figure 18). Analysis of every top type for all participants showed that the T-shirt type presented the widest variety of sizes (Appendix E6, Figure 19).
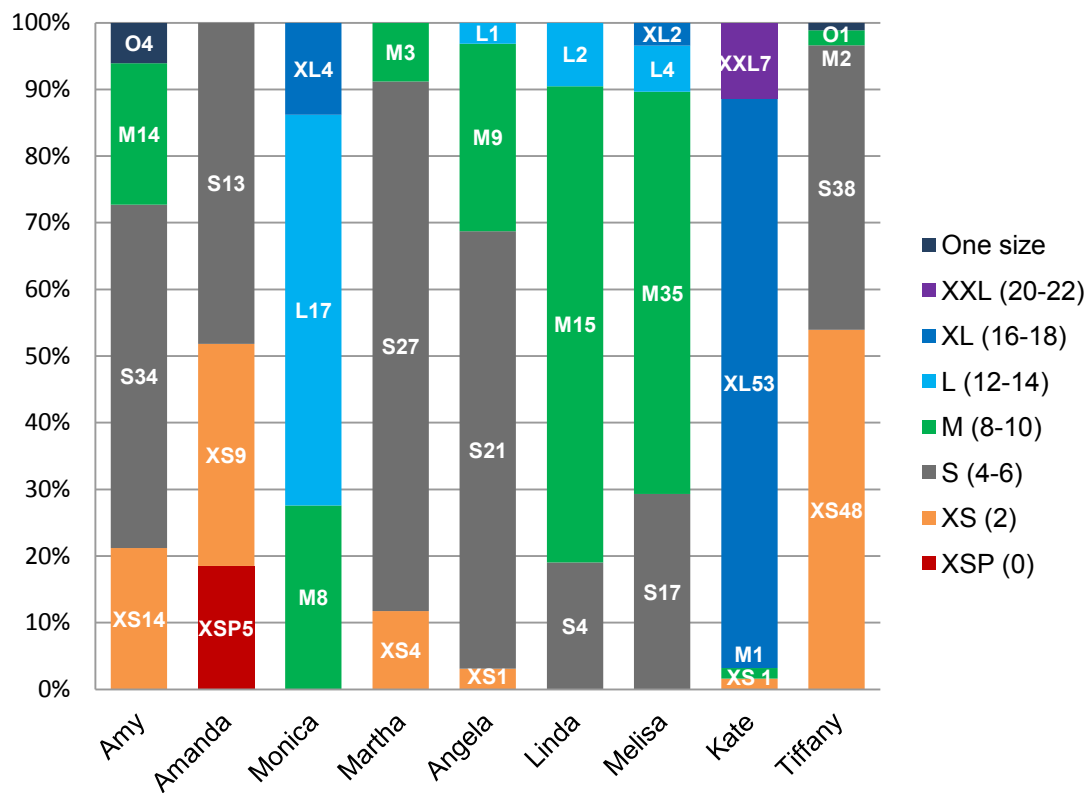
Figure 18. Frequency of occurrence of sizes in tops for each participant
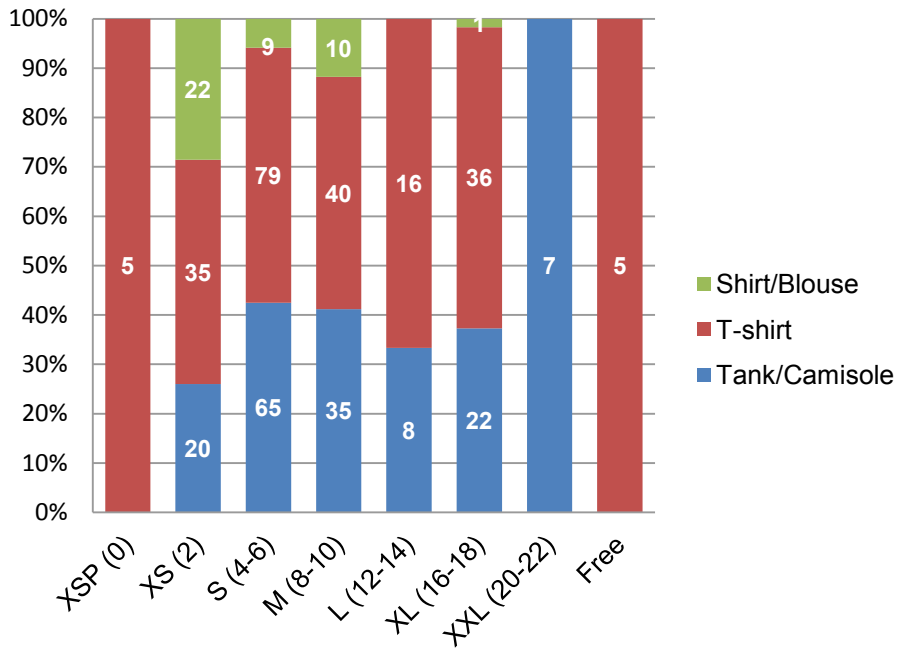
Figure 19. Frequency of sizes in top types for all participants

Frequency of Silhouette in Tops

In the wardrobes of the participants, the majority of tops had a straight silhouette (91%); the remainder was either hourglass (9%), or full (1%) type. The silhouette frequencies for different top types were quantified, ranked and compared for each variable (Appendix E7).The number of varieties of silhouettes averaged two ($M_{silhouette}$=2.1, SD=0.6), and ranged from one to three different silhouettes. There were fewer variations in silhouettes than there were in other changeable design functions (Figure 20).

For more than 80% of participants, the straight silhouette was the major silhouette for all top types: tanks/camisoles (87%), T-shirt (95%), shirts/blouses (83%). The second most frequent silhouette was hourglass for all top types, and the tanks/camisoles type only featured full silhouette (Appendix E8, Figure 21).

61

In the tanks/camisoles category, participants owned an average of two different silhouettes ($M_{silhouette}$=1.78, SD=0.83), with the range of one to three silhouette variations. Participants also had an average of two different silhouettes ($M_{silhouette}$ =1.89, SD=0.33) for T-shirt top categories, with a range from one to two silhouettes. For the shirts/blouses, there was one silhouette, straight. T-shirts had slightly more variation in silhouette when compared to other top types.
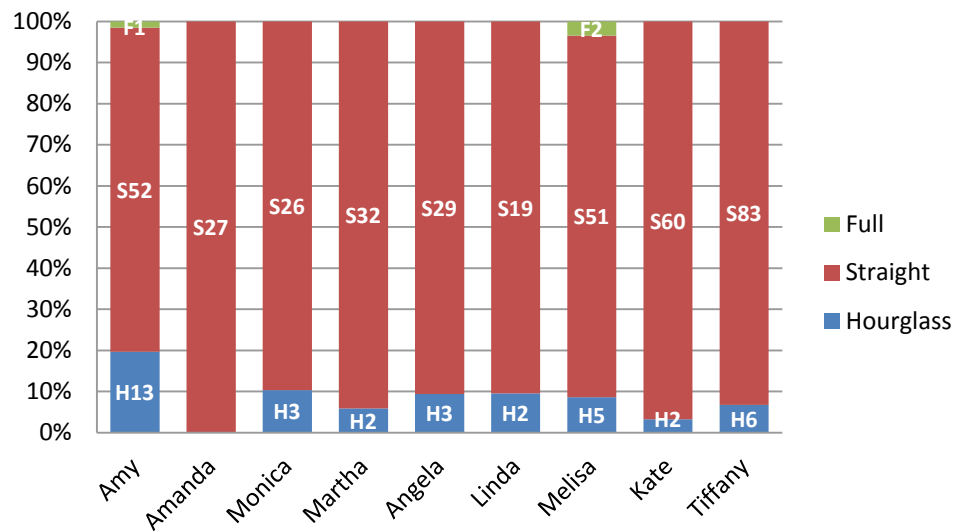
Figure 20. Frequency of silhouettes in tops for each participant
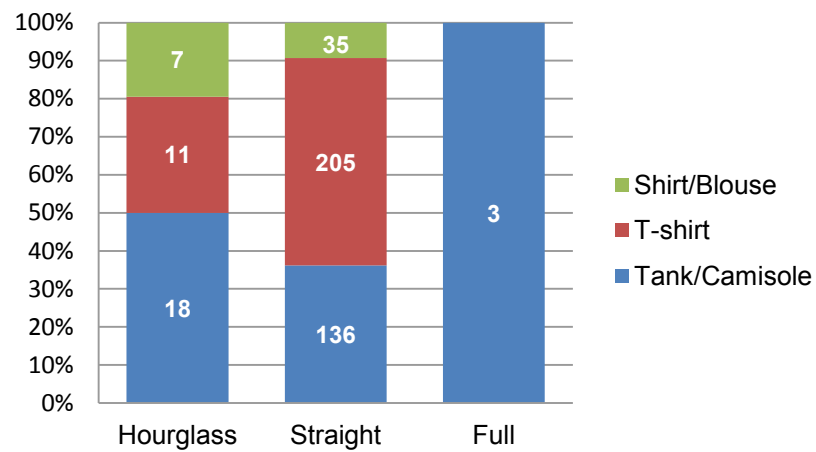
Figure 21. Frequency of silhouettes in tops for all participants

Frequency of Collar Type in Tops

The frequencies and percentages for the collar types in wardrobes, including the ranking in frequencies from the most to the least, is presented in Appendix E9.

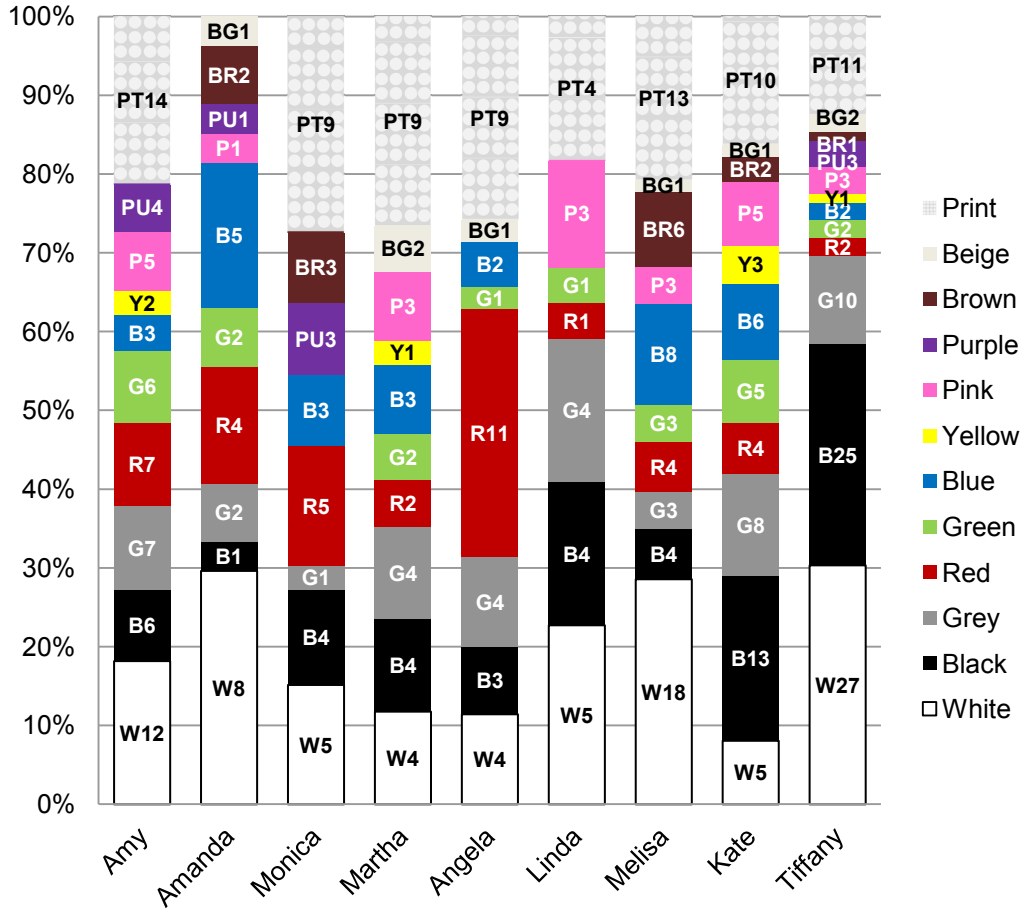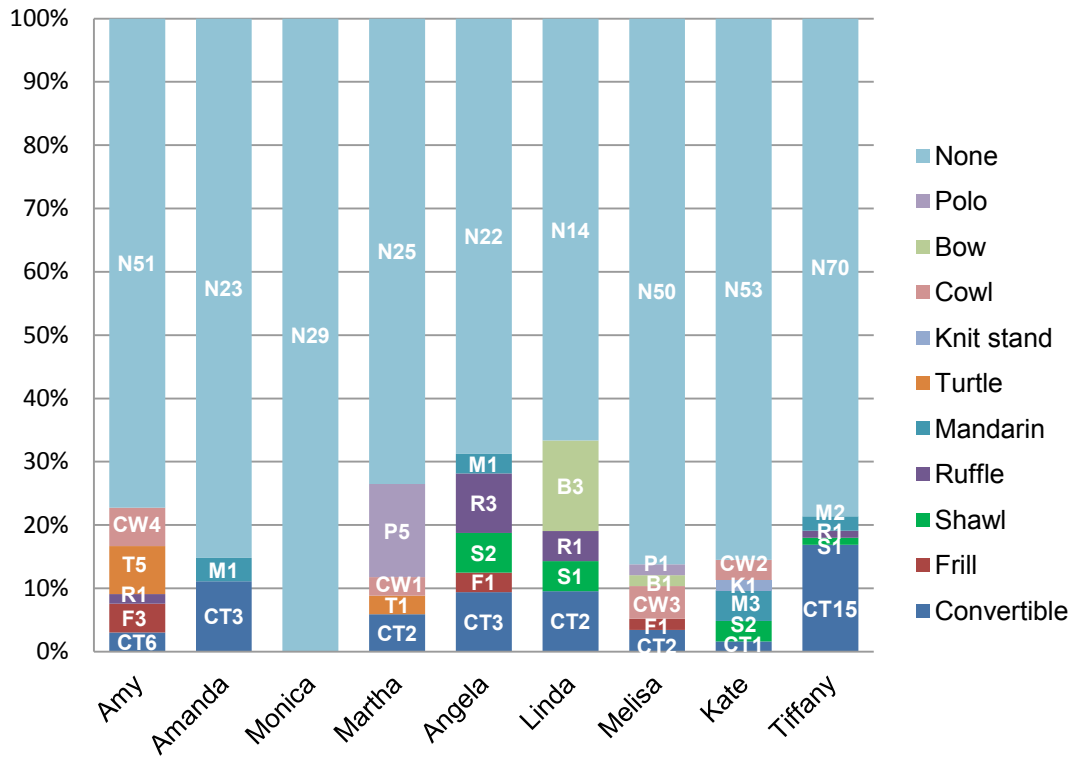*Figure 22*. Frequency of collar types in tops for each participant
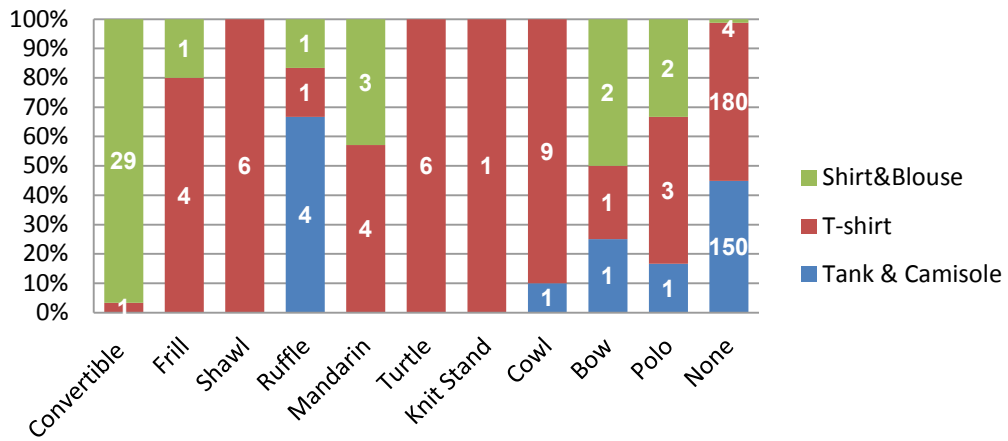
Figure 23. Frequency of collar types in top types for all participants

63

In over 80% of the tops, non-collar was the dominant attribute; and among collared-tops, the convertible style was most common (7%). Participants had five different collar types on average, with a mean of 4.8 (*SD*=1.7), and the range of one to six (Figure 22).

T-shirts had the most varied collar types, with shirts/blouses coming in second, followed by tanks/camisoles (Appendix E10, Figure 23). No-collar style (83%) was also dominant in T-shirts, and cowl (4%) was the next most popular followed by shawl and turtle (3% for each), and frill and mandarin (2% for each). In shirt/blouse, the most frequent collar type was convertible (69%) and non-collared type was only 10%. The other collar types included mandarin (7%), bow and polo (5% for each), and frill and ruffle (2%).

For tanks/camisoles, participants had two variations of collar types (M_{collar}=1.67, *SD*=1.00) in the range of one to four. Regarding T-shirt type, no-collar type was the most common style for all participants. Participants owned about three different collar types (M_{collar} =3.33, *SD*=1.41) in the range of one to five for T-shirts. For shirt/blouse types, there were also many convertible and no-collars. Participants had about two (M_{collar}=1.89, *SD*=1.17) different collar types in the range of none to four for shirts/blouses.

Frequency of Collar Size in Tops

Participants' wardrobes revealed 67% standard collar size, followed by small collars (26%), and 7% had large collars when excluding no-collared tops (Appendix E11). About 67% of participants owned standard collar sizes as the most and the next was small collar sizes (Figure 24). However, no-collar styles were the most popular among all participants.
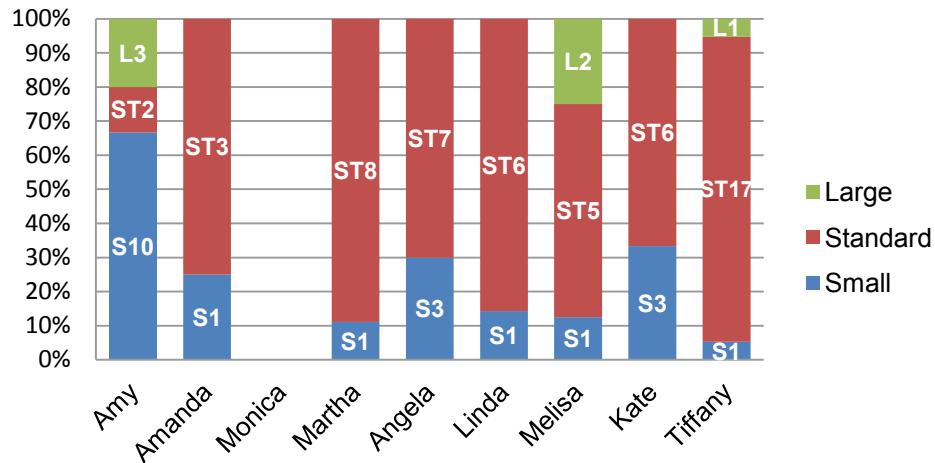
Figure 24. Frequency of collar size in tops for each participant
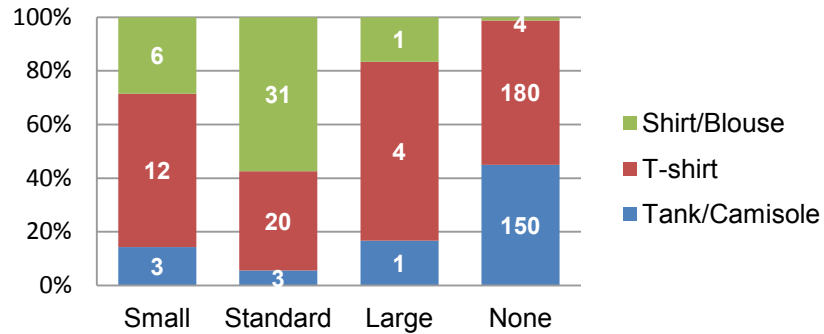
Figure 25. Frequency of collar size in top types for all participants

The tank/camisole (96%) and T-shirt (83%) types had mostly non-collars. However, there were many collars in shirts/blouses. The shirt/blouse type had the standard collar size as the most frequent into 74% and the next was small into 14% (Appendix E12, Figure 25).

Tanks/camisoles had one collar size ($M_{\text{collar-size}}$=1.09, SD=0.78), ranging from none to three; T-shirts had roughly two different collar sizes ($M_{\text{collar-size}}$=1.56, SD=0.88); and shirts/blouses had one collar size ($M_{\text{collar-size}}$=0.67, SD=1.00), ranging from one to three.

Frequency of Neckline Shape in Tops

The wardrobes reveal 40% round necklines in tops (Appendix E13). On average, there were six neckline shapes ($M_{neckline-shape}$=6.33, SD=1.87), ranging from three to nine (Figure 26).
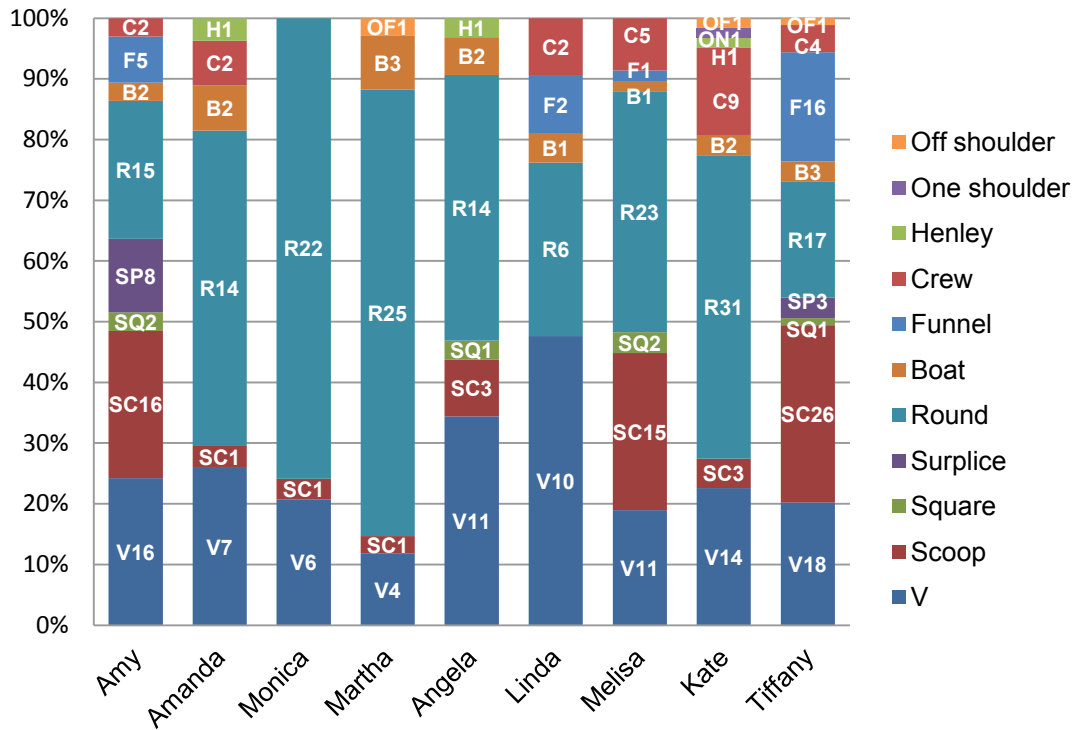
Figure 26. Frequency of neckline shapes in tops for each participant
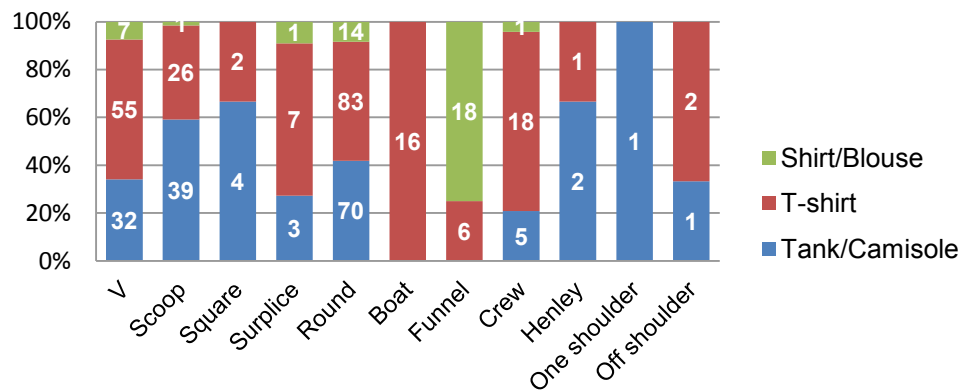
Figure 27. Frequency of neckline shapes in top types for all participants

Tank/camisole styles had nine different neckline shapes, with round (45%) being the most common. T-shirt had the most variations in neckline shapes with 10 different types. The most frequent type was round (38%). Similar to the tank/camisole style, T-shirts mostly consisted of round, V, and scoop types (Appendix E14, Figure 27).

