

SUSTAINABLE CONSUMPTION: EXPLORATION OF INTENTIONS IN
RESPONSE TO EMERGING DIGITAL APPAREL TECHNOLOGIES

A Dissertation
Presented to the Faculty of the
Graduate School of Cornell University
in Partial Fulfillment of the Requirements for the Degree of
Doctor of Philosophy

by
Fatma Baytar
August 2011

© 2011 Fatma Baytar

SUSTAINABLE CONSUMPTION: EXPLORATION OF INTENTIONS IN
RESPONSE TO EMERGING DIGITAL APPAREL TECHNOLOGIES

Fatma Baytar, Ph.D.

Cornell University 2011

Humanity's ecological impact to the ecosystem is enormous. For the apparel industry, the shift from four or five season-based fashion cycles to continuously changing styles has amplified its impact on economies, societies and the environment over the last two decades. Consumers individually contribute to ecological damage by purchasing a lot of garments and disposing of them frequently. The energy embodied in garments during manufacture, transportation, and usage often ends up in landfills in wasteful, unsustainable consumption cycles.

Technological advancements in virtual imaging, apparel try-on technologies, and online interaction offer some potential for contributions toward development of a more sustainable consumption model for apparel. Technology can have an effect on consumer involvement with their garments through digital design and communication tools and accurate product information. This dissertation explores how the technology can change familiar apparel consumption patterns. The research is conducted in three steps: First, utilizing a broadly accepted social psychological theory, the Theory of Planned Behavior, and expanding it within the context of sustainability. Second, investigating if there is a way to avoid possible unsustainable consumption effects of these technologies by providing the consumers of these technologies with new understanding of the problems and processes of apparel production and consumption. Third, testing how users would approach such technologies and investigating attitudes toward their actual customized designs.

This dissertation demonstrated that these new technologies could be used as a design tool for consumers to create and preview personalized clothing if optimized into a working system. The positive interactions between the users and the technology suggested that garments designed using these methods could be better cared for, used for a longer time, and worn with pride- thus, disposing them less frequently and consuming these products more sustainably.

BIOGRAPHICAL SKETCH

Fatma Baytar was born in Razgrad, Bulgaria, and raised in Bursa, Turkey. She received her B.Sc. (Uludag University, 2000) and M.Sc. (Istanbul Technical University, 2003) degrees in textile engineering. She came to Cornell in 2006 to undertake her Ph.D. study in Apparel Design. Since then, she has been working under the supervision of Dr. Susan Ashdown on various research projects and immensely enjoying challenging herself and learning something new every day. She wishes to be as good as her mentors at Cornell one day and to pass the wisdom she has gained from them on to her students. Fatma will continue to pursue her studies as an assistant professor in the Department of Apparel, Merchandising and Design at Iowa State University in Ames, Iowa. Her goal as a teacher and researcher will be to initiate collaborative and interdisciplinary research in several areas, including advancements in technology and their effects on design practices, and how these would affect the apparel industry and society at large.

This dissertation is dedicated
to my beloved family: Fikret (Dad), Gulizar (Mom), Deniz (brother)
and to Mehmet ♥

ACKNOWLEDGMENTS

I am extremely grateful to my advisor, Dr. Susan Ashdown, for your continuous guidance, support, patience, and understanding through these past five years. Thank you for all of the wonderful opportunities you provided me during my training to become a scholar. I would not have completed this long journey without your belief in me. I learned so much from you and am immensely inspired by your passion for research and teaching. Thank you for being an excellent role model!

To Dr. Suzanne Loker: thank you for being an incredible mentor, and a voice of reason. Thank you for your great support throughout my graduate student years and job hunting. You were always there for me when I needed advice.

To the most supportive and understanding dissertation committee members, Dr. Dan Cosley, Dr. David Feathers, and Dr. Suzanne Loker: thank you for the classes you teach. They inspired me enormously and eventually influenced my decision to change my dissertation topic. Thank you for being flexible with my varying research interests and for your continuous feedback on and support of this research.

To Dr. Charlotte Jirousek, who interviewed me in Turkey and recommended me to the faculty with whom I have always wanted to work: thank you for being a part of making my dreams come true, for opening your house to me and making me feel home, for the great food you cook, for your advice and continuous support. I hope you can stop by Ames to visit me when you are on your way to Minneapolis. I also hope to travel to Turkey with you someday.

To the FSAD faculty: Dr. Van Dyk Lewis, for taking the time to listen to me and to give me advice on job hunting, for sharing your wisdom with me, and for your encouragements and support; and to Dr. Anita Racine, for making me realize the importance of being organized and paying attention to details.