Participants had four ($M_{neckline-shape}$=3.78, SD=1.56) different neckline shapes, ranging with from one to six. In the category of T-shirt, participants had an average of 6 different neckline shapes ($M_{neckline-shape}$=5.11, SD=1.83) with the minimum of three and a maximum of eight different types. Regarding shirts/blouses, participants had two ($M_{neckline-shape}$=1.56 SD=1.24) different neckline shapes, which is less than tank/camisole and T-shirt types.

Frequency of Neckline Depth in Tops

The medium neckline depth (46%) was the most frequent size in tops, followed by low neckline depth (32%) (Appendix E15). Participants typically owned three ($M_{neckline-depth}$=3.44, SD=0.53) different neckline depths for tops, in a range from three to four (Figure 28).

The neckline depths were segmented into top styles, as seen in the Figure 29. The tank/camisole and T-shirt types were more varied in neckline depth than other top types. Tanks/camisoles exhibited two major types: medium (47%) and low (46%). T-shirts exhibited medium (52%) as the predominant depth. In contrast, for shirts/blouses, high (81%) predominated, medium (10%) and low (10%) came in second (Appendix E16, Figure 29).
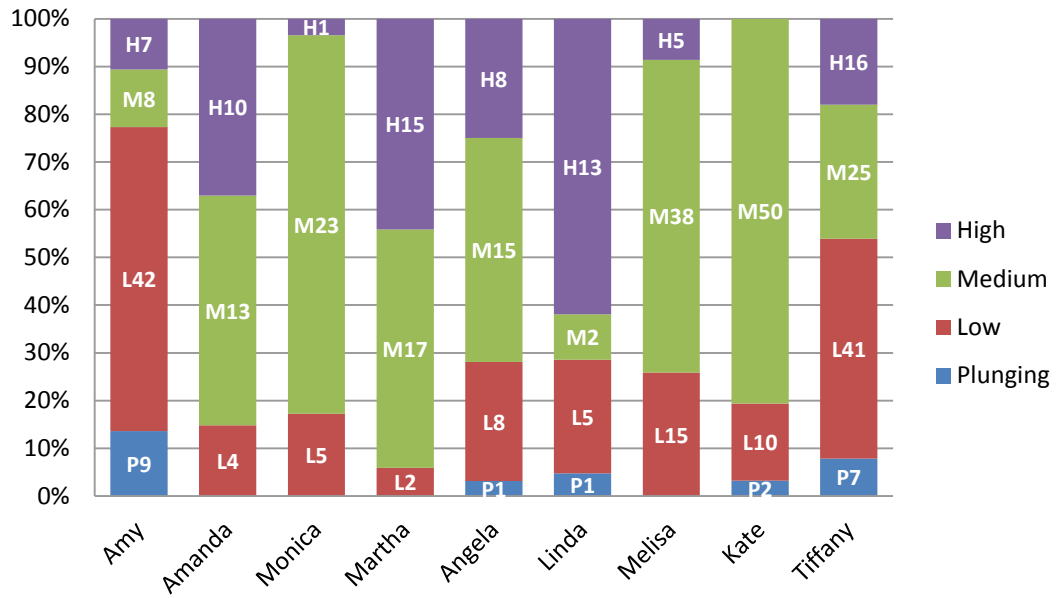
Figure 28. Frequency of neckline depths in tops for each participant
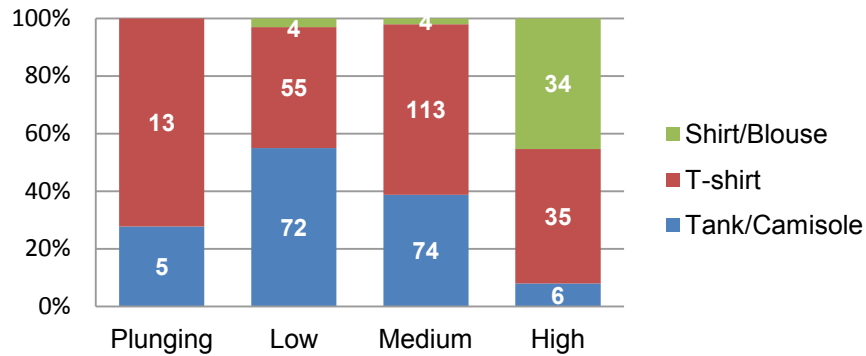
Figure 29. Frequency of neckline depths in top types for all participants

The number of variations in neckline depths differed among top types, as shown in Figure 29. Participants owned and average of three tanks/camisoles with different neckline depths, ranging from one to four ($M_{\text{neckline-depth}}$=2.56, SD=0.88). For T-shirts, there were three different neckline depths in a range of two to four ($M_{\text{neckline-depth}}$=3.00, SD=0.71). There was less variation for shirts/blouses ($M_{\text{neckline-depth}}$=1.33, SD=0.87), ranging from three to four, than for tank/camisole, and for T-shirt types.

68

Frequency of Sleeve Type in Tops

There were seven different sleeve types for tops, of which sleeveless types were most common (39%), followed by the standard set-in sleeve (37%) type (Appendix E17). As seen in the Figure 30, participants averaged four (M_{sleeve}=4.33, SD=1.00) variations in sleeve types, ranging from three to six. All participants owned sleeveless, standard set-in, and cap sleeves.
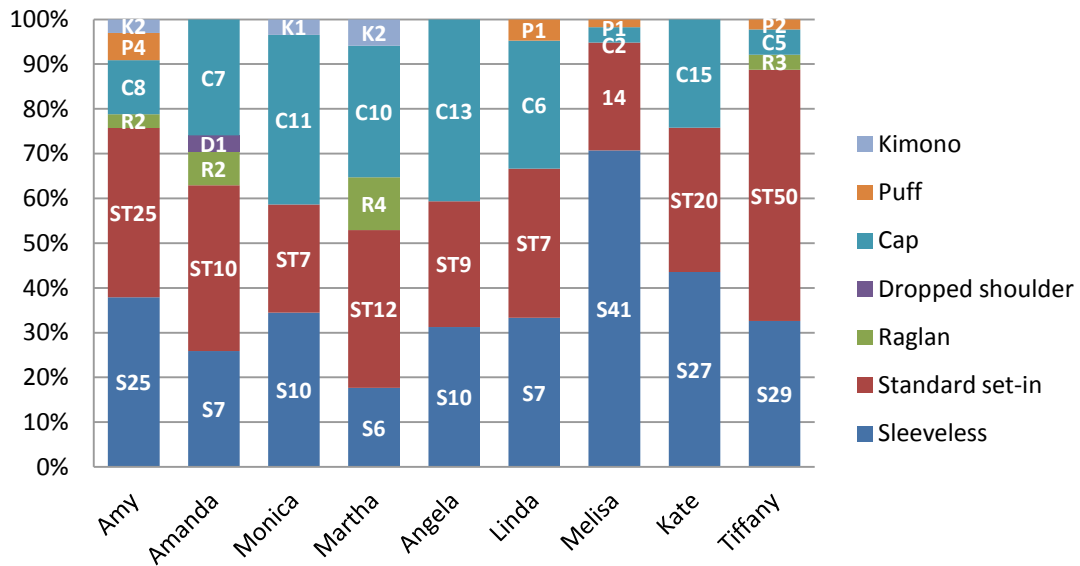
Figure 30. Frequency of sleeve type in tops for each participant
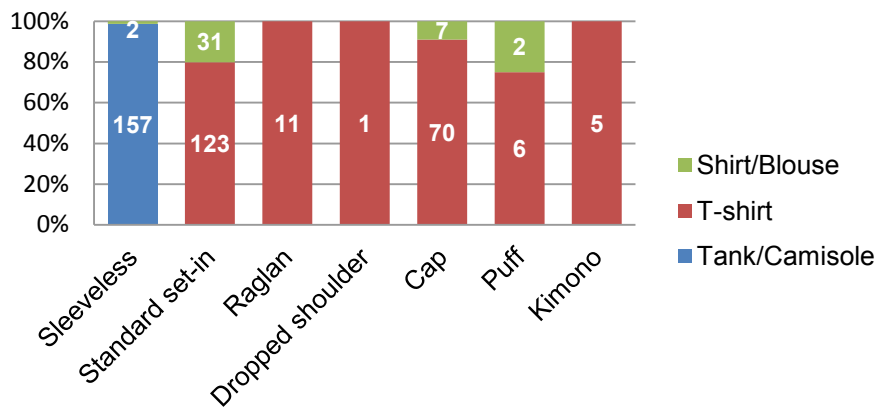
Figure 31. Frequency of sleeve type in top types all participants

T-shirts had a wide range of varieties in sleeve types among top types, and there were six different types consisting primarily of standard set-in (57%) and cap (32%). There were four sleeve types for shirts/blouses and many of them were standard set-in (74%) (Appendix E18, Figure 31).

T-shirts showed the widest range of sleeve types with an average of three per participant (M_{sleeve}=3.22, SD=1.09), with variations with a range of two to five. Across all participants, an average of two (M_{sleeve}=1.78, SD=0.97) variations were in shirts/blouses, with the range from one to three. Sleeveless types were analyzed according strap thicknesses and categorized as thin, medium, thick, and strapless (Appendix E19), For all participants, the average strap thicknesses were medium (52%), thin (25%), thick (22%), and strapless (1%), as illustrated in Figure 32.
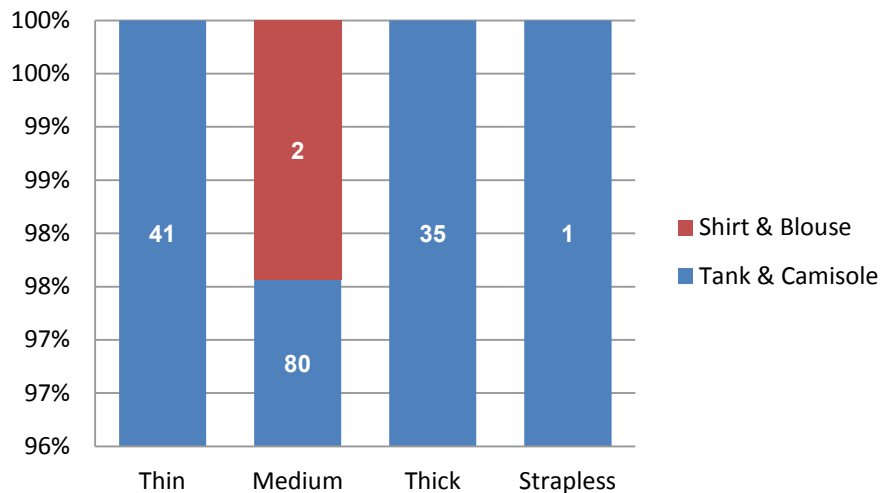
Figure 32. Frequency of strap thickness in sleeveless tops for all participants

Frequency of Sleeve Fit in Tops

Participants had three ($M_{sleeve-fit}$=3.00, SD=0.71) variations for sleeve fit in tops, on average, with the range of two to four. The results indicate that most frequent type was

fitted (61%), and the least frequent type was full/gathered (3%) sleeves (Appendix E20).

Many participants (78%) owned tops with fitted sleeve types. Furthermore, all

participants had both fitted and loose types in their wardrobes (Figure 33).
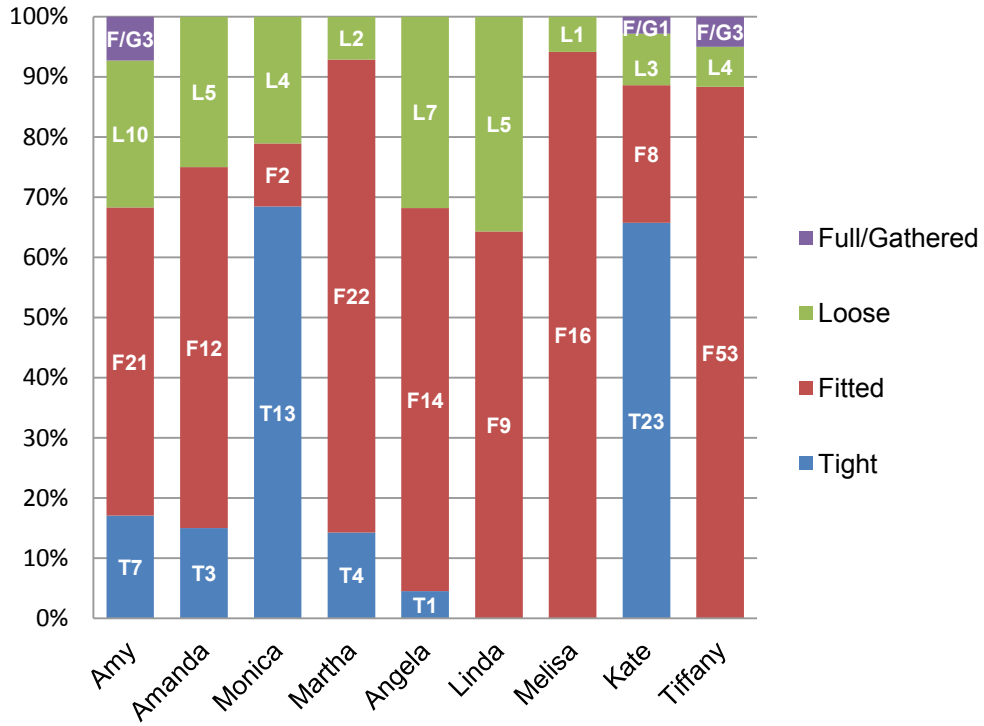
Figure 33. Frequency of sleeve fit in tops for each participant
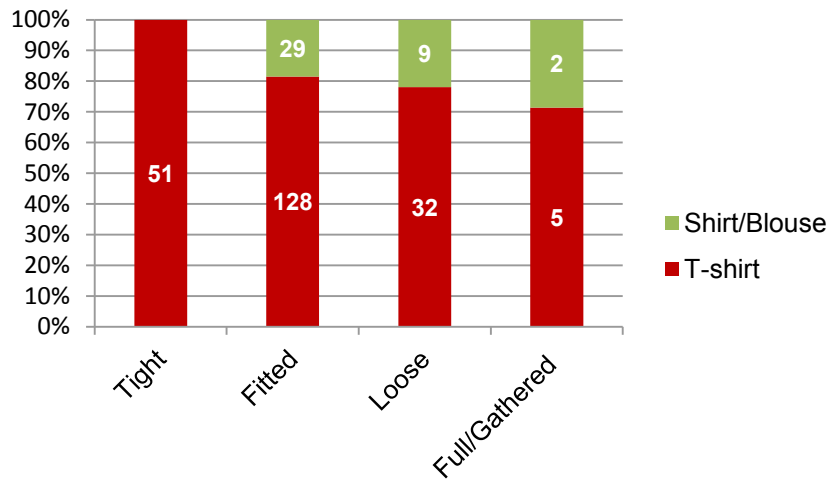
Figure 34. Frequency of sleeve fit in top types for all participants

71

Both T-shirts and shirts/blouses had fitted, loose, and fill/gathered types. However, there were no tight sleeves for shirts/blouses. In T-shirts, about 60% were fitted type (Appendix E21, Figure 34).

The greatest variety in sleeve fit is apparent for T-shirts among top types and participants had about three ($M_{\text{sleeve-fit}}$=2.78, SD=0.97) sleeve fit types with the range of one to four. Participants had two ($M_{\text{sleeve-fit}}$=1.67, SD=0.71) different sleeve types in shirts/blouses, ranging from none to two.

Frequency of Sleeve Length in Tops

Sleeve lengths were analyzed and quantified details are indicated in Appendix E22. The most frequent type sleeveless (39%), followed by very short (25%) type. Participants had five ($M_{\text{sleeve-length}}$=5.44, SD=1.13) different sleeve lengths for tops in the range of three to seven (Figure 35).

There were only sleeveless types for tanks/camisoles. In T-shirt, the most frequent type was very short (45%). In the shirt/ blouse category, there were many long (38%) sleeve length. There were three main lengths and they were very short, long, and short types for both T-shirt and shirts and blouses. There was no sleeveless types for T-shirt and there was small amount of sleeveless type in shirts/blouses (Appendix E23, Figure 36).
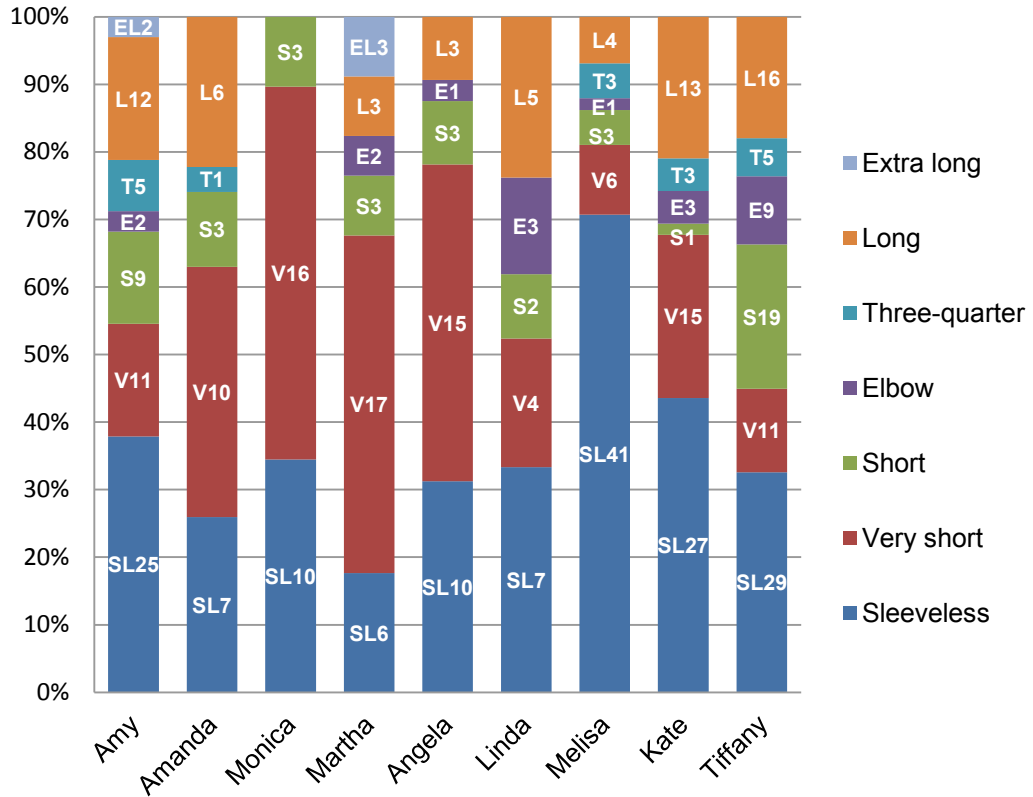
Figure 35. Frequency of sleeve length in tops for each participant
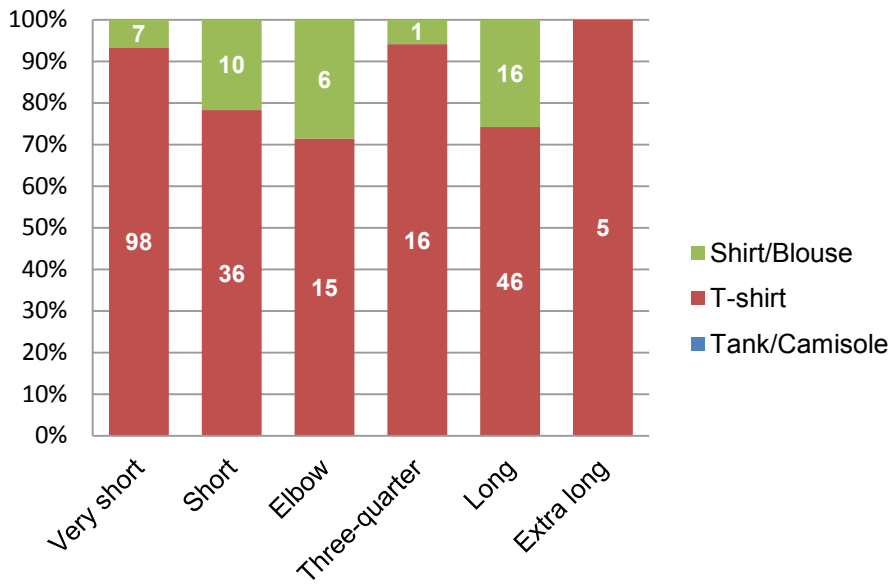
Figure 36. Frequency of sleeve length in top types for all participants

73

Frequency of Sleeve Cuff in Tops

There were many no-cuff sleeve types (39%), followed by plain cuffs (37%) (Appendix E24). The average number of variations was about three ($M_{sleeve-cuff}$=3, SD=.50), with a range of two to four, when excluding no-cuff types (Figure 37).
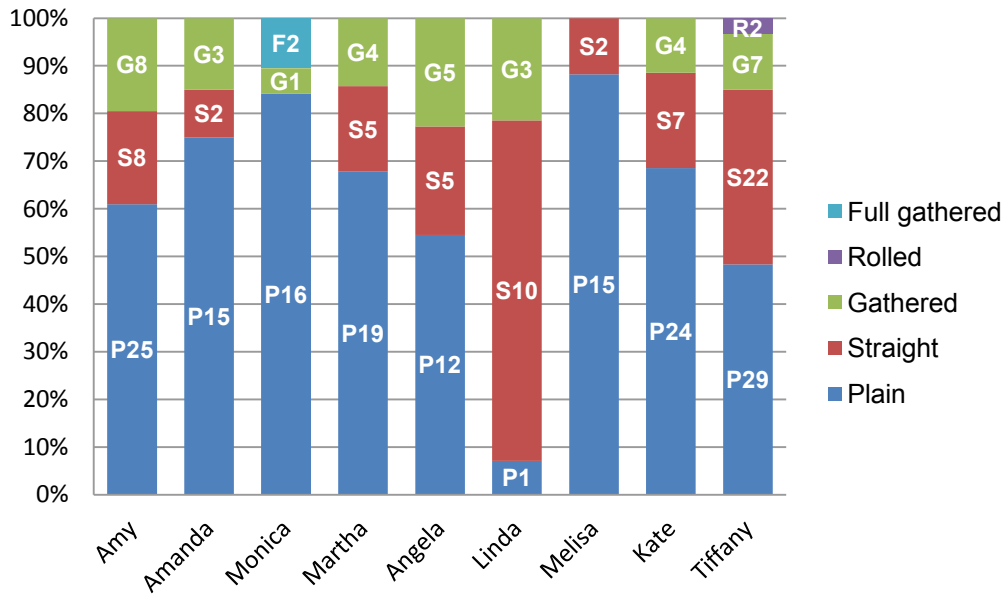
Figure 37. Frequency of sleeve cuff in tops for each participant
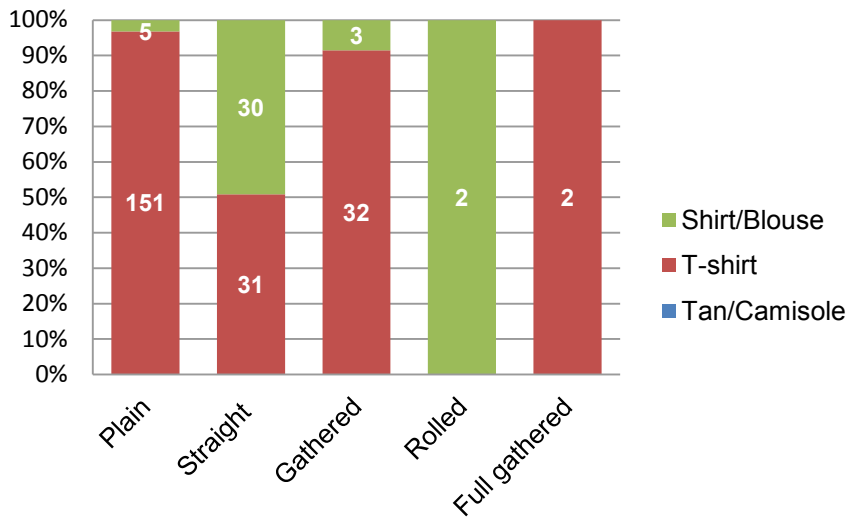
Figure 38. Frequency of sleeve cuff in top types for all participants

The shirt/blouse type had the most variations in sleeve cuffs. This may be a result of cuffs being considered one of core design elements for the shirt/blouse type. Both shirt/blouse and T-shirt categories had plain, straight, and gathered cuff styles. Straight cuff types (71%) were found in many shirts/blouses (Appendix E25, Figure 38).

Frequency of Pockets in Tops

There were many no-pocket tops (97%), and followed by patch pockets on tops. In-seam pockets may not have been detected because pockets were analyzed from the data of garment images. The most common number of variations was two (M_{pocket}=2.33, SD=.71) and the range was from one to three (Appendix E26). There were very few pockets for all participants (Figure 39). This may caused as the pockets were analyzed based on photographs of garments.

T-shirt and shirt/blouse types had more variations in pocket styles than tank/camisole. The order from the most to the least was the same in patch and set-in pockets in T-shirt, and shirt/blouse (Figure 40). The variations in pocket types were the highest in the shirt/blouse type at two (M_{pocket}=1.56, SD=0.73), whereas the other top categories had only one type such as T-shirts (M_{pocket}=1.33, SD=0.50), tank/camisole (M_{pocket}=1.11, SD=0.33).

75
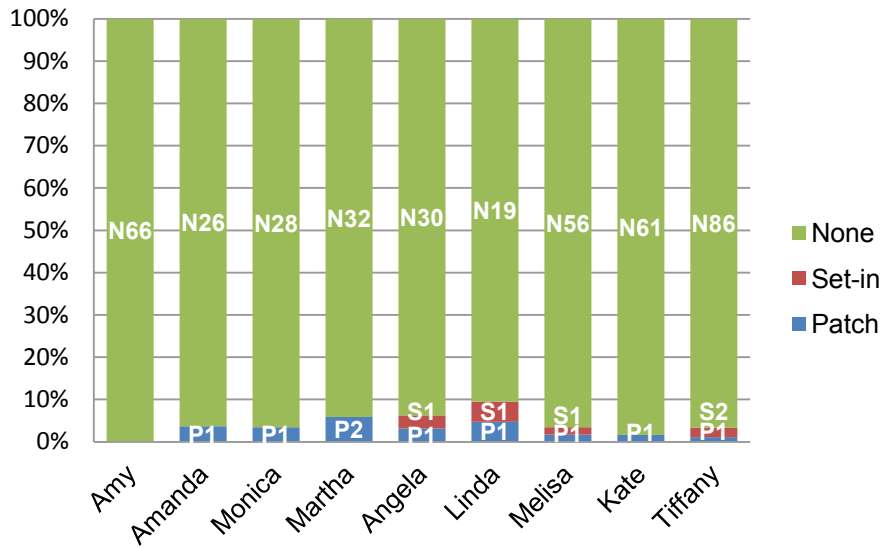
Figure 39. Frequency of pocket types in tops for each participant
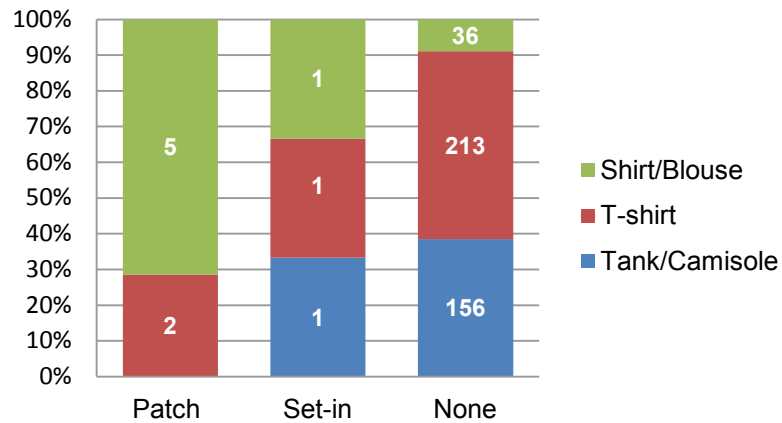
Figure 40. Frequency of pocket type in top types for all participants

Changes in Wardrobes

Subsequent to the compilation of the wardrobe database, 86% of participants bought T-shirts, 29% added shirts/blouses to their wardrobes, and 14% purchased tanks/camisoles. Among these acquisitions, 57% of the participants bought for the purpose of adding colors or patterns, while 43% looked for different sleeve lengths. In

addition, two participants, Linda and Kate, removed T-shirts. Linda was interested in having higher quality tops, whereas Kate rotated T-shirts whenever they wore out.

<center>**Perceived Varieties in Wardrobes**</center>

This second section compares participants' perceptions of variety in their own tops wardrobe with the measured variety of tops in the wardrobe databases. The purpose of this comparison is to triangulate data and to understand why people own those varieties of designs in tops and to get a basic idea of what changeable design functions would be needed for a transformable garment (Appendix D). The percentages indicate the number of participants. In this section, participants' perceptions of their own wardrobe are compared to the measured frequency and variability described in the previous section.

Garment Types

All participants perceived the most common of their wardrobe items to be tops, and only one participant, Linda, perceived it as a dress, which was correct. The reasons for owning top included 67% indicated *ease of layering* and *matching*, and 33% indicated *versatility*.

> "I can create different combinations easier with tops. There are more different collections or wardrobes that you can put together just by having different tops." (Melisa)

The other answers for having many tops were *professional outfit styling*, *salience, comfor*t, and *ease of wearing*.

The most popular top types were T-shirts (71%), and tanks/camisoles (14%). Participants said they owned T-shirts because of their *versatility* (80%) and *comfort* (40%). Angela and Kate discussed *versatility*.

<center>77</center>

"T-shirts can go with so many different things." (Angela)

"It's versatile, I feel like, yeah, just in my everyday life as well as my work." (Kate)

More than 70% perceived that they owned various styles of garments in their wardrobe, and the major reason was they wanted to have and wear *variety* (60%).

"I like to have different, lots of different things in my wardrobe to pick from. If I notice I'm starting to buy more of one color, then I will stop myself. If I go to my closet and say wow, you have a lot of blue shirts, and then I will not buy any more blue things for a while." (Martha)

"I don't like wearing the same thing every day." (Linda)

"I don't usually buy the same color or shirt. If I already have something that's similar I wouldn't buy it again, so I would say that they're varying." (Melisa)

The second reason for having varied garments was to have outfits for *different occasions* (40%). Linda commented, "I think it has a lot to do with where I am going to and what I will do that day."

Color/Pattern in Tops

Regarding color/pattern in tops, 71% of participants accurately identified the color/pattern that was the most frequent color/pattern in their own wardrobes. Participants had neutral colors (80%) or bright colors. They expressed different reasons for having different color choices. All participants who had many neutral colors commented the reason was *ease of matching*. Tiffany said, "I have a lot of fun, crazy-color jewelry, so I just find it easier to throw on a white top. It is a nice base." In addition, 29% of participants mentioned the importance of color/pattern's *versatility*.

78

"I've noticed all of my black shirts I can wear to work and it doesn't look super dressy. But then if I pair them with a nicer pant, then all of a sudden my black shirts look dressier if put the right jewelry with it." (Martha)

"I think everyone needs a lot of black in their wardrobe; I do. That's the most versatile color." (Kate)

In contrast, Angela, who had red color as the most prominent color in her wardrobe, talked about the *salience* of bright colors. Angela said, "Having a bright-colored tops helps to break up some of the cardigans that I have and catches my eye when I'm out."

Two participants, Linda and Melisa, perceived the most frequent color of tops as red and black (Linda), and black (Melisa), but in actually they both owned more white than black. A possible explanation for this perception is that Linda may have preferred those two colors, red and black, so that even if she actually owned many white garments, she would still perceive her loved colors to be the most frequent in her wardrobe. Melisa tended toward *seasonal change* in colors/patterns, and wore many black colors in winter. Since the interview was conducted in early spring, Melisa might have remembered wearing many black garments.

"I just really wear a lot of red and black. For my skin tone, those are the colors that I like the best." (Linda)

"I like all colors and I'm changed by the season. In the winter I tend to wear more black. It's really seasonal for me." (Melisa)

Also, regarding patterns in tops, 71% of participants accurately reported the most common patterns they owned as compared to those measured in the wardrobe database.

79

Their unanimous reason for liking patterns in tops was *salience.* For 29%, prints were a *trend* when they purchased them.

In top types, 86% of participants perceived color/pattern frequency as being the same as what they actually have in their own wardrobes. The most frequently occurring color for tanks/camisoles was white. Participants preferred white because of its *versatility* (43%) and *ease of matching* (29%), which coincided with the reasons for white colors for all tops. Angela commented, "I like white for camisoles to wear underneath things. The white goes with everything for the camisoles." Print was the second most frequent color/pattern type for tanks/camisoles, and participants had a variety in colors and patterns. Also for shirts/blouses, white and print predominated. The reasons were *availability* and *comfort*. For T-shirts, the most frequent types were print, followed by white. The reasons given were *versatility* (14%), *ease of matching* (14%), *variety* (14%) in colors/patterns, and for *different occasions*. Kate mentioned *ease of matching*.

> "It's so easy to mix and match those things to create different styles. Just easy to accessorize and put a colorful earring or put a colorful scarf on it, so it's not overwhelming." (Kate)

When they discussed colors and patterns, all participants responded that they chose specific colors/patterns for the *ease of matching*. Other reasons given were *versatility* (86%), *salience* (43%), *seasonal change* (29%), and *trend* (29%).

Size/Fit in Tops

All participants perceived the most frequent size/fit as the actual size/fit of the garments in their own wardrobes. The major reason for having varied garment size/fit was *brand differences* (57%).

> "Depending on the brand, but probably more like a small and a medium." (Angela)

> "Tops in different brands obviously fit differently." (Linda)

> "I do buy a lot of clothes from a specific brand. So I'd say pretty much just a medium. That's what I look for. For instance with brands made for a junior, I would probably wear a medium, but like a brand made for older women I'd probably wear a small." (Melisa)

The other reasons for owning different sizes and fits were as follows: Martha purchased sizes/fits *to fit body type*, for *ease of layering*, and to have right length. Angela did the same for *comfort*.

Interestingly, all participants responded the same regarding what they have in size/fit in their wardrobes, except for Martha, who considered there was no difference among top types for sizes/fits. However, Martha had more various sizes in T-shirts than other top types, and had three different sizes, XS, S, and M. In all three top types, participants (57%) considered *comfort* and 29% cared about *brand differences* for size/fit. The other reasons to have different sizes/fits were *ease of layering* and *good appearance* for the T-shirt. Kate said, "I prefer the more fitted T-shirts during the day, in the work day, because I'm then able to throw a sweatshirt over it, throw a cardigan over it." For the sizes and fits of shirts and blouses, Linda considered *professional outfit styling*, and Angela mentioned about *fit to body type* and said, "Just to fit my boobs. Otherwise,

81

they're always really tight to button shut, so those tend to be a little bit bigger, medium size."

When asked about sizes/fits, 86% of participants discussed *brand differences*, and 71% of participants cited *comfort*. Some participants (43%) mentioned that they care about *fit to body type,* and *good appearance* (29%).

Silhouette in Tops

All participants stated that straight-silhouetted tops were their most frequently owned item. The major reason was *ease of matching* (57%). The minor reasons were to *fit to body type* (43%), *simply like* (29%), and for a *professional outfit styling* (14%). The below conversations summarize the idea of *ease of matching*.

> "I'm normally wearing them with a slim-legged pant and I feel like that looks best, having a straight and slim silhouette somewhere and more billowy somewhere else." (Linda)

> "It's really about balance for me, so if my jeans are more flare then my top is probably tighter." (Melisa)

For hourglass silhouette, 57% answered that they have this in their wardrobes, but 86% owned hourglass silhouette in their wardrobes. Others (43%) mentioned only straight silhouette. Participants owned hourglass silhouettes for *ease of matching* (29%). Linda said, "I bought them for pants that have a wider leg, which most of my professional pants do have a wider leg, so they look good and easily go with that." Others owned hourglass silhouettes for *fun* (14%), *professional outfit styling* (14%), and to *fit to body type* (14%).

Regarding full silhouettes, Melisa recognized that there were a few full silhouettes in tops, and that she was the only participant who owned full silhouettes among the

participants. Melisa did not own many, but wanted to wear them for their *comfort* and for *ease of matching*. "They're just more comfortable," Melisa said. "The layout is how your wardrobe is balanced, so tight and straight on top, loose on bottom and vice versa."

About 71% of participants said they did not own different silhouettes of tops, but except for Amanda who owned only straight silhouettes, they all owned hourglass silhouettes. There was no hourglass silhouette in this shirts/blouses category for Martha and Angela. In contrast, Kate had hourglass silhouettes for T-shirts. There was, however, a small representation of hourglass silhouettes for all participants.

All participants cared whether the silhouettes had *ease of matching* and *fit to body type*, and many considered whether they were appropriate to *professional outfit styling* (71%). Several participants selected silhouette as *simply like* (29%) and *fun* (29%).

Collar Type in Tops

All participants picked the no-collar type as most prevalent in tops and some participants (29%) said they did not like collars, as wearing collars was not comfortable (*discomfort*). Two participants, Angela and Tiffany, talked about their second most frequent collar type, convertible collars, and the main reason was for *professional outfit styling*. Angela commented, "They seem to be kind of stylish and professional."

All participants said they owned no-collar types as the most prominent type of tanks/camisoles, and T-shirt types, which coincided with measured prominent collar type in tank/camisole from the wardrobe database analysis. About 71% of participants commented that most of their convertible collars are found in shirts/blouses. Some participants (43%) preferred no-collar tanks and camisoles because of the *ease of layering* with other items, and some bought them because they were mostly available

(*availability*) for tanks/camisoles (29%). The reason for having so many no-collar T-shirts was to *fit to body type* (43%). For shirts/blouses, convertible collars were most frequently cited as *professional outfit styling* (57%) and *availability* for shirts/blouses (29%).

While discussing collar types, a number of participants identified the use of collar types in *professional outfit styling* (86%). Some participants (43%) cared about whether collar types fit their body types (*fit to body type*), and several participants (43%) bought and wore the collar type that was the available (*availability*) in the market.

Collar Size in Tops

More than 70% of participants indicated they have standard-sized collars. Amanda and Tiffany commented they have small collars the most, but they had standard as the most prevalent according to the wardrobe database. Both Amanda and Tiffany owned small-sized collars as the second most prevalent type. Several participants (43%) preferred standard collar sizes, as they are widely available in the market, *availability*. Martha said, "They were more of them available than others." Some participants (29%) said that the standard size was more appropriate for *professional outfit styling*. "I wear them when I need to look professional," Kate said. Another reason was *ease of matching* (14%). Kate said, "It is the most classic look that would be easily paired with a blazer or a vest." On the other hand, 43% of participants did not care about collar sizes when they purchased and selected tops. Amanda said, "I don't pick the collar size, whatever the top comes in." Participants selected collar sizes for *availability* (71%), for *professional outfit styling* (43%), and for *ease of matching* (29%).

84

Neckline Shape in Tops

All participants talked about V-neckline shapes, even though those were the most prevalent top type for only 29% of them. The top reason for having V-necklines was *ease of matching* (57%), especially with accessories.

"I can wear necklaces with them." (Angela)

"It's just really easy to accessorize. It's really easy to just put a scarf on and you dress it up a little bit or get a little bit more fashionable." (Kate)

"I always like a V-neck just because I either will wear a necklace and then that helps accentuate that." (Tiffany)

The other reason to have V-neckline tops was because of *fit to body type* (43%) of necklines. Kate talked about exposure related to body type. "Just for the way any top that covers up close to my neck and makes my neck look really short, at least I feel like it does. So I prefer V-neck." In contrast, some participants considered how much skin they were showing in terms of *modesty* (29%). Linda said, "I like V-necks a lot but I don't buy a lot of shirts/blouses that way because it's just too much cleavage." Concerning the round neckline type, for 43% of the 71% of participants who identified this as the most prevalent type, the major reason to have many round necklines was *ease of matching*.

In terms of top types, Linda perceived the neckline shapes she owned differently from the neckline shapes measured in her wardrobe. Linda said there are many round necklines for tanks/camisoles and V necklines for shirts/blouses. However, as measured there were many V and scoop necklines for tanks/camisoles and round or funnel for shirts/blouses. This might be attributable to a difficulty in distinguishing between the round and scoop neck. Participants primarily considered *comfort* (43%) and *fit to body*

type (29%) for T-shirts, and *professional outfit styling* (29%) and *modesty* (29%) for shirts/blouses as reasons for preference.

When participants discussed various neckline shapes, the most frequent reasons for buying and wearing specific neckline shapes were *fit to body type* (100%), *ease of matching* (71%), *comfort* (57%), and *modesty* (57%). The others were *professional outfit styling* (29%), *fun,* and *good appearance* (14% each).

Neckline Depth in Tops

Except for Kate, the rest of the participants reported that they had medium neckline depth as the most prevalent type of neckline depth. However, there were some differences in the neckline depths measured in the wardrobe database. Linda and Tiffany reported having medium depth as the most prevalent type, but the most frequent type measured was high for Linda and low for Tiffany. In contrast, Kate had the most medium depth, but Kate indicated low and plunging types were her more frequent types of tops. Linda said that medium is the most prevalent for T-shirts, but the data indicated that high was the most frequent type. These discrepancies may have caused them to believe that the necklines matched well with their body types. The reasons reported for preferring medium depth were *modesty* (57%), and *fit to body type* (29%), and *comfort* (14%).

Regarding neckline shape, participants considered *modesty* (71%) as the most prevalent reason, *fit to body type* (43%), *comfort* (29%), and, *different occasion,* and *brand differences* had 14% each. The following comments illustrate the importance of *modesty* at work.

> "I think it's about how much skin is showing and also the way that it shapes the body." (Martha)

86

"I think they're all kind of covering that. I would be really uncomfortable if it was too low at work." (Melisa)

"I don't think low or plunging tops are appropriate, especially in the workplace. I prefer to cover my bust at work." (Melisa)

"I wear them underneath T-shirts; it's high enough that it's modest enough at work." (Kate)

"I can't go too plunging just because I have a larger bust and I bend over a lot in my job. I like a standard depth so that you can kind of accentuate but it covers it enough." (Tiffany)

Sleeve Type in Tops

Differences in participants' perception of sleeve types as compared to the wardrobe database measurements of sleeve types appeared among some participants (29%). Angela and Kate considered standard set-in as the most prevalent in their owned sleeve types, but the most frequent sleeve types were cap sleeves for Angela and sleeveless for Kate. Standard set-in sleeve type ranked third for Angela and second for Kate. However, other participants perceived that the most prominent sleeve types were sleeveless and standard set-in, which matched the wardrobe database.

The major reason to have the standard set-in sleeve was *comfort* (43%). Martha said, "Those things are comfortable to wear." Similarly, Angela commented, "I don't like kimono or bell sleeves. I think they drag into things, so I like standard sleeves when they're tight fitting." The other responses were *good appearance* (14%) and *ease of layering* (14%). Kate liked *ease of layering* "mostly because standard sleeve fits close enough to my body that I can put something over it without it looking bulky from the outside."

87

The sleeveless type was accepted because of *comfort* of movement (29%). Linda, who is a textile designer, said, "I like to be able to use my arms and not have to worry about constriction."

As expected, many participants (86%) talked about *availability* as the main reason to have the sleeveless type for tanks/camisoles. In addition, there was a comment about *comfort* with regard to thermal effects (14%). Melisa responded, "I get really warm. I would not feel comfortable taking off my other layer if I had a sleeveless spaghetti-strap tank top on or whatever that would be."

When discussing sleeve types, participants chose particular sleeve types by considering *comfort* (86%), *ease of layering* (43%), *professional outfit styling* (43%), and *good appearance* (29%).

Sleeve Fit in Tops

Most participants (71%) correctly perceived the sleeve fits for their existing tops. The differences were found in Kate's and Tiffany's responses. Kate believed many sleeves were fitted, but there were many tight sleeves. The fitted, tight, and loose types were the three major sleeve fit types in rank order in the wardrobe database analysis. Kate commented about tight sleeves as follows, which explains *ease of layering*. "They're tight enough against my body that I would be able to put a sweatshirt over it, if I wanted to, or it won't look ridiculous under my jacket or things like that." Tiffany perceived loose sleeve as comfortable (*comfort*). She said, "It's looser, just more comfortable. At work and at home, I need to move, especially with my arms or to lift. I do a lot of that. So looser is just more comfortable."

The major reason to have fitted sleeves was to *fit to body type* (43%). For example, Melisa said, "I prefer fitted sleeves … I think I like my arms and I usually wear a fitted sleeve."

More than 70% of participants chose a different type of sleeve fit for their garments than the actual type of sleeve fit for the garments in their wardrobe. Similar to sleeve fits for tops, Kate and Tiffany were different. In T-shirt types, Kate perceived that fitted type was the most prevalent, but there were many tight sleeves. Tiffany indicated that many sleeves were loose, but there were many fitted sleeves according to the wardrobe database. Tiffany preferred loose sleeves for *comfort*—movement and *long-term use*. "It's comfortable to move. I guess because I like them and I know I'll wear them a lot for a long time."

The major attributes discussed regarding sleeve fit were *ease of layering* (71%), *fit to body type* (57%), *comfort* (43%), *good appearance* (29%), and *availability* (29%).

Sleeve Length in Tops

Except for Linda, the rest of the participants (86%) incorrectly perceived the most frequent sleeve lengths. Angela, Kate, and Tiffany responded that short was the most prevalent, but Angela had the most prevalent as very short, and both Kate and Tiffany had sleeveless as the most common. All three participants' responses were the second most frequent length. Kate preferred short sleeves for their *comfort* and *ease of layering*. Tiffany owned many sleeveless tops, but she usually wears sleeved tops as for *modesty*.

> "I don't like to be in a long-sleeve top, especially if it gets hot. If I'm in different rooms for meetings and what not, that's why I put a cardigan over it, over a short-sleeve shirt." (Kate)

"I guess I have some sleeveless that are camisoles, but otherwise I don't usually wear those in public. I prefer to have a sleeve." (Tiffany)

Amanda, Martha, and Melisa considered long sleeve as the most common; however, Amanda had many very short sleeves, and Martha and Melisa had many sleeveless tops. Amanda and Martha preferred long sleeves because of their *comfort* and Melisa liked them for their *ease of layering*.

Among top types, participants (57%) perceived short sleeve as the most frequent length for T-shirts, but they all had more very short sleeves. Short sleeves were the second or third most frequent length in rank. This might caused by the difficulty in differentiating between short and very short sleeves.

The reason for wearing many sleeveless tanks/camisoles was *ease of layering* (43%). Angela stated, "I like wearing those underneath cardigans." About 47% of participants had long-sleeved shirts/blouses because of their *professional outfit styling* (29%). For instance, Linda said, "All of my button-down shirts have sleeves, and I think it has to do with the professionalism of the garment. Long sleeves are traditionally the more professional obviously."

Discussing sleeve length, most participants considered *comfort* (86%) and *ease of layering* (71%) to be the most important attributes. Some participants spoke about *professional outfit styling* (43%), and *fit to body type* (29%). Regarding *fit to body type*, participants wanted to show specific parts of their arms. Melisa said, "I have very small wrists and I like wearing bracelets, and I like how the shorter sleeve looks."

90

Sleeve Cuff in Tops

The most frequent type was plain cuff, and all participants accurately perceived that they had many plain cuffs among their tops. Among top types, all participants correctly perceived what kinds of sleeve cuffs they had for shirts/blouses.

The main reasons participants preferred plain cuffs were *simple style* (43%), and *comfort* (29%). Participants considered plain cuffs simple in design.

"I don't want it like drooping on my wrists, so I like plain and simple cuffs." (Angela)

"I like little details on cuffs." (Linda)

"I like that it has a little detail, but the majority of mine are probably the ones that are plain. I like cuff details, something simple." (Melisa)

Pockets in Tops

All participants correctly believed they had the highest frequency of non-pocket tops. Angela, however, perceived there to be no variation in pockets for tops but had patch and set-in pockets. The main reason to have pockets for tops was for *practicality* (29%). "Put my keys in them or put my hands in them," Martha said. Added Melisa: "It's kind of comfortable to stand like that, something to do with your hands."

On the other hand, 57% of participants, including Angela and Tiffany, considered pockets are not practical (*impracticality*).

"I just don't think about buying them. I don't see the purpose of a pocket." (Amanda)

"I guess they just have like little ones that aren't really practical. It's more like pockets in my jeans or my pants that I actually use." (Angela)

"I just think it's an extra something that doesn't need to be there." (Kate)

91

"I don't like the look of it on my tops because they're not functional. If it has a pocket, usually it has just a little breast pocket … that's not functional." (Tiffany)

When discussing pockets, participants mentioned *practicality* (86%), *fit to body type* (14%), and *availability* (14%).

Values of Changeable Design Functions

The purpose of this part was to understand what varieties and changeable design functions people valued in their tops.

Considerations of Sustainability

Among the nine participants, seven (except Amy and Monica) agreed to participant in the personal interviews. At the outset of the interview, participants were asked for their own definitions of *sustainability*. Approximately 71% participants commonly mentioned sustainability in fashion as involving buying and wearing garments that can be used for the long-term (*long-term use*).

> "Keeping the same things for a long time or keeping the same things in fashion. I think about it like buying central pieces that would be things I can hold onto for a long time, or buying more things that will last a long time." (Angela)

> "Something that has longevity and your wardrobe is sustainable." (Linda)

> "As I've gotten older, I care much more about it. I want it to last awhile and be of good quality." (Melisa)

> "Basic pieces will stand the test of time such as black colors." (Tiffany)

About 57% of participants said that sustainability in fashion involved *reusing and recycling* garments. Martha said, "I go to a lot of thrift stores. I'll alter things, too. So, I think sometimes if I see a garment, like it's a nice fabric and it's a good price, but it wouldn't quite fit me, I'll buy it anyway. And then I can alter it. I'll hand sew or use a

machine." Kate also thrift-shopped, went to secondhand stores, and recycled and reused

worn out T-shits into craft projects.

> "I tend to do a cycle a lot of my V-neck just cotton T-shirts because they get dirty and there's stains that can't come out. I do a pretty big cycle with those. So I have given away or recycle a lot to do like craft projects with. Twice a year, I go through my entire closet and I'll give those away or I'll recycle them. Even, I give them to friends or we have a clothing swap." (Kate)

Some participants (29%) commented about *eco-friendly materials*. Kate said, "I

just think of the word sustainability in fashion [as an item] that isn't going to harm the

environment." Amanda mentioned that sustainability is buying and wearing

biodegradable fabrics.

Other definitions involved *sustainability standards*. Linda said, "Most importantly

the way that it's created, if it uses manufacturing practices that are up to standards of

today's times."

Seventy-one percent said they cared about sustainability when they buy and wear

garments. Among them, if they buy expensive garments, about 60% of participants

concerned sustainability and *versatility* of garments.

> "I try to find thing that are functional that can have multiple uses. So I don't usually buy items that I'll only wear one time." (Martha)

> "I might buy a black cardigan, if I spent lots of money, for instance, like what I have on today, and wear it many different ways." (Melisa)

The others bought garments that they can wear for a long time, *long-term use*

(40%). Linda commented, "I expect there to be sustainability built in to that cost for

pieces that are more expensive, and also pieces that I know I'll use over a long period of

time." More than 70% of the participants were willing to pay more for transformable

garments than regular garments because of their *versatility* (71%) and *long-term use* (57%) potential.

However, Amanda and Angela did not care about sustainability, because these products were usually *expensive*. Amanda said, "I don't care enough about it as I may have to pay the extra amount of money that it might cost".

Use Phase

Preferences in changeable design functions. In considering candidates for changeable design functions, all participants preferred colors/patterns, and sleeve length. The next highest preference was collar type, neckline shape, and neckline depth, which 86% of participants wanted to change (Table 8, Figure 41).

Table 8

Preferences in Changeable Design Functions

Rank	Design Functions	Participants who preferred (%)
1	Color/Pattern, Sleeve length	100
2	Neckline shape, Neckline depth, Collar type	86
3	Silhouette	71
4	Size/Fit, Sleeve fit, Sleeve cuff, pocket	43
5	Sleeve type, Collar size	29
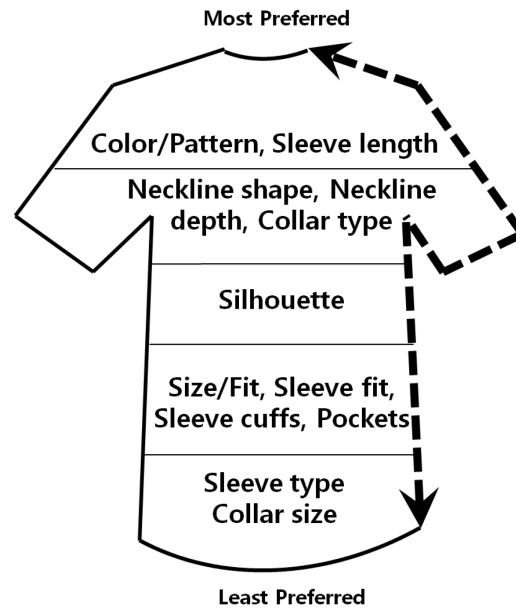
Figure 41. Preferences in Changeable Design Functions

Color/Pattern. All participants responded that they wanted to have a changing function for colors/patterns in tops the most.

The number of color options suggested by participants was 2 to 3 colors (43%), or 5 colors (43%). Participants preferred changeable colors options as follows: green (57%); yellow (43%); red, pink, and blue (29% each); and black, white, and grey (14% each). More than a half of participants (57%) wanted to have various color options.

The major reasons to have color/pattern changes were for *versatility* (43%), for *seasonal changes* (29%), or for other reasons such as *long-term use, economics, ease of matching*, and for *trends* (14% respectively). Linda and Tiffany stated that color/pattern changing functions would be beneficial for different seasons (*seasonal changes*).

"Color was nice because the colors change like a lot per season" (Linda)

"Colors would give that particular garment much more versatility than anything else if it was something that you invested in to have the option to change the color as the seasons change." (Tiffany)

95

The following conversations summarized *versatility.*

"It will be more worthwhile if tops have very different colors from each other" (Martha)

"Having different colors, I feel like [the top is] something that I can wear with a lot of different things, versus just changing, other things. I feel like colors determine a lot of what you can wear with it." (Angela)

Among top types, 43% of participants preferred to have brighter colors in tanks/camisoles and in T-shirts than dark and neutral colors. In contrast, 29% of participants liked to have dark and neutral colors in shirt/blouse to wear as a *professional outfit styling* (29%).

Size/Fit. Only 43% of participants were interested in the ability to change the size/fit of tops. Participants who were interested in size/fit changes wanted to have 2-3 size/fit options and 29% would like to change continuously such as XS to S for *ease of care*, *comfort* and *brand differences* in size. Amanda described *ease of care*. "I hate worrying that it might shrink in the wash or that like even though it's an extra small." Otherwise, 14% of participants liked extreme changes like S to L as for *variety* and *ease of matching*.

In contrast, 57% were not interested in changing size/fit because they already knew which sizes/fits worked well with their body types, *fit to body type* (43%); and those that were comfortable to wear, *comfort* (29%). Amanda mentioned *comfort* and Linda discussed both *fit to body type* and *comfort* in the following quotes.

"I feel like I want to be more comfortable in a longer shirt, and size and fit. I think mostly comfortability." (Amanda)

"I know my body type and what I'm comfortable with, and I don't think I would ever change it because if you're like changing it because you've gained weight or lost weight." (Linda)

Silhouette. More than 70% of participants were interested in silhouette changes in tops. Many of them (60%) wanted to have three different silhouette options, while the remainder wanted to have two or four options (20% each). Among those who preferred to change silhouette, all participants wanted to have straight and hourglass silhouettes. Four participants preferred full silhouettes, and Amanda and Martha wanted to have as many silhouettes as possible. People preferred to have silhouette change function in tops for *versatility* (29%), *ease of matching* (29%), and to *fit to body type* (14%). For example, Martha mentioned *versatility* and other two participants, Angela and Melisa commented *ease of matching*.

"I mean that'd have to be a very versatile tops, so I think it should probably be able to change maybe any silhouette, if it can change silhouette then I think it should be able to just pretty much do anything you want it to do." (Martha)

"I could kind of wear, like, different accessories with it and the belts." (Angela)

"I could change that then based on like what your pant is so if you had like a skinny jean you could make it more billowy or if you had like a pant that goes out at the bottom then you could make it more silhouette or hour glass." (Melisa)

Collar type. About 86% of participants were interested in changing collar types to a range of 2 to 5 styles. The most participants (57%) suggested a collar type that was detachable and attachable collars. Other collar types were ruffle, turtle, peter pan, convertible, and pop up/down (29% for each) with 14% each for frill. The reasons they preferred to change were various, and included *experimentation* (43%), *fun* (29%), *versatility* (29%), and *ease of matching* (14%). Kate was the only participant who did not

97

want any changes, as she did not like to have collars in tops, and Kate, in actuality, did not own many collars.

Among top types, as candidates for changeable collars, 71% of all participants preferred shirt/blouse. The main reason for preferring shirts and blouses was *fun* (29%).

"It's kind of fun to be able to wear it, like, or to have it change collars." (Angela)

"It would be more fun wearing those collars." (Melisa)

Collar size. Only 29% of participants were interested in changing collar sizes and preferred to have small and big sized collars (14%) or a standard collar (14%). The other participants, who did not want to change collar sizes, commented that they *rarely wear* collars (43%) and or that collars were not practical (*impracticality*) (29%). Participants preferred to have collar size changing function in the shirt/blouse type (43%) as for *availability* (29%), *professional outfit styling* (14%), and *versatility* (14%).

Neckline shape. Many participants (86%) preferred to have a neckline shape-changing function in tops. The number of changeable neckline shape options was suggested to have 2 kinds (43%). The most popular neckline shape was V-neck (71%); other preferences were round, scoop, cowl, and boat (29% respectively).

More than 40% of the participants selected T-shirts as the most preferred top type to change neckline shape. The reasons for preferring neckline shape-changing function was *variety* (43%), *ease of matching* (29%), and *modesty* (14%). Amanda mentioned *variety*, "I think just to get more variety in my shirts." The following conversation illustrates the other main reason, *ease of matching* (29%), especially with accessories.

"I usually wear a lot of earrings, some necklaces, and scarves a little bit … I can wear different jewelry with different necklines." (Angela)

"It would be nice especially in how you might want it accessorized, the top, I think that it'd be nice to be able to change that and like wear a different necklace with it or different earrings." (Kate)

Neckline depth. Participants (86%) preferred changing neckline depth second most among preferred changeable design functions. The major reason for this change preference was *ease of matching* (29%) and *modesty* (29%). Tiffany said, "I bend over so often. Standing straight up or sitting down, I like a deeper neck, but if I'm going to keep bending, it might be nice to quickly be able to like pull that up a little bit." The preferred number of neckline depth options were two (29%) or three (43%) with the combination of low (71%), medium (86%), and high (43%) depths. Approximately, 30% of participants preferred to have neckline depth changing function in T-shirts.

Sleeve type. Only some participants (29%) preferred to have the sleeve type changing function. A significant portion of participants thought it was not practical (*impracticality*) (43%). For example, Linda discussed *impracticality*. "I already have an idea in my head of what that garment would look like and what sleeve type [it must have] and I don't wear a wide range, variety of sleeves to begin with so I just don't feel I'd be interested in changing a garment once it's already been purchased."

However, if participants could choose sleeve types, they preferred to have a standard set-in (43%) and cap sleeve (29%). The reasons were for *different occasions* (43%) and for *ease of layering* (29%).

Sleeve fit. About 40% of participants preferred to have a sleeve fit changing function and the main reason was for *different occasions* (29%). Participants preferred a

99

shirt/blouse (29%) as the best type of top to have the sleeve fit changing function. Two or three kinds of options were suggested, and the preferred sleeve fit types for changing were fitted, loose, and tight. In contrast, 57% did not prefer to change sleeve fit because they wore tops with few varieties of sleeve fit; thus the function was not practical, *impracticality* (57%). Martha said, "Most of my sleeves are fitted anyway, so probably not." Similarly, Melisa also mentioned, "I guess that wouldn't be as important to me because I like a fitted sleeve."

Sleeve length. All participants selected sleeve length as the most preferred changeable design function in tops with the color/pattern-changing function. The most frequently mentioned number of options was three (57%). The most preferred option for the sleeve length changing function was long (86%), short and three-quarters (71% each), very short and elbow (29% each), followed by sleeveless (14%).

The reasons for preferences in sleeve lengths were wide ranging, but the major reasons were *comfort* (43%), *versatility* (29%), and *ease of layering* (29%). For instance, Kate talked about comfort, focusing on thermal aspects, and Martha and Melisa discussed *versatility*.

"It is one of the more versatile things." (Martha)

"It would be an interesting option if I really could change my shirt type by just changing the sleeves. I can change the whole dynamic of a top and wear it in various ways." (Melisa)

"I could really wear it in any type of weather, and in any type of temperature changes." (Kate)

Sleeve cuff. Only 43% of participants responded that they preferred changing sleeve cuffs over not changing. Two to three (43%) options were suggested. Out of these,

attachable/detachable cuff type, plain cuff, and straight cuff (29% for each) were the most

wanted as for *comfort* (43%), and *fun* (29%). The other suggestions included gathered

cuff, flipping, out or in, and width or length change. All participants suggested that

shirts/blouses deserved most consideration because shirts/blouses more frequently have

cuffs than other top types—*availability* (29%). "Usually the shirts and blouses type has

sleeve cuffs", reported Martha.

    Pockets. About 41% of participants preferred to have the pocket changing

function in tops. The number of changeable pocket options was two (14%) to three (43%),

including pocket types of attachable/detachable, patch, and seam types (43% each), and

position changeable pockets (14% each). Participants said that the most applicable top

type for changing to pockets was the T-shirt. The reason was that participants wanted to

change pockets for *fun* (29%). Martha stated, "It'd be fun just to be able to change

pockets as sort of an accessory."

    In contrast, other participants (57%) who did not want to change pockets

commented that for not wanting to do so was *not caring* (43%) about pockets in tops.

> "I don't really care that much about pockets. Pockets aren't that big of a deal to me." (Angela)

> "The pocket is enough of a detail for me, so I don't think I would care it." (Melisa)

> "Generally, in my tops, I don't use the pockets. It's more so in my dresses or what not that it's important to me." (Tiffany)

    Other changeable aspects. Besides the choice of changeable design functions, 57%

of participants suggested fabric changes such as texture, weight, or thickness. The next

most suggested functions were top length and transforming to other item categories, such

101

as a top that becomes a skirt, dress, or accessory. The other responses were decreasing

volume for traveling, ventilation, and other decorative details.

Among garment categories, 86% of participants picked tops as attractive for

transformable garments; and after that 29% of participants mentioned the dress; others

choices were pants, skirts, and outerwear (14% each).

Select Phase

Regular tops. Over half of the participants considered color/pattern to be the top

priority when selecting tops to wear from their wardrobe. More than 70% of participants

selected tops from their wardrobes by considering their activities for the day—*different*

occasions—when selecting tops from wardrobes.

> "If I feel like it's going to be more of like a professional day, like I'm going to be seeing more people, then I might dress up more." (Amanda)

> "It's mostly has to do with what I'm going to be doing that day." (Linda)

> "If I have a meeting with an upper management then it will be more professional. If I have something with my girlfriends at night I take that into consideration, so it's just all based on what I have the next day. I check the night before I leave my office what do I have going on tomorrow and I think about that when I'm picking out my wardrobe." (Melisa)

> "A lot of it really depends on what I have going on that day too and so the days where I am just at work and in meetings. If I'm going on meetings with people that I don't know or that I'm looking to start a relationship or friendship with, I wear more colorful tops." (Kate)

> "It's mostly going to depend on what I'm doing that day. If I'm going to be seeing clients, then I want it to be something that's going to look really professional. If I'm going to be in public, I always consider I want it to be really colorful and stylish." (Tiffany)

About 57% of participants chose to wear garments to be professionally dressed (*professional outfit styling*). For example, Linda and Melisa who both wear professional and semi-casual outfits at work commented about *professional outfit styling*.

"So the fit and length is the most important with professional." (Linda)

"It's always some sort of professionalism in the clothing I'm picking for work." (Melisa)

Some participants mentioned *comfort* (43%) and *ease of layering* (29%). Kate talked about both *comfort* and *ease of layering*. "What I'm looking for in an outfit, in a top, is what I am going to be most comfortable in and what am I going to be able to layer."

Transformable tops. When wearing transformable tops, 43% of participants considered differences compared with wearing regular tops. Most important were *ease of using* (43%). The below conversations present the importance of *ease of using*.

"How fast I can change it … in the morning and [if] I had to rush out? But if it takes a long time and it is hard to change, then I probably wouldn't." (Angela)

"Something that doesn't have a lot of … I would want it to be like a simple change." (Melisa)

A significant number of participants (71%) responded that they would wear transformable tops more than other "regular tops", and a newly emerging theme for consideration when wearing transformable tops was *durability* (29%). Tiffany said, "I guess durability would be a big question, though, because I think for that to work it would have to be durable, as I will wear it many times." Participants (29%) discussed about changes in their behavior that they would care more about garment categories other than tops when selecting garments.

"I will more look for other items beyond tops." (Amanda)

"I would spend more time picking out the type of bottom that would go with them because I'd feel like I'd made a commitment to this top; now I want to make sure it's going with the right bottom." (Linda)

When wearing transformable tops, 57% of participants mentioned that they would be easy to match (*ease of matching)* with other items. Martha said, "I'm able to match it with more items."

Purchase Phase

Regular tops. Participants (70%) cared significantly about *size/fit*, followed by *color/pattern* and *neckline shape* (both 43%) when purchasing tops. These comments related to *size/fit*.

"If it's a little more fitted, I like that, compared to loose. That usually goes with size." (Amanda)

"It isn't too fitted in a way that's inappropriate." (Linda)

"I look for something loose-fitting to be comfortable." (Tiffany)

Martha and Kate considered color/pattern, "I usually try to buy a color that I don't have a lot of. So I usually try to keep a variety with the color." (Martha) "I always consider the color."(Kate).

More than 40% of participants looked for neckline shapes when they purchased tops. Amanda looked for V, round, and crew necklines, Melisa wanted scoop and round necklines and Tiffany also looked for V and scoop necks. Tiffany said, "I always go for a V-neck, an open scoop neck."

Some participants considered *variety* (29%) and *price* (29%). Other attributes that the participants had positive attitudes toward were *fit to own style, trend, fit to body type, ease of matching, decorative details,* and *fabric* (14% for each).

Transformable tops. When purchasing transformable tops, participants consider *ease of care* (43%), especially as related to washing.

> "I tend not to buy as many items that are dry-clean-only or if they have to be hand-washed. So that'd be important, how to care for it." (Martha)

> "How easy is it to wash? Because you're still going to wash it." (Melisa)

> "It would need to be very washable. I'm conceivably going to be wearing it three to five times a week, so I would have to be able to wash it and have it hold up pretty well." (Tiffany)

Ease of using (43%) was also a top consideration. Some examples are as follows:

> "How easy it would be to change it is an important factor." (Angela)

> "I will care the simplicity of it. It would need to be a simple change." (Melisa)

> "Not too many options. Like, I might not grab that as quickly if I was in a hurry as I would if it just could change colors. It needs to be easy to change." (Tiffany)

The second most important attributes for purchasing transformable tops were *durability* (29%), *practicality* (29%), and *price* (29%). A newly emerging theme, that did not appear in regular tops, but did in transformable tops, was *wearability* (14%). Melisa pointed out the importance of *wearability* for transformable tops, saying, "It needs to be really wearable [like regular clothes]."

All participants responded that they would buy fewer garments if they had transformable tops, primarily due to *versatility* (57%). The other influence was *long-term use* (29%). The following quotes describe the *versatility* of transformable tops.

105

"It's because one shirt could serve as maybe three or four." (Martha)

"I feel like I'd buy fewer tops because I would have more variety with the ones that I do have." (Angela)

"I would have more options in these ones, in this one type." (Linda)

"Because then you have more variance with that one garment." (Melisa)

"I'd focus more on what bottoms pair well with it if I could get that much versatility out of it." (Tiffany)

Willingness to pay. Regarding prices for transformable tops, all participants responded that they intend to pay more than they would for regular tops. More than 70% of participants commented that they would be willing to pay two to three times more than the price of regular tops if the item had great versatility and was adaptable to long-term use. The minimum price for transformable tops was $20 and the maximum was $200.

The reasons for paying more were mainly its *versatility* (71%) and *long-term use* (57%). Tiffany said, "I'd rather pay more for one piece than less if that was going to last me a while; I'd rather that than spend 10 dollars on a T-shirt that I'm going to have to throw away in a couple of months anyway." Regarding versatility, comments were as follows:

"I would be willing to pay more, obviously, if it was transferable and replace tons of shirts." (Amanda)

"Five shirts in one, then, or have a lot of functions and purposes in it." (Angela)

"I'd expect it to take the place of three garments." (Linda)

"I can get multiple styles out of this one garment. If it gave me that much versatility and it had some longevity to it then I will choose it." (Kate)

Store Phase

Regarding transformable garments, 71% of participants expected that they will decrease the size of their wardrobes, and the main reason was its *versatility* (43%). For example, Amanda commented, "It would probably save space in my closet, as it is versatile and would replace many other garments."

CHAPTER FIVE: DISCUSSION

Natural Engagement in Sustainable Acts

Consumers continue to purchase garments to fulfill their various needs and wants, and "fast fashion" manufacturing trends allow consumers to frequently purchase more garments at a low price, thus supporting the desire for something new while reducing the hesitation of discarding garments that are no longer wanted, and shortening the clothing lifecycle. This shorter cycle has negative impacts on our environment, society, and economy (Fletcher & Grose, 2012). How can we solve this problem? Designers can develop fashion products that will be more sustainable, encourage consumers to be involved in sustainable dressing practices, and contribute to reducing the impact of the whole product lifecycle. Transformable garments are seen as one possible solution by expanding the garment lifecycle and satisfying consumers' needs with fewer items that have more versatility. This study expands designers' understanding of transformable design by analyzing the aesthetic attributes of garments that can be effectively changed by understanding consumers' wardrobe contents, and their desires with respect to transformable garments.

Transformable garments have the potential to prevent or minimize waste. The participants in this study did consistently report explicitly considering sustainability when purchasing garments, but frequently reporting focusing on versatility, and long-term use, and durability. Their explicit sustainability-oriented practices included shopping at thrift stores, altering the garments, or buying products manufactured according to sustainability

standards. Using a garment frequently for a long time is one of many ways to prevent or minimize waste and is the most preferred option among waste management methods.

In an effort to motivate consumers to care more about the sustainability of their clothing, many researchers have suggested educating consumers (Birtwistle & Moore, 2007; Ha-Brookshire & Hodges, 2009; Reiley, 2008). However, changing the behavior of consumers is not simple, and behavior modifications generally have the best chance to occur when they are convenient, affordable, and available (Janigo, 2011). Several of the participants in this research indicated that they valued sustainability, but didn't always put it into practice when shopping. However, participants were observed to engage in shopping strategies that did minimize consumption by favoring garments with attributes that made them easier to match and wear with a wider variety of other garments, and to wear in multiple ways. Transformable garments are expected to influence consumers to wear these pieces over longer periods of time and more frequently due to their ability to serve multiple needs. Guy, Green, and Banim (2003) also observed that people will wear a garment for a long time if it can satisfy different needs. Even though consumers may lack knowledge or indicate little concern about sustainability, transformable garments have the potential to encourage them to engage in sustainable behavior without their awareness. Designers can support this behavior by encouraging consumers to naturally consider versatile, transformable fashion while still satisfying their needs and wants.

The Paradigm Shift of the Sustainable Clothing Lifecycle

Transformable garment design has the potential to affect the entire paradigm of consumer behavior, and thus contribute to a more sustainable clothing lifecycle. In this study, participants responded that they would like to decrease their garment purchases

and the size of their wardrobes as a result of increasing the use of transformable tops. Major variables that emerged from participant interviews as influencing aspects of wearers' care and use of garments during the clothing lifecycle (purchase, selection, storage, and utility) are illustrated in Figure 42, with respect to the original model presented in chapter two. Incorporating the variables indicated in the figure in transformable garment design will facilitate a paradigm shift towards more sustainable practices.

Among the major attributes that the participants considered, versatility was the most important reason that would allow them to decrease their garment purchases, lessen the size of their wardrobe, and increase the use of transformable garments. Participants owned many items for the sake of versatility in design and usage. For example, there were many similar designs of T-shirts with one particular difference in design, such as color, pattern, or neckline. Thus, instead of owning and wearing different items for versatility, participants wanted to have one item that can be changed into various designs. With a versatile design, a transformable garment can be changed into multiple designs, thereby expanding the opportunity to fulfill the wearer's needs and wants. Considering the flexibility of transformable garment designs, wearers can better satisfy their needs and wants while decreasing their concerns about selecting a specific design for one item. In contrast, the participants did look for specific designs features such as size/fit, color/pattern, and neckline shapes for regular garments when purchasing them. However, when selecting transformable garments, the participants worried less about specific design features and cared more about usability, care, and durability.

Usability, care, and durability were important attributes for transformable garments. As the participants knew little about transformable garments, they were concerned about the use and care of these garments to ensure frequent and long-term use. At the same time, they did not want to invest a great deal of effort and time in transforming a garment and ensuring the durability for frequent changes. Thus, enhancing the usability, care, and durability of transformable garments is necessary to convince consumers to accept garments with the potential to transform.

Therefore, designers need to be aware of usability, and design changeable design functions that are easy and quick to understand and change. The number of changeable design options must be taken into account, with consideration of the possibility of overload. Regarding ease of care, the amount of time and effort required would affect the consumers' decisions for using transformable garments. Since transformable garments encourage consumers to wear the garment more frequently and for longer periods than regular garments, transformable garments need to be durable enough to withstand frequent changes. This will be discussed more in a later section.

Consumers who wear transformable garments can change their clothing into various designs for different occasions. These garments can be transformed one or more times to better fit the wearer's preferences. Even if the wearer does not transform a garment into all the potential variations, a few changes will result in a better outfit that can accurately meet the wearer's tastes and thus be worn frequently for a long time. Even a one-time, "improvement" transformation has possibilities for increasing sustainability since the garment would become better than when it was purchased. Thus, the consumers

might wear the garment more frequently and for longer periods because it is more well-liked. The item could then become one of the favorite or core items in their wardrobe.

Price was an important attribute considered by the participants when purchasing regular or transformable garments. The best scenario, therefore, would be if transformable garments provided versatility at reasonable prices. However, transformable garments may be more expensive than regular garments, due to value-added technologies, extra efforts by designers and manufacturers to develop these garments, and the cost of materials. The positive aspect was that the participants had willingness to pay more for transformable garments as the tradeoff for gaining versatility and longer-term use.

Transformable garments have the potential to deepen wearers' emotional attachment to the garments. When selecting future transformable garments, the participants preferred specific changeable design options that were fun and they wanted to experiment with new and different designs. Providing entertainment may postpone the disposal of a garment. During the frequent and long-term use of a transformable garment, the accumulation of positive memories about wearing the garment may create a strong emotional attachment. In Schifferstein and Zwartkruis-Pelgrim's (2008) research, enjoyment encouraged an attachment to new products to develop and memories were associated with older products. They suggested designing durable products for strong attachments that prompted wearers to postpone the disposal of the products, which increases sustainability. Norman (1998) also emphasized the importance of positive memories in making users feel attached to products, and ease of use, care, and durability would facilitate good memories without limiting enjoyment of the products. In contrast, if a product is hard to use and care for and easily broken or worn out, consumers would

112

have negative memories about using it.

Transformable garment designs therefore need to provide enjoyment, satisfy wearers' various needs and wants with changeable design functions for long-term use, and create positive memories during frequent and long-term use. To facilitate a strong attachment to transformable garments, the attributes of usability, care, and durability need to be supplemented by entertainment and positive memories.

Purchase
Versatility
Long-term use
Ease of care, Ease of using, Price
Durability, Practicality
Wearability

Use
Versatility
Fun, Ease of matching, Comfort
Different occasions
Variety, Ease of layering
Modesty, experimentation, Professional outfit
Ease of caring, Brand differences
Fit to body type

Consumer

Transformable garments

Select
Ease of using
Durability

Store
Versatility

Wardrobe

Figure 42. Transformable Garment Lifecycle

Preferences for Transformable Garments

Transformable garments are expected to have more versatile designs than regular garments. "Versatility" in transformable tops can be defined as flexibility in design by changing various design options to fulfill consumers various needs and wants for long-

113

term use. Understanding what versatility meant to participants was important as it was most common reason that they wanted to transform changeable design functions such as colors/patterns, sleeve lengths, collar types, silhouettes, and collar sizes.

Participants described versatility of regular garments primarily in terms of layering and matching with other items to be worn in various styles for different occasions. They considered black or white colored-tops to be versatile as they have wide possibilities to go well with other garments. However, salient colored pattern tops were considered to have low versatility.

Versatility of transformable garments is also mentioned regarding layering and matching with other items for various contexts. Versatility of transformable garments was discussed in terms of "different styles," "changes in design," or "multiple design options," when describing the reasons for pursuing changeable functions. Transformable garments have the potential to be more layer-able and match-able with other items than regular garments due to their versatility. Although the need for versatility in regular garments was satisfied by acquiring several items, the versatility of transformable garments can be satisfied with one item. That is, change in design occurs by wearing different regular garments, but when wearing transformable garments, consumers can wear a single item and change its design. To make the garments versatile enough for long-term use, the changeable options required tradeoffs between neutral and classic options and accent options. The participants wanted to have basic design options for easier matching and layering, but also wanted to have new and different options for a variety of designs. Therefore, if a single top can change colors/patterns, consumers might not have to purchase multiple tops. For example, a T-shirt can have neutral and vibrant

colors/patterns at the same time, such as white, black, and red or colorful prints. This might allow the wearers to wear a transformable T-shirt that matches various styles for work and for weekends. Regarding silhouette changes, for instance, participants wanted to change transformable garments into various silhouettes to balance the volume of top and bottom. They thought that the versatility of transformable garments would make the garment easier to match and layer than regular garments.

Regarding versatility of transformable garments, the participants mainly discussed the design changes to be worn in various contexts. The multiple design options for transformable garments provide a variety of designs, and thus the participants expected to be able to replace many items with one transformable garment. The versatility of transformable garments was also expected to result in multiple uses or functions as the garments were worn on different occasions in everyday life, at work, or in various types of weather. For instance, Martha and Angela talked about versatility in colors/patterns and how they would be able to wear the garment both at work and during weekends. Kate talked about versatility in sleeve length to wear during temperature changes. When selecting transformable garments, Angela would evaluate whether they "…have a lot of functions and purposes in it."

In addition to that, the transformable garments may reduce the need for layering or matching with other items. The one garment could be various layers by changing the thickness of a garment, or a top can become a dress which creates a different look.

Improved versatility for transformable tops is one of the core variables crucial to increasing sustainability in the clothing's lifecycle. Transformable tops are expected to replace many tops with their changeable design options. Thus, wearers may not need to

purchase five different black T-shirts with different necklines but only purchase a single black T-shirt with five transformable necklines. As one item can replace many items, the wardrobe size is expected to decrease. Woodward (2007) also observed the downsides of wasteful purchasing and the excessive accumulation of garments in wardrobes that make it harder to access and select garments to wear. Free wardrobe space may increase and garments may become easier to find and wear.

Participants expected that the versatility of transformable garments would satisfy their functional, hedonic, and social needs. For example, transformable tops can be worn in a variety of ways, making them easy to match and layer with other items and to wear on different occasions. Regarding hedonic expectations, transformable garments provide fun and allow users to experiment with the garments' inherent flexibility in design and usage. Moreover, participants expected that they would have greater possibilities to easily change styles according to context and modesty, so they could wear the garment for various social occasions (Figure 43).

Versatility can also be a powerful promotion point to consumers. This can lead to success in the market for the following reasons: (a) participants were willing to pay more for transformable tops than regular tops for their versatility; (b) purchasing versatile garments was one way participants exhibited sustainable behavior; (c) versatility is an important attribute for participants when they purchase expensive garments which can be justified if worn with various styles and occasions by matching or layering.
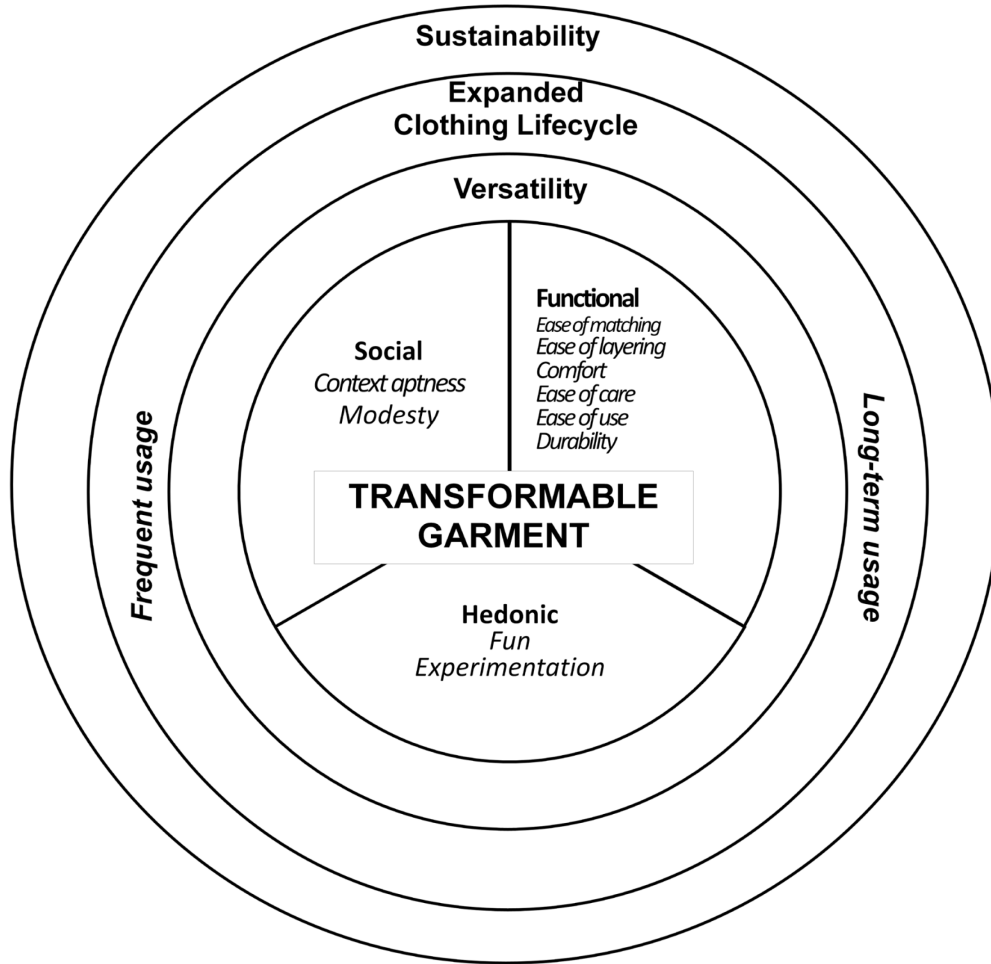
Figure 43. Desires for transformable garments

Functional Expectations

 Ease of matching and ease of layering. Participants expect transformable

garments to be easier to match and layer than regular garments. The variable "ease of

matching" in transformable garments can be defined as the ability to go with other items

that cover different sections of the body, and "ease of layering" as the ability to put other

items over the garment that covers the same or similar sections of the body. For both ease

of matching and layering, balancing design aesthetics was an important aspect to consider;

and in addition to that, maintaining comfort was a significant variable for ease of layering.

117

Participants expected the versatility in design of transformable garments to make it easier to match and layer with other items than regular tops. Wearers preferred neckline shapes, depth, collar types, colors and patterns, and silhouettes as key changeable design functions that would allow a top to match more items. Concerning tops, matching accessories and bottoms were the most important issues for participants. Specifically, participants expected that matching a transformable top to a variety of accessories, such as necklaces or earrings, would be easier, a feat they achieved by changing the necklines. When matching bottoms with transformable tops, wearers can narrow their top when matching with wide pants or full skirts, or they can change their top into a full silhouette when wearing skinny pants or skirts to preserve balance in their top and bottom garments. Thus, when designing transformable tops, it is helpful for designers to consider what kinds of accessories and bottoms consumers preferred to own.

The participants wanted the transformable garments be easy to layer with other items by virtue of its changeable design functions. Participants preferred changeable designs in sleeve type and length in their tops for ease of layering. By changing the silhouette of a garment, participants can maintain their aesthetic satisfaction while maintaining comfort. Cardigans and other outwear were important items to layer with tops by transforming sleeve design, as long as the layers did not create a bulky appearance. These kinds of changes facilitate other items being worn. For example, wearers can change puff- or kimono-sleeved tops to fitted, standard, set-in sleeves when they wear cardigans or jackets over the top This configuration not only provides a slim appearance, but it also allows comfortable arm and shoulder movement.

Participants also wanted to have more dramatic transformations in designs the previous case. For example, when a wearer feels cold and wants to cover his/her arms, instead of layering a short-sleeved or sleeveless shirt with a cardigan, a short-sleeved transformable garment can be converted into long sleeves.

Comfort. Participants expected transformable tops to increase wearing comfort with regard to temperature and movement. Body temperature and body movement were identified as comfort objectives in this study, and participants thought these factors could be controlled by changing the aesthetics of the transformable tops they wore; for example, they could sustain body comfort by changing sleeve lengths. If future research in transformable garments focuses on functional usage, such as protective work clothing, wearers might also expand the definition of comfort.

Participants preferred changeable design functions for sleeve length and fit for comfort due to the areas of the body covered by the garment and the range of body movements. For example, a wearer could convert the top to sleeveless, or open holes in the sleeves when the temperature is high, and convert to long sleeves or multiple-layered sleeves when working in an air–conditioned building. Also, wearers could change garments into a looser fit to provide extra room to move.

Ease of use, ease of care, and durability. To be worn frequently and provide longer use, transformable garments need to be easy to use, care for, and be durable. Participants placed importance on these three variables when they considered purchasing or selecting transformable tops. In different to regular garments, transformable garments would use changing methods and may integrate new technologies Most participants did not know what transformable garments were and what technologies or methods might be

applied to change the garments. Thus, they had more anxiety about usability, care, and durability of transformable garments than regular garments. According to Rogers (2003), consumers perceive higher risk from new and different products. They lack information or experience in purchase and use of new products. By reducing the consumer's anxiety about usability, care, and durability, the designer would lessen the perceived risks about the products and allow consumers to purchase and wear transformable garments with little concern.

"Ease of use" in transformable garments indicates the need for little effort or time to transform the design and wear the garment. Transformable garments emphasize changeable design functions and have the potential to employ new technologies. In employing new technologies, designers can think about the following issues regarding ease of use: "Is the changeable design function easily understandable?" "Is the changeable design function easily changeable?" "Is the changeable design function quickly changeable?" If the transformable garment is hard to change or difficult to understand, it is likely that people would not wear the garment every day, as they have to put in extra effort and time in comparison to regular tops. Dunne et al. (2011) reported that about 43% of women spend less than five minutes dressing, thus the design of transformable tops must allow use of the garment which takes little effort, is easy to understand, and requires little time. Minimizing cognitive loads for users and developing affordances to ensure users can intuitively wear the garments will be critical. Affordance is an attribute that naturally informs wearers on how to use their garments, using the design's visual clues as intuitive teaching tools (Norman, 1998). While Norman emphasizes the need for affordance in good design, many designers are open to similar

ideas that make transformable garments easy to use. The participants preferred to have changeable design options in only two to three transformable garments rather than for all the varieties that they actually owned. Too many changeable elements can overwhelm and frustrate participants. For example, having too many design options was reported to be the main issue when asking consumers to design their own products (Ive & Piccoli, 2003; Piller et al., 2005; Wu, 2010). Thus, having many options is not the best solution for transformable garment designs; and when developing transformable tops, designers need to consider how to simplify consumers' decision making process by understanding how the garments will be used. Designers can conduct formative and summative usability tests in the design process of transformable garments, and this is discussed in the future research section. Also, according to Rogers (2003), increased trialability of products can increase the rate of adopting new products. Thus, if consumers can try changing design functions in transformable garments, it may decrease their perceived risks of using the garments.

Consumers were concerned that caring for transformable garments would require more effort than for regular garments. If caring for a transformable garment requires extra time and effort, consumers may choose not to wear the garment frequently. "Ease of care" in transformable garments is to be sure that washing, drying, storing, ironing, and repairing the garment is uncomplicated. The amount of time that a person wants to spend taking care of his or her wardrobe often affects the initial decision to purchase garments (Chambers & Moulton, 1969). A busy working woman may have limited time available to care for her garments, and it will be important for transformable tops to be easy care.

"Durability" in transformable garments is designing the garment and the changeable design functions to be strong enough to use many times for long periods. For instance, if a top is changeable in sleeve length by folding or tying, the folded line or strap for tying needs to be durable enough for a considerable number of changes. In the case of modular designed tops, the linking methods to hold each module need to perform over a long period of time. Durability is one of the challenges for smart clothing, and many researchers emphasize the importance of durability in usage and care as one of the requirements for smart clothing design (Park & Jayaraman, 2003; Tang, Po, & Stylios, 2006; Van Langenhove & Hertleer, 2004). The transformable garments need to maintain good quality and appearance through many changes for frequent and long-term use. To make durable designs for transformable tops, the following variables may need to be considered: the quality of materials, methods for changing, placement of changeable parts in tops, and awareness of body movements and context of use.

Hedonic Expectations

    Fun and experimentation. Transformable garments are expected to provide more fun and be easier to experiment with by changing design functions than regular garments. "Fun" in transformable garment is providing hedonic satisfaction to wearers when changing and wearing the garment with changeable design functions. "Experimentation" in transformable garment can be defined as easily trying new and different designs by changing design functions.

    Participants expected to satisfy these hedonic needs with transformable sleeve cuffs, collar types, and pockets. These elements are small parts and provide decorative design features so they may decrease users' worries about wearing a design that is not

new or different enough. With these changeable design functions, transformable garments have the potential to increase the satisfaction for hedonic needs for fun and newness, and reduce the need to purchase excessive garments to satisfy those hedonic needs. However, wearers' preferences in their garments' ease of use, care, and durability need to be taken into account. If wearers have trouble understanding how to use and care for their garment, or if they worry about its durability, the fun stops and frustration begins, perhaps even leading to a long-term dislike of transformable garments.

Social Expectations

Context aptness. Transformable tops are expected to be easier-to-adjust styles that are appropriate for their roles and statuses in various contexts, such as changing a top from casual for weekends to professional for work outfits. "Context aptness" in transformable garments can be defined as the flexibility to change garment style into appropriate garments for various contexts.

As the participants were all working women, they wanted professional styles for both regular tops and transformable tops appropriate to wear at work. However, after work or during weekends, they did not want to wear professional outfits but preferred casual styles. Adjusting the degree of professionalism in a garment is related to versatility in use for different occasions. By modifying the professional style with changeable design functions, an item can be worn both at work and on weekends. As an example of how a garment's level of professionalism can be transformed, the color of shirts and blouses can be changed from white to colorful solid colors or even to prints on weekends.

123

In addition to shirts/blouses, a variety of top types that can be altered to fit many different occasions. For example, a casual long-sleeved T-shirt can be worn at work by attaching structured collars or cuffs with neutral colors.

Regarding context aptness, working women discussed the importance of wearing a professional outfit at work. Exhibiting professionalism may not be as important for students or workers who require more casual garments, or for children. Thus, in the future research, it would be beneficial to investigate whether there are differences among participants of different ages or with different occupations.

Modesty. Transformable garments are expected to control the level of modesty. "(Controlling) Modesty" in transformable garments is the flexibility to change the areas of coverage and exposure of the body.

Participants mainly discussed the need to control the exposure of the body, especially the neck area, with transformable tops. This is because the exposure of the neck area is also related to the face, neck, breasts, upper arms, and shoulders. By controlling modesty with changeable design functions, the tops can be worn for various activities at different occasions. For instance, a top with a medium neckline depth can be worn at work and changed to be a low or plunging neckline for a casual party at night. This variable of modesty may be viewed differently in other cultures, thus, it would be interesting to analyze the differences among various cultures on the importance of controlling modesty for transformable design.

Criteria for Evaluating Transformable Garment Design

In this research, people's desires for changeable design functions in transformable tops were investigated to provide insight to designers of transformable tops. As there is

not much research about designing transformable garments, the criteria indicated in Table 9 were developed based on participants' desires for transformable tops. When developing transformable garments, these criteria will help designers better understand consumer needs in transformable garments, to identify the most important variables in transformable garment design, to ideate possible designs for each variable, and to select and evaluate resulting designs.

Table 9

Criteria for the Transformable Garment Design

Criteria	Questions
Functional needs	
Ease of matching	Is the garment easy to match with other garments?
Ease of layering	Is the garment easy to layer with other garments?
Comfort	Does the garment provide comfort of body temperature and movement by transformable design?
Ease of care	Is the garment easy to wash, dry, store, and repair?
Ease of use	Is the changeable design function easily understandable?
	Does the changeable design function easily and quickly?
	Does the garment design have good usability that help the wearer easily use?
Durability	Is the garment durable enough to be worn many times?
	Is the garment durable enough to be used for long periods?
Hedonic needs	
Fun	Is the garment fun to wear and is it fun to change the design functions of the garment?
Experimentation	Does the garment serve the trial easiness of new and different designs?
Social needs	
Professionalism	Is it easy to control the level of professional outfit style?
Modesty	Does the garment make it easy to control the level of modesty regarding coverage and exposure of the wearer's body?
Versatility	
Versatile design	Can the garment be worn in various styles?
	Does the garment fulfill consumers' various needs and wants with flexibility in design?
Versatile usage	Can the garment be worn for different occasions and activities?
Expanded clothing lifecycle	
Frequent usage	Can the garment be worn many times?
	Is the garment designed to wear frequently?
Long-term usage	Can the garment be worn for the long-term?
Overall sustainability	Is the garment designed to use sustainable materials?
	Is the garment designed to be sustainably produced?
	Is the garment helpful to increasing sustainability in distribution and transport?
	How much is the garment is designed to encourage wearers to involve in sustainable act??
	Can the garment be reused and recycled?

CHAPTER SIX: FUTURE STUDIES

The aim of this research study was to identify what changeable design functions people want to have in transformable garments. It relied on a bottom-up approach, using quantitative and qualitative methods to understand people's wardrobes, perceptions, and values with regard to the kind of clothing that they own and in transformable garments.

Demographic Backgrounds

The participants in this study were all women in the Midwestern US, working in offices, ranging in age range from 18 to their 40s. This homogeneity limits the application of the results to other characteristics of the population. Therefore, it might be beneficial to study people who have different demographic characteristics, such as occupations, genders, ages, or nationalities to investigate whether there are differences among people in different demographic groups. For example, the participants in this research were working women, so professionalism was one of the important variables to consider for transformable garments. However, professional outfit styles may not be important for participants who are students, freelance artists, or business owners who work at home. Since this study involved only women, there might be different results if men were to be included in future research. Modesty was considered to be important in reference to transformable garments, but that characteristic may not be expected to matter in reference to male participants. Other social, hedonic, or functional variables may be important in terms of transformable garments. Age differences also have the potential to influence the results, as the needs and wants for garments may vary among different age groups. To design marketable products and to develop appropriate promotions to target

consumers, it may be worthwhile to investigate differences in terms of what people want in transformable garments. Regional and cultural differences may also affect the results, so it might be interesting to investigate that.

The Number of Participants

This study investigated a small number of participants. To increase the trustworthiness and verification of the study, it might be worthwhile to recruit a larger number of participants. Future research could involve the use of questionnaires with numerous participants to compare common and varying desires in reference to the garments. Although it would be harder to evaluate their wardrobe content via self-reporting, participants' actual voices and their inner reasoning behind their desire for transformable garments enable the researcher to identify common phenomena and compare them among participants. A comparison of multiple data can be used for triangulation and for better generalization of the results. In addition, it might be helpful to use statistical analysis such as the t-test or ANOVA to investigate whether there are differences in opinions based on demographics, including gender, occupation, cultural background, income level, or degree of consciousness about sustainability. Furthermore, a regression analysis would reveal relationships among demographic characteristics of participants and their preferences for different changeable design functions.

Garment Categories

This research focused on the garment category tops, which was the largest category of garments for most participants. Other garment types, such as dresses, cardigans, outwears, skirts, and pants, may indicate different desired attributes or transformable garments. Moreover, common desired attributes may exhibit different

preferences for attributes of transformable garments. In contrast, common desired attributes may appear in all garment types, and this could be helpful in terms of guiding designers in their attempts to generalize and apply their designs to transformable garments. For instance, colors/patterns and sleeve lengths were the most preferred changeable design functions in transformable tops; however, for dresses, silhouettes or changing sizes/fits might be the most preferred. Thus, future research might focus on identifying people's different and common desires for transformable garments in terms of different garment categories. Also the garments can be categorized along different variables such as purposes of usage or types of fabrics like knit or woven garments. The different categories of those garments may represent different desires for transformable garments and require different changeable functions.

The Transformable Design Process

In future research, based on the results of people's desires for transformable tops, prototypes can be developed and tested to determine whether they really satisfy consumer needs and wants. Also, a transformable garment design process can be prepared to help students and designers understand how to create transformable designs in reference to differences with regular tops. When designing transformable garments, the following steps would be necessary to explore in depth: (a) searching for possible technologies and materials to realize the transformation; (b) overcoming challenges of usability, care, and durability; (c) understanding the contexts of use; (d) solving possible challenges that would occur when using the garment; (e) anticipating how use behavior would change; and (f) evaluating the impacts of transformable design throughout the clothing lifecycle to enhance sustainability.

129

In the transformable garment design process, in-depth research on technologies or methods and the possibilities of applying them to garment design will be required to realize the changeable designs' functions. For example, what kind of technologies or design looks occurred by kinds of technologies would be appropriate for the kinds of desired changeable design functions? The designs can appear to be very different depending on the technologies that are applied. A T-shirt with dynamic graphics or aesthetic may achieve that goal by emitting light in different colors, or by reflecting different colors through a color-changing dye or surface treatment. Differences in reflectance are a standard part of current apparel – this is how standard clothing appears different colors or textures. However, light-emitting technologies are not currently part of everyday clothing, and may consequently require a much greater level of adaptation on the part of the user. Thus, the relationships between consumers' preferred changeable design options and the preferred changing methods include technologies that need to be investigated. Also, existing transformable garments, for color/pattern changing functions, have applied electronic lighting technologies such as LEDs or ELs. However, these technologies may cause discomfort in movement due to the bulkiness of wires and electronic devices and their low flexibility. Furthermore, the constant bending or friction of wires can cause the malfunction of electronic devices in garments. Thus, future research can determine the best areas to place wires and electronic devices to increase comfort in movement and maintain the transformable garments' functions. In addition, interfacing methods to operate the functions can be developed to increase usability by understanding user behaviors in different contexts. Other existing methods to change colors/patterns include using chromic materials or fabrics that refract lights in various

130

angles. These materials may raise problems of low durability and washability, so it will be beneficial to study how to overcome these while simultaneously maintaining their low impact on the environment. Furthermore, related research on nanotechnology, which creates biomimic materials inspired by the behavior of natural organisms that change their colors/patterns, silhouettes, or sizes, or innovative garment construction methods such as spraying clothing on wearers' bodies may bring new solutions for transformable garments.

However, applying these technologies and materials can create harmful environmental waste such as electronic wires and batteries. If a fewer number of transformable garments causes a higher impact on the environment than many regular garments, then it would be hard to consider the transformable garments as contributing to environmental sustainability. When designing transformable garments, checking the design's impact on the environment would be beneficial for applying the best technologies and materials. The assessment of transformable garment designs' impacts on the environment using different methods can be compared. For example, a color/pattern transformable top design applying EL wires and a top coated with thermochromic inks can be compared by using environmental impact assessment software tools.

Methods to enact transformability in other design features such as size/fit, silhouette, or other decorative details include garments that are reversible, folded, tied, cut, developed into modular designs, or use wearable technologies such as inflatable materials, or motors. However, these may present some problems such as weakness that impedes long-term use, complexity in use, and difficulty in care. For example, modular

designs suffer from weakness of linkage between every piece. Therefore, future research needs to seek ways to link the modules for durability without losing any flexibility in the changeable design or the wearer's comfort. Wearable technologies may hard to understand, and it may be difficult to learn how to use and care for them. These improvements in transforming technologies would accelerate the development of transformable garments and the possibilities of adaptation by consumers.

To increase usability, it would be beneficial to study the optimal range of design options to achieve versatility without overwhelming the consumer. In the transformable garment design process, the step of studying the wearer's behavior regarding usability is necessary as it facilitates the frequent and long-term use of a garment. A transformable garment can be prototyped for a wear testing in which participants are observed and asked about their experiences in wearing the garment. Formative usability tests can be used when developing prototypes, though it is important to explain the design concepts and use scenarios to participants, and discuss the virtues and drawbacks of paper prototypes before implementation. After reviewing the results of the formative usability tests, 3D prototypes can be prepared for summative usability tests. Participants can be asked to transform the prototype and check the time it took for them to understand and make changes to the design functions, and to examine whether they correctly understood how to transform the garment. After that, participants can use a garment for several months and to post self-taken photos when they wear it to go out. Researchers can measure the times the garment was worn, the varieties of matched items, and the number of purchased garments and their types to investigate whether the transformable garments

were worn more frequently and thus have potential to change the whole paradigm of product lifecycle. The results can then be used to modify and improve from the design.

In reference to actual transformable garments, the effects of transformable garments on consumer behaviors and clothing life cycles could be investigated. Researchers might ask participants to wear the transformable garment prototypes for some period of time; the researchers could observe or interview participants to understand how transformable garments influence their clothing life cycle and any changes that may occur in consumer behaviors regarding sustainability to confirm whether the transformable garments actually facilitated frequent and long-term use. These future studies will enrich the body of knowledge about transformable garments and reinforce the virtue of their sustainable impact on consumers and on clothing life cycles.

REFERENCES

Almeida, Y. (2008). Urban empathy: Work in progress. *Proceedings of the Sixth International Conference on Pervasive Computing*. Sydney, Australia: Retrieved from http://www.pervasive2008.org/Papers/Workshop/w8-01.pdf.

Allwood, J., Laursen, S., Rodriguez, C., & Bocken, N. (2006). *Well dressed? The present and future sustainability of clothing and textiles in the UK*. Cambridge, UK: University of Cambridge Institute for Manufacturing Mill Lane.

Bain & Company. (2010). *Why she shops: The 2010 fashion and beauty study*. Retrieved from http://www.bain.com/Images/Bain_and_Vogue_2010-Why-she-shops.pdf.

Baldt, L. (1916). *Clothing for women: Selection, design, construction: A practical manual for school and home*. Philadelphia, PA: Lippincott Company.

Banim, M., & Guy, A. (2003). Discontinued selves: Why do women keep clothes they no longer war? In A. Guy, E. Green & M. Banim (Eds.), *Through the Wardrobe* (pp.190-202). New York, NY: Berg.

Baxter, P., & Jack, S. (2008). Qualitative case study methodology: Study design and implementation for novice researchers. *The Qualitative Report, 13*(4), 544-559.

Berzowska, J., & Coelho, M. (2005). Kukkia and Vilkas: Kinetic electronic garments. *Proceedings of the Ninth IEEE International Symposium on Wearable Computers*. 18-21 Oct. 2005, 82-85. doi:10.1109/ISWC.2005.29.

Berzowska, J., & Laflamme, A. (2011). PLEET: Light-emitting electronic garment. *Fashion Practice, 3*(1), 11-28.

Birtwistle, G., & Moore, C. (2007). Fashion clothing: Where does it all end up? *International Journal of Retail & Distribution Management, 35*(3), 210-216.

Black, S. (2008). *Eco-chick: The fashion paradox*. London, UK: Black Dog Publishing.

Black, S. (2009). Designer Hussein Chalayan in conversation with Sandy Black. *Fashion Practice, 1*(2), 239-250.

Bloomberg, L., & Volp, M. (2008). *Completing your qualitative dissertation*. Thousand Oaks, CA: Sage Publications.

Bureau of Labor Statistics. (2010). *Women in the labor force: A databook*. BLS Report 1026. Retrieved from http://www.bls.gov/cps/wlf-databook2010.htm

Bureau of Labor Statistics. (2011). *Women at work: BLS spotlight on statistics*. Retrieved from http://www.bls.gov/spotlight/2011/women/pdf/women_bls_spotlight.pdf

Bureau of Labor Statistics. (2011). *Labor force statistics from the current population survey*. Retrieved from http://data.bls.gov/pdq/querytool.jsp?survey=ln

Brantlinger, E., Jimenez, R., Klingner, J., Pugach, M., & Richardson, V. (2005). Qualitative studies in special education. *Exceptional children, 17*, 195-207.

Bye, E. (2010). *Fashion design*. New York, NY: Berg.

Chambers, H., & Moulton, V. (1969). *Clothing selection: Fashions, figures, fabrics*. Philadelphia, PA: JB Lippincott Co.

Chen, C., & Lewis, V. (2005). The life of a piece of cloth: Developing garments into a sustainable service system. *of the International Textile and Apparel Association, 62*, Res-662.

Cho, E., & Grover, L. (1978). *Looking terrific*. New York, NY: Ballantine Books.

Creswell, J. (2007). *Qualitative inquiry and research design: Choosing among five approaches*. Thousand Oaks, CA: Sage Publications.

Crommentuijn-Marsh, P., Eckertb. C., & Potterc, S. (2010). Consumer behavior

towards sustainability within fashion. *International Conference on Kansei Engineering and Emotion Research (KEER)*. Retrieved from http://pie.kansei.tsukuba.ac.jp/keer2010/Papers/0956.pdf

Cupit, M. (1996). *Opportunities and barriers to textile recycling*. Abingdon, UK: AEA Technology.

Dallman, J., & Dallman, R., (2011). *Dress thin! 330 tips*. Florence, SC: Seaboard press.

Deflin, E., Weill, A., & Koncar, V. (2002). Communicating clothes: Optical fiber fabric for a new flexible display. *Proceedings of the Avantex Conference, Proc. Avantex Symposium*. Frankfurt, Germany: GEMTEX Publication.

DeLong, M. (1998). *The way we look: Dress and aesthetics*. New York, NY: Fairchild.

Dombek-Keith, A., & Loker, S. (2011). Sustainable clothing care by design. In A. Gwilt & T. Rissanen, *Shaping sustainable fashion: Changing the way we make and us clothes* (pp. 101-118). London, UK: Earthscan.

Dunne, L. (2010). Wearable computer design exhibition, shiver: Exploring subtle haptic and kinetic aesthetics in smart clothing. *IEEE International Symposium on Wearable Computers (ISWC' 14)*. Seoul, Korea, ISBN 978-1-4244-9046-2.

Dunne, L., Ashdown, S., & McDonald, E. (2002). "Smart systems": Wearable integration of intelligent technology. *Proceedings of the First Conference of the International Centre for Excellence in Wearable Electronics and Smart Fashion Products*. Retrieved from http://www.dressit.de/com/06/pdf/05.pdf.

Dunne, L., Zhang, V., Danzl, A., Koo, H., & Terveen, L. (2011). Consumer practice in the home wardrobe: Decision-making and management strategy. *Proceedings of the International Textile and Apparel Association,* Nov 2-5, Philadelphia, PA.

Eaton, K. (2011). *E-ink on cloth raises the terrible prospect of t-shirt ads*. Retrieved from

   http://www.fastcompany.com/1751530/e-ink-screen-on-cloth-raises-the-terrible-

   prospect-of-ads-on-your-t-shirt.

Eckman, M. (1992). *Consumer aesthetic evaluation of clothing: The effect of age, sex,

   and fashion involvement*. (Unpublished doctoral dissertation.) University of

   Maryland, College Park, MD.

Eckman, M., Damhorst, L., & Kadolph, J. (1990). Toward a model of the in-store

   purchase decision process: Consumer use of criteria for evaluating women's

   apparel. *Clothing and Textiles Research Journal, 8*(2), 13-22.

Ehrenfeld, J. (2004). Searching for sustainability: No quick fix, *Reflections, 5*(8), 1-14.

Environment, Community, and Local Government. (1998). *Waste management changing

   our ways − Policy statement*. Retrieved from

   http://www.environ.ie/en/Environment/Waste/PublicationsDocuments/FileDownL

   oad,1468,en.pdf.

Environment, Community, and Local Government. (2004). *Waste management–Taking

   stock and moving forward*. Retrieved from

   http://www.environ.ie/en/Environment/Waste/PublicationsDocuments/FileDownL

   oad,1471,en.pdf.

Farrer, J. (2011). Remediation: Discussing fashion textiles sustainability. In A. Gwilt & T.

   Rissanen, *Shaping sustainable fashion: Changing the way we make and us clothes*

   (pp. 19-34). London, UK: Earthscan.

Finney, K. (2006). *How to be a budget fashionista.* New York, NY: Ballantine Books.

Fletcher, K. (2008). *Sustainable fashion and textiles: Design journeys*. London, UK:

Earthscan.

Fletcher, K., & Grose, L. (2012). *Fashion and sustainability: Design for change*. London, UK: Laurence King.

Frankfort-Nachmias, C., & Nachmias, D. (2008). *Research in the Social Sciences* (7th ed.). New York, NY: Worth Publishers.

Gill, P. (2008). Economy of scale: A global context. In J. Hethorn & C. Ulasewicz (Eds.), *Sustainable fashion: Why now? A conversation about issues, practices, and possibilities* (pp. 165-183). New York, NY: Fairchild Books.

Gillen, K. (2003). Choosing an image: Exploring women's images through the personal shopper. In A. Guy, E. Green & M. Banim (Eds.), *Through the Wardrobe* (pp.54-70). New York, NY: Berg.

G-moda. (2011). *Transformable garments – What are the possibilities?* Retrieved from http://www.gdotmoda.com/en/blog/transformable-garments-what-are-the-possibilities-155.

Guy, A., Green, E., & Banim, M. (2003), *Through the wardrobe.* New York, NY: Berg.

Graedel, T. (1998), *Streamlined life-cycle assessment*. Englewood Cliffs, NJ: Prentice-Hall, Inc.

Green, E. (2003). Suiting ourselves: Women professors using clothes to signal authority, belonging, and personal style. In A. Guy, E. Green & M. Banim (Eds.), *Through the Wardrobe* (pp.97-116). New York, NY: Berg.

Gwilt, A. (2011). Producing sustainable fashion: The points for positive intervention by the fashion designer. In A. Gwilt & T. Rissanen, *Shaping sustainable fashion: Changing the way we make and us clothes* (pp. 59-74). London, UK: Earthscan.

Gwilt, A., & Rissanen, T. (2011). *Shaping sustainable fashion*. London, UK: Earthscan.

Ha-Brookshire, J., & Hodges, N. (2009). Socially responsible consumer behavior?

   Exploring use clothing donation behavior. *Clothing and Textiles Research

   Journal, 27*(3), 40-53.

Han, S., & Kim, Y. (2008). *Fashion design*. Seoul, Korea: Kyohak Yeongusa.

Hawley, J. (2008). Economic impact of textile and clothing recycling. *In Sustainable

   fashion: Why now? A conversation about issues, practices, and possibilities* (pp.

   207-232). New York, NY: Fairchild Books.

Hethorn, J., & Ulasewicz, C. (2008). *Sustainable fashion: Why now? A conversation

   exploring issues, practices, and possibilities*. New York, NY: Fairchild Books.

Holbrook. B., & Dixon, G. (1985). Mapping the market for fashion: Complementarity in

   consumer preferences. In M. R. Solomon (Ed.), *The psychology of fashion* (pp.

   109-126). Lexington, MA: D.C. Heath and Company.

Holman, D., & Vertegaal, R. (2008). Organic user interfaces: Designing computers in

   any way, shape or form. *Communications of the ACM, 51*(6), 26-30.

Ives, B., & Piccoli, G. (2003). Custom made apparel and individualized service at land's

   end. *The Communications of the Association for Information System 11*, 79–93.

Janigo, K. (2011). *Collaborative redesign of used clothes as a sustainable fashion

   solution: Exploring consumer interest and experience*. (Master's Thesis).

   Available from ProQuest LLC. (UMI No. 1505631).

Kaiser, S., Chandler, J., & Hammidi, T. (2003). Minding appearances in female academic

   culture. In A. Guy, E. Green & M. Banim (Eds.), *Through the wardrobe* (pp.97-

   116). New York, NY: Berg.

Kodama, S., & Takeno, M. (2001). Sound-responsive magnetic fluid display. *Proceedings of the Interact' 01 Conference*. Retrieved from www.kodama.hc.uec.ac.jp/project/shortPaper.pdf.

Kong, M., & An, Y. (2003). *Design for fashion*. Seoul, Korea: Yehaksa.

Koo, H. (2011). Wearable computer design exhibition, color it your dress with touch-sensitive fiber-optics and remote-controlled LEDs: The coloring dress I and II. *IEEE International Symposium on Wearable Computers (ISWC' 15)*. San Francisco, CA.

Koo, H. (2010). Wearable computer design exhibition: The combination of projection technology with garments for communication. *IEEE International Symposium on Wearable Computers (ISWC' 14)*. Seoul, Korea.

Lamb, J., & Kallal, M. (1992). A conceptual framework for apparel design. *Clothing and Textiles Research Journal, 10*(2), 42-47.

Laursen, S., & Hansen, J. (1997). *Environmental assessment of textiles*. Copenhagen, Denmark: Danish Environmental Protection Agency.

Lee, L., Kim, I., Kim, H., Park, M., Lee, S., Lee, S., … Jung, H. (2002). *Modern society and fashion*. Seoul, Korea: Konkuk Press.

Lewis, V. (2008). Developing strategies for a typology of sustainable fashion design. In J. Hethorn & C. Ulasewicz (Eds.), *Sustainable Fashion: Why now? A conversation about issues, practices, and possibilities* (pp.233-268). New York, NY: Fairchild Books.

Lincoln, Y. (1995). Emerging criteria for quality in quality and interpretive research. *Qualitative Inquiry, 1*, 275-289.

Loker, S. (2008). A technology-enabled sustainable fashion system, In J. Hethorn & C. Ulasewicz (Eds.), *Sustainable Fashion: Why now? A conversation about issues, practices, and possibilities* (pp.95-126). New York, NY: Fairchild Books. New York, NY: Fairchild Books.

Luke, R. (2008). Popular culture, marketing, and the ethical consumer. In J. Hethorn & C. Ulasewicz (Eds.), *Sustainable Fashion: Why now? A conversation about issues, practices, and possibilities* (pp.77-94). New York, NY: Fairchild Books. New York, NY: Fairchild Books.

McDonald, S., Oates, C., Thyne, M., Alevizou, P., & McMorland, L. (2009). Comparing sustainable consumption patterns across product sectors. *International Journal of Consumer Studies, 33*, 137-145.

Mcjimsey, H. (1963). *Art in clothing selection,* Ames, IA: Iowa State University Press.

McQuillan, H. (2011). Zero-waste design practice: Strategies and risk taking for garment design. In A. Gwilt & T. Rissanen, *Shaping sustainable fashion: Changing the way we make and us clothes* (pp. 83-100). London, UK: Earthscan.

Merriam, S. (2002). *Qualitative research in practice: Examples for discussion and analysis*. San Francisco, CA: Jossey-Bass.

Miles, M., & Huberman, A. (1994). *Qualitative data analysis: An expanded source book* (2nd ed.). Thousand Oaks, CA: Sage.

Milmo, S. (2007). Developments in textile colorants. *Textile Outlook International, 127*, January-February.

Nicholson, J. (1999). *Dressing smart in the new millennium*. Manassas Park, VA: Impact Publications.

Norman, D. (1998). *The design of everyday things*. New York, NY: Basic Books.

Oakers, S. (2009). *Style naturally: The savvy shopping guide to sustainable fashion and beauty*. San Francisco, CA: Chronicle Books.

Odenbach, S. (2002). *Ferrofluids: Magnetically controllable fluids and their applications,* (Lecture Notes in Physics), Springer-Verlag.

Office of Textiles and Apparel of the International Trade Administration. (2012). *U.S. textile and apparel category system.* Retrieved from http://otexa.ita.doc.gov/corr.htm.

O'Mahony, M. (2011). Sustainable textiles: Nature or nurture? In A. Gwilt & T. Rissanen, *Shaping sustainable fashion: Changing the way we make and us clothes* (pp. 43-56). London, UK: Earthscan.

Orth, M., Post, R., & Cooper, E. (1998). Fabric computing interfaces. *Proceedings of the CHI '98 Conference Summary on Human Factors in Computing Systems*. doi:10.1145/286498.286800.

Orzada, B., & Moore, M. (2008). Environmental impact of textile production. In J. Hethorn & C. Ulasewicz (Eds.), *Sustainable Fashion: Why now? A conversation about issues, practices, and possibilities* (pp.299-325). New York, NY: Fairchild Books.

Palmer, A., & Clark, H. (2005). *Old clothes, new looks: Second hand fashion*. Oxford, UK: Berg.

Park, S., & Jayaraman, S. (2003). Enhancing the quality of life through wearable technology: the role of a personalized wearable intelligent information

infrastructure in addressing the challenges of healthcare. *IEEE Engineering in Medicine and Biology Magazine,* pp. 41-48.

Piller, F., Schebert, P., Koch, M., & Moslein., K. (2005). Overcoming mass confusion: Collaborative customer co-design in online communities. *Journal of Computer-Mediated Communication 10*(4). Retrieved from http://jcmc.indiana.edu/vol10/issue4/piller.html

Pechoux, B., & Ghosh, T. (2002). *Apparel sizing and fit. Manchester*. UK: The Textile Institute International.

Randerson, J. (2007). Smart clothes to power your iPod or light your home… just don't wash them. *The Guardian*. Retrieved from http://www.guardian.co.uk/science/2007/aug/13/sciencenews.news

Rasband, J. (1996). *Wardrobe strategies for women*. New York, NY: Fairchild Books & Visuals.

Reiley, K. (2008). *Definitions of uniqueness in terms of individual appearance: Exploring vintage clothing and new clothing wearer*s. (Doctoral dissertation). Available from ProQuest LLC. (UMI No. 3343553).

Rissanen, T. (2008).Creating fashion without the creation of fabric waste. In J. Hethorn & C. Ulasewicz (Eds.), *Sustainable Fashion: Why now? A conversation about issues, practices, and possibilities* (pp.184-206). New York, NY: Fairchild Books.

Rodriquez, S., Roman, M., Sturhahn, S., & Terry, E. (2002). Sustainability assessment and reporting for the University of Michigan's Ann Arbor campus. (University master's project.) University of Michigan, Ann Arbor, MI.

Rogers, E. (2003). *Diffusion of innovations*. New York: Free Press.

Rosselot, K., & Allen, D. (2002). *Life-cycle concepts, product stewardship, and green engineering*. Retrieved from http://www.utexas.edu/research/ceer/esm282/dfe/Chap13final.PDF.

Ruddel, F. (2006). Shopping with a social conscience: Consumer attitudes toward sweatshop labor. *Clothing and Textiles Research Journal, 24*, 282-296.

Saboura, S., (2005). *Sam Saboura's real style.* New York, NY: Clarkson Potter.

Sawa, K., Rodriguez, C., Aramaki, K., & Kunieda, H. (2003). A new detergent-free dry-cleaning system. *International Journal of Clothing Science and Technology, 16*(30), 324-334.

Schifferstein, H., & Zwartkruis-Pelgrim, E. (2008). Consumer-product attachment: Measurement and design implications. *International Journal of Design, 2*(3), 1-14.

Schwartz, J., & Laky, G. (2008). Exploration of materials: An inspirational overview. In J. Hethorn & C. Ulasewicz (Eds.), *Sustainable Fashion: Why now? A conversation about issues, practices, and possibilities* (pp.275-298). New York, NY: Fairchild Books.

Scott, W. (2008). Recycle and Reuse as Design Potential. In J. Hethorn & C. Ulasewicz (Eds.), *Sustainable Fashion: Why now? A conversation about issues, practices, and possibilities* (pp.385-417). New York, NY: Fairchild Books.

Shove, E. (2003). *Comfort, cleanliness + convenience. The social organization of normality*. Oxford, UK: Berg.

Skov, L. (2011). *Entering the space of the wardrobe. The working paper in the Wardrobe ethnographies conference.* June 15-17, 2011, at Textilforum in Herning, Denmark.

Brantlinger, E., Jimenez, R., Klingner, J., Pugach, M., & Richardson, V. (2005).

Qualitative studies in special education. *Exceptional children, 17*, 195-207.

Sproles, G. (1979). *Fashion: Consumer behavior toward dress*. Minneapolis, MN: Burgess.

Steckl, A., You, H., & Kim, D. (2011). Flexible electrowetting and electrowetting on flexible substrates. *The International Society of Optics and Photonics.* Retrieved from www.nanolab.uc.edu/Publications/PDFfiles/401.pdf.

Takamura, Z. (1993). *Fashion with style*. Tokyo, Japan: Graphic Sha Pub Co.

Tang, S., Po, L., Stylios, G. (2006). An overview of smart technologies for clothing design and engineering. *International Journal of Clothing Science and Technology, 18*(2): 108-128.

The Metropolitan Museum of Art. (2006). *"Airplane" dress.* Retrieved from http://www.metmuseum.org/toah/works-of-art/2006.251a-c.

The U.S. Environmental Protection Agency (EPA). (2010). *Municipal solid waste generation, recycling, and disposal in the United States.* Retrieved from http://www.epa.gov/wastes/nonhaz/municipal/pubs/msw_2010_data_tables.pdf.

Ulasewicz, C. (2008). Fashion, Social Marketing, and the Eco-Savvy Shopper, In J. Hethorn & C. Ulasewicz (Eds.), *Sustainable Fashion: Why now? A conversation about issues, practices, and possibilities* (pp.30-52). New York, NY: Fairchild Books.

UNEP. (1993). *The textile industry and the environment, industry and the environment technical report No. 16*. Paris, France: United Nations Publications.

U.S. Customs and Border Protection (CBP). (2008). *What every member of the*

Trade Community should know About: Classification: Apparel terminology under the HTSUS. Retrieved from

http://www.cbp.gov/linkhandler/cgov/trade/legal/informed_compliance_pubs/icp0

57.ctt/icp057.pdf.

Van Langenhhove, L., & Hertleer, C. (2004). Smart clothing: A new life. *International Journal of Clothing Science and Technology, 16* (1-2): 63-72.

Wagner, J., Anderson, C., & Ettenson, R. (1990). Evaluating attractiveness in apparel design: A comparison of Chinese and American consumers. In P. E. Horridge (Ed.), *ACPTC Proceedings National Meeting* (p. 97). Monument, CO: Association of College Professors of Textiles and Clothing.

Waite, M. (2009). Sustainable textile: the role of bamboo and a comparison of bamboo textile properties. *Journal of Textile and Apparel, Technology and Management, 6*(2): 1-21.

Webelow Wear. (2009). *SMA shape changing clothes.* Retrieved from http://www.webelowwear.com/wwblog/?p=626.

Welters, L. (2008). The fashion of sustainability. In J. Hethorn & C. Ulasewicz (Eds.), *Sustainable Fashion: Why now? A conversation about issues, practices, and possibilities* (pp.7-29). New York, NY: Fairchild Books.

Woodward, S. (2007). *Why women wear what they wear*. New York, NY: Berg.

Word Watch Institute. (2003). *Harnessing institutional procurement for people and the planet.* Retrieved from www.worldwatch.org.

Wu, J. (2010). Co-design communities online: Turning public creativity into wearable and sellable fashions. *Fashion Practice, 2*(1): 85–104.

146

Yoo, S. (2003). Design functions and consumer characteristics relating to design

    preferences of working females. *Clothing and Textiles Research Journal, 21*(2),

    49-62.

Yoon, J., & Jasper, C. (1996). Key dimensions of women's ready-to-wear apparel:

    Developing a consumer size-labeling system. *Clothing and Textiles Research

    Journal, 14*(1), 89-95.

Young, C., Jirousek, C., & Ashdown, S. (2004). Undesigned: A study in sustainable

    design of apparel using post-consumer recycled clothing. *Clothing and Textiles

    Research Journal, 22*, 61-68.

APPENDICES

Appendix A. Apparel Designer's Actions for Sustainability

Phase 1	Material manufacture and selection
Social	·Choose fair vendors ·Local manufacture
Economic	·Recycled materials (fiber, textile and accessories) ·Reuse materials (from disposed or stocked fiber, textile, or accessories) ·Hybrid materials
Environmental	·Eco-friendly fibers ·Eco-friendly spinning, weaving and knitting ·Closed-cycle for toxic chemical free ·Eco-friendly textile bleaching: Use hydrogen peroxide; avoid chlorine-based products; combine bleaching with scouring; biological treatment of wastewater (Fletcher, 2008) ·Eco-friendly textile coloration: (Dyeing) Non-blue/green/turquoise color; lighter shades, reuse and exhaust dye baths; electrochemical dyeing; non-aqueous systems; universal dyes; natural dyes; automated systems; energy efficiency measurement; biodegradable or bio-eliminable dyestuffs; reuse and exhaust dye liquors and rinse water; (Printing) Careful cleaning of screens; reuse rinse water; water-based PVC; use phthalate-free printing formulations; avoid aromatic solvents (Fletcher, 2008) ·Standard sequence of effluent treatment: Varify the amount; screening-equalization-biological treatment (Fletcher, 2008) ·Eco-friendly accessories ·Smart textiles ·Nanotechnology ·Assessment tools
Phase 2	Clothing manufacture
Social	·Choose fair vendors ·Welfare for workers ·Local manufacture ·Develop product plan codes ·Collaboration with researchers ·Sharing knowledge
Economic	·Laser cutting ·Minimalism ·Digital textile printing ·Computer-aided design ·Flexible production system ·Minimized process ·Up-cycling design ·Free from trends/slow fashion
Environmental	·Consumer analysis ·Technology-aid sizing system ·Zero-waste patterning ·Seamless knitting/whole garment ·Co-design ·Transformable design

	·Modular design
	·Smart clothing
	·DIY design
	·Biomimicry design
	·Lightweight
	·Higher quality and longer lasting design
	·Invisible sustainability design
	·Clean production system
	·Assessment tools
Phase 3	Packaging, distribution, transportation, retail
Social	·Use green suppliers
	·Welfare for workers
	·Consumer's choice
Economic	·Minimized packages
	·Boat or rail, not air
	·Eco-stores
Environmental	·Eco-friendly packaging materials
	·Eco-label
	·Reusable packages
	·Sustainable care labels
	·Sustainable marketing
Phase 4	Consumer use
Social	·Educate consumers
	·Motivate moral responsibilities
Economic	·Clean environment to reduce pollution
	·Use moisture absorber
	·Organized wardrobe
	·Smart wardrobe
	·Fewer garments and longer use
	·Less water and energy usage
	·Efficient washing machines
	·Shower-able garments
	·Alterable designs
	·Multi-lives garment design
Environmental	·Anti-stain/odor/bacterial finish
	·Design requiring less washing
	·Less detergent or eco-friendly detergent
	·Anti-wrinkle finish
	·Design requiring less ironing
Phase 5	End of life
Social	·Secondhand Cloth
	·Donation
Economic	·Prevention, Minimization, and Reuse
	·Recycle materials and clothing
	·Redesign
Environmental	·Waste management strategies
	·Vintage style

Appendix B. Invitation Letter

Hello! I am Helen Koo, a Ph.D. student at the University of Minnesota, studying with Dr. Lucy Dunne and Dr. Missy Bye. I understand that you have participated in Dr. Dunne's wardrobe research in the past. I am building on some of the earlier wardrobe research for my dissertation, and I would like to invite you to participate in a research study about wardrobe variations and sustainability that I am conducting. I have been working with the wardrobe databases collected from Dr. Dunne's earlier work, and would like to follow up with the owners of some of those wardrobes to explore variability and sustainability in more depth.

The purpose of my study is to understand what kinds of variations are most common in our wardrobes. During a 1-1.5 hour interview, I will ask about your perceptions of and the value of the varieties in your wardrobe, as well as some demographic information. I will record voices, take photographs, and write memos to gather accurate information. It will not be used for any purpose other than this research. Everything is confidential and your identity will remain anonymous.

Your decision to participate will not affect your current or future relationships with the University of Minnesota. If you decide to participate, you are free to not answer any question or withdraw at any time without affecting those relationships.Please send me email at kooxx044@umn.edu if this interview will be possible for you. If you are interested in participating, please let me know a few times that would work with your schedule. Thank you very much for your time!

Appendix C. Consent Form

Design functions in transformable garments for sustainability

You are invited to be in a research study of design functions in transformable garments for sustainability. You have been selected as a possible participant because you are a professional working woman between the ages of 20 and 49. This study is being conducted as part of a dissertation of a doctoral degree program by Helen Koo, Department of Design, Housing, and Apparel, University of Minnesota under the supervision of Dr. Elizabeth Bye and Dr. Lucy Dunne.

Background Information and Procedure

The purpose of this study is to understand what kind of changeable functions we desire in transformable garments. The wardrobe data collection will consist of photographed and recorded varieties of garments in your wardrobe. It will take you about 2 hours to complete. If you have already completed the wardrobe data collection, you can only participate in an interview. The interview is designed to ask demographic information, perception and value of the varieties in your wardrobe, and methods to change garments when they are worn. It will take you approximately 1-1½ hours to complete and will take place in your home.

Confidentiality, Risks, and Benefits of Participation

Your decision to participate will not affect your current or future relationships with the University of Minnesota. If you decide to participate, you are free to not answer any question or withdraw at any time without affecting those relationships. Participants

151

will be completely anonymous, and the information you provide will not be identifiable. You will receive $50 for your participation in this study.

Contact Information

The researchers conducting this study are Helen Koo, Dr. Elizabeth Bye, and Dr. Lucy Dunne. If you have questions, please contact Helen Koo at 240 McNeal Hall, 1985 Buford Avenue, St. Paul, MN 55108; email: kooxx044@umn.edu. If you have any questions or concerns regarding this study and would like to talk to someone other than the researchers, you are encouraged to contact the Research Subjects' Advocate Line, D528 Mayo, 420 Delaware St. Southeast, Minneapolis, Minnesota 55455; (612) 625-1650. If you decided to participate in this research, please sign and write today's date in the blank.

I have read the above information. I consent to participate in the study.

Name (Print) _____ Age_____

Signature _____ Date_____

Please indicate a convenient time to do a wardrobe data collection in your home.

Day_____ Time_____

Please indicate a convenient time to have an interview in your home.

Day_____ Time_____

Is it okay to contact you for future research?

_____

Appendix D. Interview Script

Introduction

Hello! I am a Ph.D. student at the University of Minnesota and I am working on my dissertation, transformative garments design for sustainability. Your participation is valuable and will contribute to increase sustainability in garment design.

Your participation is voluntary, and you may withdraw at any time if you do not want to continue. I will record voices, take photographs, and write memos to gather accurate information. It will not be used for any purpose other than this research, and everything is confidential. Whenever you feel uncomfortable, please let me know.

I will ask several questions regarding your perception, and value regarding the variety of your wardrobe. If you are unclear during the interview, please tell me about it. The interview will take approximately one to one and a half hours.

Interview questions

Step 1: Demographics

QD1. What is your occupation? (Occupation)

QD2. What kinds of garment do you need to wear at work? (Attire at work)

QD3. What is your own definition of sustainability in fashion? (Definitions of sustainability in fashion)

QD4. How much do you care about sustainability when you buy and wear clothes, and why? (Sustainability consciousness)

Step 2: Perception

QP1. What categories of garments do you have the most? Why? (Frequent garment type)

153

QP2. What is your core item? What do you wear the most? Please select by looking at your actual garments or garment images in your wardrobe. (Core item)

QP3. Do you have similar types of garments or very different types of garments? Why? (Varieties in a wardrobe)

QP4. What kind of tops do you wear the most? (Frequent top types)

QP5. Do you have any tops that are same style? Please describe if you have purchased same tops with different variations. (Varieties in tops)

QP6. What colors/patterns do you own the most of? What are the other varieties? Are there any differences among tanks/camisoles, T-shirts, and shirts/blouses? Why do you think you have those varieties? (Varieties in colors/patterns)

QP7. What size/fit do you own the most of? What are the other varieties? Are there any differences among tanks/camisoles, T-shirts, and shirts/blouses? Why do you think you have those varieties? (Varieties in sizes/fits)

QP8. What silhouette do you own the most of? What are the other varieties? Are there any differences among tanks/camisoles, T-shirts, and shirts/blouses? Why do you think you have those varieties? (Varieties in silhouettes)

QP9. What collar type do you own the most of? What are the other varieties? Are there any differences among tanks/camisoles, T-shirts, and shirts/blouses? Why do you think you have those varieties? (Varieties in collar types)

QP10. What collar size do you own the most of? What are the other varieties? Are there any differences among tanks/camisoles, T-shirts, and shirts/blouses? Why do you think you have those varieties? (Varieties in collar sizes)

QP11. What neckline shape do you own the most of? What are the other varieties? Are there any differences among tanks/camisoles, T-shirts, and shirts/blouses? Why do you think you have those varieties? (Varieties in neckline shapes)

QP12. What neckline depth do you own the most of? What are the other varieties? Are there any differences among tanks/camisoles, T-shirts, and shirts/blouses? Why do you think you have those varieties? (Varieties in neckline depths)

QP13. What sleeve type do you own the most of? What are the other varieties? Are there any differences among tanks/camisoles, T-shirts, and shirts/blouses? Why do you think you have those varieties? (Varieties in sleeve types)

QP14. What sleeve fit do you own the most of? What are the other varieties? Are there any differences among tanks/camisoles, T-shirts, and shirts/blouses? Why do you think you have those varieties? (Varieties in sleeve fits)

QP15. What sleeve length do you own the most of? What are the other varieties? Are there any differences among tanks/camisoles, T-shirts, and shirts/blouses? Why do you think you have those varieties? (Varieties in sleeve lengths)

QP16. What sleeve cuff do you own the most of? What are the other varieties? Are there any differences among tanks/camisoles, T-shirts, and shirts/blouses? Why do you think you have those varieties? (Varieties in sleeve cuffs)

QP17. What pockets do you own the most of? What are the other varieties? Are there any differences among tanks/camisoles, T-shirts, and shirts/blouses? Why do you think you have those varieties? (Varieties in pockets)

Step 3: Value

QV1. What important aesthetic aspects do you consider when you buy tops? (Concerning aspects when purchasing and wearing tops)

QV2. What important aesthetic aspects do you consider when you select tops from your wardrobe to wear? (Concerning aspects when selecting tops in a wardrobe)

QV3. What tops have you recently throw out or added to your wardrobe? If not tops, what kind of garments? Why did you throw away or add clothes to your wardrobe? (Wardrobe change)

QV4. If tops can change various aspects, which variables in design you would want to be changeable? (Changeable design functions in tops)

QV5. If tops can be changed into various colors/patterns, how many varieties would you prefer to be changed and what varieties do you want to change? Are there any differences among tanks/camisoles, T-shirts, and shirts/blouses? (Changes in colors/patterns)

QV6. If tops can be changed into various sizes/fits, how many varieties would you prefer to be changed and what varieties do you want to change? Are there any differences among tanks/camisoles, T-shirts, and shirts/blouses? (Changes in sizes/fits)

QV7. If tops can be changed into various silhouettes, how many varieties would you prefer to be changed and what varieties do you want to change? Are there any differences among tanks/camisoles, T-shirts, and shirts/blouses? (Changes in silhouettes)

QV8. If tops can be changed into various collar types, how many varieties would you prefer to be changed and what varieties do you want to change? Are there any differences among tanks/camisoles, T-shirts, and shirts/blouses? (Changes in collar types)

QV9. If tops can be changed into various collar sizes, how many varieties would you prefer to be changed and what varieties do you want to change? Are there any differences among tanks/camisoles, T-shirts, and shirts/blouses? (Changes in collar sizes)

QV10. If tops can be changed into various neckline shapes, how many varieties would you prefer to be changed and what varieties do you want to change? Are there any differences among tanks/camisoles, T-shirts, and shirts/blouses? (Changes in neckline shapes)

QV11. If tops can be changed into various neckline depths, how many varieties would you prefer to be changed and what varieties do you want to change? Are there any differences among tanks/camisoles, T-shirts, and shirts/blouses? (Changes in neckline depths)

QV12. If tops can be changed into various sleeve types, how many varieties would you prefer to be changed and what varieties do you want to change? Are there any differences among tanks/camisoles, T-shirts, and shirts/blouses? (Changes in sleeve types)

QV13. If tops can be changed into various sleeve fits, how many varieties would you prefer to be changed and what varieties do you want to change? Are there any differences among tanks/camisoles, T-shirts, and shirts/blouses? (Changes in sleeve fits)

QV14. If tops can be changed into various sleeve lengths, how many varieties would you prefer to be changed and what varieties do you want to change? Are there any differences among tanks/camisoles, T-shirts, and shirts/blouses? (Changes in sleeve lengths)

QV15. If tops can be changed into various sleeve cuffs, how many varieties would you prefer to be changed and what varieties do you want to change? Are there any differences among tanks/camisoles, T-shirts, and shirts/blouses? (Changes in sleeve cuffs)

157

QV16. If tops can be changed into various pockets, how many varieties would you prefer to be changed and what varieties do you want to change? Are there any differences among tanks/camisoles, T-shirts, and shirts/blouses? (Changes in pockets)

QV17. Among, (1) Color/Pattern, (2) Size/Fit, (3) Silhouette, (4) Collar type, (5) Collar size, (6) Neckline shape, (7) Neckline depth, (8) Sleeve type, (9) Sleeve fit, (10) Sleeve length, (11) Sleeve cuffs, (12) Pockets, which one you prefer to change in your garments and tops? Please state them in order. Please describe reasons why you selected those. (Preferences in changeable design functions)

QV18. What other aspects do you prefer to change besides lists? (Preferences in other changeable design functions)

QV19. What do you consider important when you purchase and wear tops that can be changed? (Preferences in other changeable design functions)

QV20. If your tops could change, would it influence how you wear and buy garments? Why? (Wear and purchase behavior)

QV21. How much do you willing to pay for changeable tops compared to other general tops? (Willingness to pay)

QV22. What other categories of garment types do you want as garments that can be changed? (Other garment type for transformable garments)

Please tell me if I missed something or if there is anything you want to add. Thank you. We appreciate your valuable participation.

Appendix E1. Frequency of Top Type

Top Types	Tank/Camisole	T-shirt	Shirt/Blouse	Others	Total
Amy					
Q'ty	25	37	4		
%	38	56	6		66
Ranking	2	1	3		
Amanda					
Q'ty	6	18	3		
%	22	67	11		27
Ranking	2	1	3		
Monica					
Q'ty	10	19			
%	34	66			29
Ranking	2	1			
Martha					
Q'ty	6	24	4		
%	18	71	12		34
Ranking	2	1	3		
Angela					
Q'ty	10	19	3		
%	31	60	9		32
Ranking	2	1	3		
Linda					
Q'ty	7	10	4		
%	33	48	19		21
Ranking	2	1	3		
Melisa					
Q'ty	40	13	4	1	
%	69	22	7	2	58
Ranking	1	2	3	4	
Kate					
Q'ty	27	34	1		
%	44	55	2		62
Ranking	2	1	3		
Tiffany					
Q'ty	26	42	19	2	
%	29	47	21	2	89
Ranking	2	1	3	4	
Total					
Q'ty	157	216	42	3	
%	38	52	10	1	418
Ranking	2	1	3	4	

Appendix E2. Frequency of Color/Pattern in Tops

Color/Pattern	Amy	Amanda	Monica	Martha	Angela	Linda	Melisa	Kate	Tiffany	Total
White										
Q'ty	12	8	5	4	4	5	18	5	27	88
%	18	30	15	12	11	23	29	8	30	20
Ranking	2	1	2	2	3	1	1	5	1	1
Black										
Q'ty	6	1	4	4	3	4	4	13	25	64
%	9	4	12	12	9	18	6	21	28	15
Ranking	4	5	3	2	4	2	5	1	2	3
Grey										
Q'ty	7	2	1	4	4	4	3	8	10	43
%	11	7	3	12	11	18	5	13	11	10
Ranking	3	4	5	2	3	2	6	3	4	4
Red										
Q'ty	7	4	5	2	11	1	4	4	2	40
%	11	15	15	6	31	5	6	6	2	9
Ranking	3	3	2	4	1	4	5	6	6	5
Green										
Q'ty	6	2		2	1	1	3	5	2	22
%	9	7		6	3	5	5	8	2	5
Ranking	4	4		4	6	4	6	5	6	8
Blue										
Q'ty	3	5	3	3	2		8	6	2	32
%	5	19	9	9	6		13	10	2	7
Ranking	9	2	4	3	5		3	4	6	6
Yellow										
Q'ty	2			1				3	1	7
%	3			3				5	1	2
Ranking	7			5				7	7	12
Pink										
Q'ty	5	1		3		3	3	5	3	23
%	8	4		9		14	5	8	3	5
Ranking	5	5		3		3	6	5	5	7
Purple										
Q'ty	4	1	3						3	11
%	6	4	9						3	3
Ranking	6	5	4						5	10
Brown										
Q'ty		2	3				6	2	1	14
%		7	9				10	3	1	3
Ranking		4	4				4	8	7	9
Beige										
Q'ty		1		2	1		1	1	2	8
%		4		6	3		2	2	2	2
Ranking		5		4	6		7	9	6	11
Print										
Q'ty	14		9	9	9	4	13	10	11	79
%	21		27	26	26	18	21	16	12	18
Ranking	1		1	1	2	2	2	2	3	2
Total	66	27	33	34	35	22	63	62	89	431

Appendix E3. Frequency of Color/Pattern in Top Types

Color/Pattern	Tank/Camisole	T-shirt	Shirt/Blouse	Vest	Total
White					
Q'ty	40	34	14		88
%	24	16	33		20
Ranking	1	2	1		1
Black					
Q'ty	21	33	8	2	64
%	13	15	19	67	15
Ranking	3	3	3	1	3
Grey					
Q'ty	15	25	3		43
%	9	11	7		10
Ranking	4	5	4		4
Red					
Q'ty	13	26	1		40
%	8	12	2		9
Ranking	5	4	6		5
Green					
Q'ty	11	11			22
%	7	5			5
Ranking	6	8			8
Blue					
Q'ty	13	17	2		32
%	8	8	5		7
Ranking	5	6	5		6
Yellow					
Q'ty	4	3			7
%	2	1			2
Ranking	9	11			12
Pink					
Q'ty	10	13			23
%	6	6			5
Ranking	7	7			7
Purple					
Q'ty	4	6	1		11
%	2	3	2		3
Ranking	9	9	6		10
Brown					
Q'ty	8	6			14
%	5	3			3
Ranking	8	9			9
Beige					
Q'ty	1	5	1	1	8
%	1	2	2	33	2
Ranking	10	10	6	2	11
Print					
Q'ty	28	39	12		79
%	17	18	29		18
Ranking	2	1	2		2
Total	168	218	42	3	431

Appendix E4. Frequency of Print in Top Types

Print Type	Tank/Camisole	T-shirt	Shirt/Blouse	Total
Floral				
Q'ty	12	9	1	22
%	43	23	8	28
Ranking	1	3	4	1
Ethnic				
Q'ty	3	1		4
%	11	3		5
Ranking	4	5		4
Modern				
Q'ty	4	13	2	19
%	14	33	17	24
Ranking	3	1	3	2
Stripe				
Q'ty	8	11	3	22
%	29	28	25	28
Ranking	2	2	2	1
Check				
Q'ty	1	4	6	11
%	4	10	50	14
Ranking	5	4	1	3
Animal				
Q'ty		1		1
%		3		1
Ranking		5		5
Total	28	39	12	79

Appendix E5. Frequency of Size/Fit in Tops

Size/Fit	Amy	Amanda	Monica	Martha	Angela	Linda	Melisa	Kate	Tiffany	Total
XSP (0)										
Q'ty		5								5
%		19								1
Ranking		3								7
XS (2)										
Q'ty	14	9		4	1			1	48	77
%	21	33		12	3			2	54	18
Ranking	2	2		2	3			3	1	3
S (4-6)										
Q'ty	34	13		27	21	4	17		38	154
%	52	48		79	66	19	29		43	37
Ranking	1	1		1	1	2	2		2	1
M (8-10)										
Q'ty	14		8	3	9	15	35	1	2	87
%	21		28	9	28	71	60	2	2	21
Ranking	2		2	3	2	1	1	3	3	2
L (12-14)										
Q'ty			17		1	2	4			24
%			59		3	10	7			6
Ranking			1		3	3	3			5
XL (16-18)										
Q'ty			4				2	53		59
%			14				3	85		14
Ranking			3				4	1		4
XXL (20-22)										
Q'ty								7		7
%								11		2
Ranking								2		6
Free										
Q'ty	4								1	5
%	6								1	1
Ranking	3								4	7
Total	66	27	29	34	32	21	58	62	89	418

Appendix E6. Frequency of Size/Fit in Top Types

Size/Fit	Tank/Camisole	T-shirt	Shirt/Blouse	Vest	Total
XSP (0)					
Q'ty		5			5
%		2			1
Ranking		6			7
XS (2)					
Q'ty	20	35	22		77
%	13	16	52		18
Ranking	4	4	1		3
S (4-6)					
Q'ty	65	79	9	1	154
%	41	37	22	33	37
Ranking	1	1	3	2	1
M (8-10)					
Q'ty	35	40	10	2	87
%	22	19	24	67	21
Ranking	2	2	2	1	2
L (12-14)					
Q'ty	8	16			24
%	5	7			6
Ranking	5	5			5
XL (16-18)					
Q'ty	22	36	1		59
%	14	17	2		14
Ranking	3	3	4		4
XXL (20-22)					
Q'ty	7				7
%	4				2
Ranking	6				6
Free					
Q'ty		5			5
%		2			1
Ranking		6			7
Total	157	216	42	3	418

Appendix E7. Frequency of Silhouette in Tops

Silhouette	Amy	Amanda	Monica	Martha	Angela	Linda	Melisa	Kate	Tiffany	Total
Hourglass										
Q'ty	13		3	2	3	2	5	2	6	36
%	20		10	6	9	10	9	3	7	9
Ranking	2		2	2	2	2	2	2	2	2
Straight										
Q'ty	52	27	26	32	29	19	51	60	83	379
%	79	100	90	94	91	90	88	97	93	91
Ranking	1	1	1	1	1	1	1	1	1	1
Full										
Q'ty	1						2			3
%	2						3			1
Ranking	3						3			3
Total	66	27	29	34	32	21	58	62	89	418

165

Appendix E8. Frequency of Silhouette in Top Types

Silhouette	Tank/Camisole	T-shirt	Shirt/Blouse	Vest	Total
Hourglass					
Q'ty	18	11	7		36
%	11	5	17		9
Ranking	2	2	2		2
Straight					
Q'ty	136	205	35	3	379
%	87	95	83	100	91
Ranking	1	1	1	1	1
Full					
Q'ty	3				3
%	2				1
Ranking	3				3
Total	157	216	42	3	418

Appendix E9. Frequency of Collar Type in Tops

Collar type	Amy	Amanda	Monica	Martha	Angela	Linda	Melisa	Kate	Tiffany	Total
Convertible										
Q'ty	2	3		2	3	2	2	1	15	30
%	3	11		6	9	10	3	2	17	7
Ranking	5	2		3	2	3	3	4	2	2
Frill										
Q'ty	3				1		1			5
%	5				3		2			1
Ranking	4				4		4			6
Shawl										
Q'ty					2	1		2	1	6
%					6	5		3	1	1
Ranking					3	4		3	4	5
Ruffle										
Q'ty	1				3	1			1	6
%	2				9	5			1	1
Ranking	6				2	4			4	5
Mandarin										
Q'ty		1			1			3	2	7
%		4			3			5	2	2
Ranking		3			4			2	3	4
Turtle										
Q'ty	5			1						6
%	8			3						1
Ranking	2			4						5
Knit stand										
Q'ty								1		1
%								2		0
Ranking								4		8
Cowl										
Q'ty	4			1			3	2		10
%	6			3			5	3		2
Ranking	3			4			2	3		3
Bow										
Q'ty						3	1			4
%						14	2			1
Ranking						2	4			7
Polo										
Q'ty				5			1			6
%				15			2			1
Ranking				2			4			5
None										
Q'ty	51	23	29	25	22	14	50	53	70	337
%	77	85	100	74	69	67	86	85	79	81
Ranking	1	1	1	1	1	1	1	1	1	1
Total	66	27	29	34	32	21	58	62	89	418

Appendix E10. Frequency of Collar Type in Top Types

Collar type	Tank/Camisole	T-shirt	Shirt/Blouse	Vest	Total
Convertible					
Q'ty		1	29		30
%		0	69		7
Ranking		6	1		2
Frill					
Q'ty		4	1		5
%		2	2		1
Ranking		4	5		6
Shawl					
Q'ty		6			6
%		3			1
Ranking		3			5
Ruffle					
Q'ty	4	1	1		6
%	3	0	2		1
Ranking	2	6	5		5
Mandarin					
Q'ty		4	3		7
%		2	7		2
Ranking		4	3		4
Turtle					
Q'ty		6			6
%		3			1
Ranking		3			5
Knit stand					
Q'ty		1			1
%		0			0
Ranking		6			8
Cowl					
Q'ty	1	9			10
%	1	4			2
Ranking	3	2			3
Bow					
Q'ty	1	1	2		4
%	1	0	5		1
Ranking	3	6	4		7
Polo					
Q'ty	1	3	2		6
%	1	1	5		1
Ranking	3	5	4		5
None					
Q'ty	150	180	4	3	337
%	96	83	10	100	81
Ranking	1	1	2	1	1
Total	157	216	42	3	418

Appendix E11. Frequency of Collar Size in Tops

Collar size	Amy	Amanda	Monica	Martha	Angela	Linda	Melisa	Kate	Tiffany	Total
Small										
Q'ty	10	1		1	3	1	1	3	1	21
%	15	4		3	9	5	2	5	1	5
Ranking	2	3		3	3	3	4	3	3	3
Standard										
Q'ty	2	3		8	7	6	5	6	17	54
%	3	11		24	22	29	9	10	19	13
Ranking	4	2		2	2	2	2	2	2	2
Large										
Q'ty	3						2		1	6
%	5						3		1	1
Ranking	3						3		3	4
None										
Q'ty	51	23	29	25	22	14	50	53	70	337
%	77	85	100	74	69	67	86	85	79	81
Ranking	1	1	1	1	1	1	1	1	1	1
Total	66	27	29	34	32	21	58	62	89	418

Appendix E12. Frequency of Collar Size in Top Types

Collar size	Tank/Camisole	T-shirt	Shirt/Blouse	Vest	Total
Small					
Q'ty	3	12	6		21
%	2	6	14		5
Ranking	2	3	2		3
Standard					
Q'ty	3	20	31		54
%	2	9	74		13
Ranking	2	2	1		2
Large					
Q'ty	1	4	1		6
%	1	2	2		1
Ranking	3	4	4		4
None					
Q'ty	150	180	4	3	337
%	96	83	10	100	81
Ranking	1	1	3	1	1
Total	157	216	42	3	418

Appendix E13. Frequency of Neckline Shape in Tops

Neckline shape	Amy	Amanda	Monica	Martha	Angela	Linda	Melisa	Kate	Tiffany	Total
V										
Q'ty	16	7	6	4	11	10	11	14	18	97
%	24	26	21	12	34	48	19	23	20	23
Ranking	1	2	2	2	2	1	3	2	2	2
Scoop										
Q'ty	16	1	1	1	3		15	3	26	66
%	24	4	3	3	9		26	5	29	16
Ranking	1	4	3	4	3		2	4	1	3
Square										
Q'ty	2				1		2		1	6
%	3				3		3		1	1
Ranking	5				5		5		7	7
Surplice										
Q'ty	8								3	11
%	12								3	3
Ranking	3								6	6
Round										
Q'ty	15	14	22	25	14	6	23	31	17	167
%	23	52	76	74	44	29	40	50	19	40
Ranking	2	1	1	1	1	2	1	1	3	1
Boat										
Q'ty	2	2		3	2	1	1	2	3	16
%	3	7		9	6	5	2	3	3	4
Ranking	5	3		3	4	4	6	5	6	5
Funnel										
Q'ty	5					2	1		16	24
%	8					10	2		18	6
Ranking	4					3	6		4	4
Crew										
Q'ty	2	2				2	5	9	4	24
%	3	7				10	9	15	4	6
Ranking	5	3				3	4	3	5	4
Henley										
Q'ty		1			1			1		3
%		4			3			2		1
Ranking		4			5			6		8
One shoulder										
Q'ty								1		1
%								2		0
Ranking								6		9
Off shoulder										
Q'ty			1					1	1	3
%			3					2	1	1
Ranking			4					6	7	8
Total	66	27	29	34	32	21	58	62	89	418

Appendix E14. Frequency of Neckline Shape in Top Types

Neckline shape	Tank/Camisole	T-shirt	Shirt/Blouse	Vest	Total
V					
Q'ty	32	55	7	3	97
%	20	25	17	100	23
Ranking	3	2	3	1	2
Scoop					
Q'ty	39	26	1		66
%	25	12	2		16
Ranking	2	3	4		3
Square					
Q'ty	4	2			6
%	3	1			1
Ranking	5	8			7
Surplice					
Q'ty	3	7	1		11
%	2	3	2		3
Ranking	6	6	4		6
Round					
Q'ty	70	83	14		167
%	45	38	33		40
Ranking	1	1	2		1
Boat					
Q'ty		16			16
%		7			4
Ranking		5			5
Funnel					
Q'ty		6	18		24
%		3	43		6
Ranking		7	1		4
Crew					
Q'ty	5	18	1		24
%	3	8	2		6
Ranking	4	4	4		4
Henley					
Q'ty	2	1			3
%	1	0			1
Ranking	7	9			8
One shoulder					
Q'ty	1				1
%	1				0
Ranking	8				9
Off shoulder					
Q'ty	1	2			3
%	1	1			1
Ranking	8	8			8
Total	157	216	42	3	418

Appendix E15. Frequency of Neckline Depth in Tops

Neckline depth	Amy	Amanda	Monica	Martha	Angela	Linda	Melisa	Kate	Tiffany	Total
Plunging										
Q'ty	9				1	1		2	7	20
%	14				3	5		3	8	5
Ranking	2				3	4		3	4	4
Low										
Q'ty	42	4	5	2	8	5	15	10	41	132
%	64	15	17	6	25	24	26	16	46	32
Ranking	1	3	2	3	2	2	2	2	1	2
Medium										
Q'ty	8	13	23	17	15	2	38	50	25	191
%	12	48	79	50	47	10	66	81	28	46
Ranking	3	1	1	1	1	3	1	1	2	1
High										
Q'ty	7	10	1	15	8	13	5		16	75
%	11	37	3	44	25	62	9		18	18
Ranking	4	2	3	2	2	1	3		3	3
Total	66	27	29	34	32	21	58	62	89	418

Appendix E16. Frequency of Neckline Depth in Top Types

Neckline shape	Tank/Camisole	T-shirt	Shirt/Blouse	Vest	Total
Plunging					
Q'ty	5	13		2	20
%	3	6		67	5
Ranking	4	4		1	4
Low					
Q'ty	72	55	4	1	132
%	46	25	10	33	32
Ranking	2	2	2	2	2
Medium					
Q'ty	74	113	4		191
%	47	52	10		46
Ranking	1	1	2		1
High					
Q'ty	6	35	34		75
%	4	16	81		18
Ranking	3	3	1		3
Total	157	216	42	3	418

Appendix E17. Frequency of Sleeve Type in Tops

Sleeve type	Amy	Amanda	Monica	Martha	Angela	Linda	Melisa	Kate	Tiffany	Total
Sleeveless										
Q'ty	25	7	10	6	10	7	41	27	29	162
%	38	26	34	18	31	33	71	44	33	39
Ranking	1	2	2	3	2	1	1	1	2	1
Standard set-in										
Q'ty	25	10	7	12	9	7	14	20	50	154
%	38	37	24	35	28	33	24	32	56	37
Ranking	1	1	3	1	3	1	2	2	1	2
Raglan										
Q'ty	2	2		4					3	11
%	3	7		12					3	3
Ranking	4	3		4					4	4
Dropped shoulder										
Q'ty		1								1
%		4								0
Ranking		4								7
Cap										
Q'ty	8	7	11	10	13	6	2	15	5	77
%	12	26	38	29	41	29	3	24	6	18
Ranking	2	2	1	2	1	2	3	3	3	3
Puff										
Q'ty	4					1	1		2	8
%	6					5	2		2	2
Ranking	3					3	4		5	5
Kimono										
Q'ty	2		1	2						5
%	3		3	6						1
Ranking	4		4	5						6
Total	66	27	29	34	32	21	58	62	89	418

Appendix E18. Frequency of Sleeve Type in Top Types

Sleeve type	Tank/Camisole	T-shirt	Shirt/Blouse	Vest	Total
Sleeveless					
Q'ty	157		2	3	162
%	100		5	100	39
Ranking	1		3	1	1
Standard set-in					
Q'ty		123	31		154
%		57	74		37
Ranking		1	1		2
Raglan					
Q'ty		11			11
%		5			3
Ranking		3			4
Dropped shoulder					
Q'ty		1			1
%		0			0
Ranking		6			7
Cap					
Q'ty		70	7		77
%		32	17		18
Ranking		2	2		3
Puff					
Q'ty		6	2		8
%		3	5		2
Ranking		4	3		5
Kimono					
Q'ty		5			5
%		2			1
Ranking		5			6
Total	157	216	42	3	418

Appendix E19. Frequency of Sleeveless Type in Top Types

Sleeveless type	Tank/Camisole	Shirt/Blouse	Vest	Total
Thin				
Q'ty	41			41
%	26			25
Ranking	2			2
Medium				
Q'ty	80	2	3	85
%	51	100	100	52
Ranking	1	1	1	1
Thick				
Q'ty	35			35
%	22			22
Ranking	3			3
Strapless				
Q'ty	1			1
%	1			1
Ranking	4			4
Total	157	2	3	162

* Only about sleeveless tops

Appendix E20. Frequency of Sleeve Fit in Tops

Sleeve fit	Amy	Amanda	Monica	Martha	Angela	Linda	Melisa	Kate	Tiffany	Total
Tight										
Q'ty	7	3	13	4	1			23		51
%	17	15	68	14	5			66		20
Ranking	3	3	1	2	3			1		2
Fitted										
Q'ty	21	12	2	22	14	9	16	8	53	157
%	51	60	11	79	64	64	94	23	88	61
Ranking	1	1	3	1	1	1	1	2	1	1
Loose										
Q'ty	10	5	4	2	7	5	1	3	4	41
%	24	25	21	7	32	36	6	9	7	16
Ranking	2	2	2	3	2	2	2	3	2	3
Full/Gathered										
Q'ty	3							1	3	7
%	7							3	5	3
Ranking	4							4	3	4
Total	41	20	19	28	22	14	17	35	60	256

* Excluded sleeveless tops

Appendix E21. Frequency of Sleeve Fit in Top Types

Sleeve fit	T-shirt	Shirt/Blouse	Total
Tight			
Q'ty	51		51
%	24		20
Ranking	2		2
Fitted			
Q'ty	128	29	157
%	59	73	61
Ranking	1	1	1
Loose			
Q'ty	32	9	41
%	15	23	16
Ranking	3	2	3
Full/Gathered			
Q'ty	5	2	7
%	2	5	3
Ranking	4	3	4
Total	216	40	256

* Excluded sleeveless tops

Appendix E22. Frequency of Sleeve Length in Tops

Sleeve length	Amy	Amanda	Monica	Martha	Angela	Linda	Melisa	Kate	Tiffany	Total
Sleeveless										
Q'ty	25	7	10	6	10	7	41	27	29	162
%	38	26	34	18	31	33	71	44	33	39
Ranking	1	2	2	2	2	1	1	1	1	1
Very short										
Q'ty	11	10	16	17	15	4	6	15	11	105
%	17	37	55	50	47	19	10	24	12	25
Ranking	3	1	1	1	1	3	2	2	4	2
Short										
Q'ty	9	3	3	3	3	2	3	1	19	46
%	14	11	10	9	9	10	5	2	21	11
Ranking	4	4	3	3	3	5	4	5	2	4
Elbow										
Q'ty	2			2	1	3	1	3	9	21
%	3			6	3	14	2	5	10	5
Ranking	6			4	5	4	5	4	5	5
Three-quarter										
Q'ty	5	1					3	3	5	17
%	8	4					5	5	6	4
Ranking	5	5					4	4	6	6
Long										
Q'ty	12	6		3	3	5	4	13	16	62
%	18	22		9	9	24	7	21	18	15
Ranking	2	3		3	4	2	3	3	3	3
Extra long										
Q'ty	2			3						5
%	3			9						1
Ranking	6			3						7
Total	66	27	29	34	32	21	58	62	89	418

Appendix E23. Frequency of Sleeve Length in Top Types

Sleeve length	Tank/Camisole	T-shirt	Shirt/Blouse	Vest	Total
Sleeveless					
Q'ty	157		2	3	162
%	100		5	100	39
Ranking	1		5	1	1
Very short					
Q'ty		98	7		105
%		45	17		25
Ranking		1	3		2
Short					
Q'ty		36	10		46
%		17	24		11
Ranking		3	2		4
Elbow					
Q'ty		15	6		21
%		7	14		5
Ranking		5	4		5
Three-quarter					
Q'ty		16	1		17
%		7	2		4
Ranking		4	6		6
Long					
Q'ty		46	16		62
%		21	38		15
Ranking		2	1		3
Extra long					
Q'ty		5			5
%		2			1
Ranking		6			7
Total	157	216	42	3	418

Appendix E24. Frequency of Sleeve Cuff in Tops

Sleeve cuff	Amy	Amanda	Monica	Martha	Angela	Linda	Melisa	Kate	Tiffany	Total
No-cuffs										
Q'ty	25	7	10	6	10	7	41	27	29	162
%	38	26	34	18	31	33	71	44	33	39
Ranking	1	2	2	2	2	2	1	1	1	1
Plain										
Q'ty	25	15	16	19	12	1	15	24	29	156
%	38	56	55	56	38	5	26	39	33	37
Ranking	1	1	1	1	1	4	2	2	1	2
Straight										
Q'ty	8	2		5	5	10	2	7	22	61
%	12	7		15	16	48	3	11	25	15
Ranking	2	4		3	3	1	3	3	2	3
Gathered										
Q'ty	8	3	1	4	5	3		4	7	35
%	12	11	3	12	16	14		6	8	8
Ranking	2	3	4	4	3	3		4	3	4
Rolled										
Q'ty									2	2
%									2	0
Ranking									4	5
Full gathered										
Q'ty			2							2
%			7							0
Ranking			3							5
Total	66	27	29	34	32	21	58	62	89	418

Appendix E25. Frequency of Sleeve Cuff in Top Types

Sleeve cuff	Tank/Camisole	T-shirt	Shirt/Blouse	Vest	Total
No-cuffs					
Q'ty	157		2	3	162
%	100		5	100	39
Ranking	1		4	1	1
Plain					
Q'ty		151	5		156
%		70	12		37
Ranking		1	2		2
Straight					
Q'ty		31	30		61
%		14	71		15
Ranking		3	1		3
Gathered					
Q'ty		32	3		35
%		15	7		8
Ranking		2	3		4
Rolled					
Q'ty			2		2
%			5		0
Ranking			4		5
Full gathered					
Q'ty		2			2
%		1			0
Ranking		4			5
Total	157	216	42	3	418

Appendix E26. Frequency of Pocket Type in Tops

Pocket type	Amy	Amanda	Monica	Martha	Angela	Linda	Melisa	Kate	Tiffany	Total
Patch										
Q'ty		1	1	2	1	1	1	1	1	9
%		4	3	6	3	5	2	2	1	2
Ranking		2	2	2	2	2	2	2	3	2
Set-in										
Q'ty					1	1	1		2	5
%					3	5	2		2	1
Ranking					2	2	2		2	3
None										
Q'ty	66	26	28	32	30	19	56	61	86	404
%	100	96	97	94	94	90	97	98	97	97
Ranking	1	1	1	1	1	1	1	1	1	1
Total	66	27	29	34	32	21	58	62	89	418

Appendix E27. Frequency of Pocket Type in Top Types

Pocket type	Tank/Camisole	T-shirt	Shirt/Blouse	Vest	Total
Patch					
Q'ty		2	5	2	9
%		1	12	67	2
Ranking		2	2	1	2
Set-in					
Q'ty	1	1	1	1	4
%	1	0	2	33	1
Ranking	2	3	3	2	3
None					
Q'ty	156	213	36		405
%	99	99	86		97
Ranking	1	1	1		1
Total	157	216	42	3	418