To the previous and current Body Scan Research Group project managers, Lindsay Lyman-Clarke and Catherine Devine: thank you for teaching me how to use the 3D body scanner and related software, and for your great problem-solving skills and your support for the projects I worked on. To the lovely FSAD staff, Karen Steffy, Judy Wiiki, Valorie Adams, Michele Draiss: Thank you for your assistance, support, and candies.

To my fabulous fellow graduate students and post-docs, with whom I shared an office and a graduate student life (in alphabetical order): Adriana, Beth, Eun Jung, Hwa Kyung, Janine, Jen, Jing, Jung Soo, Kyung-Ja, Lindsey, Mario, Prof. Do, Sanchit, Sun Yoon, and Tasha; and to my neighbors Julia, her mom Susan, and Betsy. Thank you all for being a family for me here. You are invaluable to me.

Special thanks to Alexandria Taylor, for creating an amazing intervention video; Francoise Vermeyleen, for providing the most helpful statistical assistance; Kristen Ebert-Wagner, for being the best editor ever; Wendy Skinner, for contributing to my intervention video and for being an inspirational person, and Marina Tokman for patiently answering my Checkbox related questions.

To all my dear friends and beloved family, for all your love, international calls, and support—thank you!

This research was supported by a grant from the Department of Fiber Science & Apparel Design Graduate Students Research Awards Fund, the Gulizar and Fikret Baytar Fund, and the Mehmet Ozturk Fund.

TABLE OF CONTENTS

BIOGRAPHICAL SKETCH.....	iii
DEDICATION	iv
ACKNOWLEDGMENTS.....	v
TABLE OF CONTENTS	vii
LIST OF FIGURES.....	x
LIST OF TABLES	xi
CHAPTER 1: INTRODUCTION.....	1
REFERENCES.....	7
CHAPTER 2: LITERATURE REVIEW.....	9
2.1. Overview: Environmental Impact of the Textiles and Apparel Industry	9
2.2. Definition of Sustainability and Various Strategies for a Sustainable Fashion System.....	11
2.3. Sustainability in the Digital Age: Enabling Technologies and Sustainability in the Apparel Industry	15
2.3.1. 3D Body Scanning Applications in Apparel Design.....	17
2.3.2. Virtual Try-on and Customization.....	18
2.3.3. The Internet and Online Social Networking.....	22
2.4. Transition Towards Sustainable Apparel Consumption in a Digitally Networked Age: Video Intervention	25
2.5. Theoretical Framework	27
REFERENCES.....	31
CHAPTER 3: THE EFFECTS OF DIGITAL TECHNOLOGIES ON BEHAVIORAL INTENTIONS OF APPAREL DESIGN STUDENTS TOWARD CONSUMING LESS.....	40
3.1. Overview	40
3.2. Sustainability	41
3.3. Enabling Technologies and Sustainability in the Apparel Industry	44
3.3.1. 3D Body Scanning Applications in Apparel Design.....	45
3.3.2. Virtual Try-On and Customization.....	46
3.3.3. The Internet and Online Social Networking.....	49
3.4. Theoretical Framework	51
3.5. Video Intervention.....	53
3.6. Justification for the Present Study.....	53
3.7. Sample Selection	54
3.8. Hypotheses	56
3.8.1. Mediating Effect of Attitudes.....	62
3.9. Methodology.....	63
3.9.1. Instrument Development	63
3.9.2. Variables in the Study	64
3.9.3. Pretesting and Pilot Testing.....	67
3.9.4. Survey Administration.....	68

3.9.5. Survey Structure	69
3.10. Data Analysis.....	73
3.11. Results	73
3.11.1. Respondent Profile	74
3.11.2. Purchasing and Discard Behaviors.....	76
3.11.3. Preliminary Data Analysis for Multiple Regression	78
3.11.4. Reliability (Chronbach’s Alpha) and Internal Consistency (Factor Analysis) of the Scales.....	79
3.11.5. Mean Comparisons.....	83
3.11.6. Multiple Regressions	85
3.11.7. Data Analysis of Responses to Open-Ended Questions.....	93
3.12. Conclusions and Future Study.....	105
3.13. Limitations.....	113
REFERENCES	115

CHAPTER 4: AN INTERVENTION STUDY ON USING VIDEO CLIPS AS
PERSUASION AGENTS FOR SUSTAINABILITY IN APPAREL
CONSUMPTION

123	
4.1. Background and Justification	123
4.1.1. Creating Awareness for Sustainable Consumption	124
4.1.2. The Effect of Multimedia on Learning and Behavioral Change	126
4.2. Sample Selection	131
4.3. Methodology.....	133
4.3.1 Instrument Development	133
4.3.2. Variables in the Study	134
4.3.3. Pretesting and Pilot Testing.....	136
4.3.4. Survey Administration.....	137
4.3.5. Survey Structure	139
4.3.6. Treatment (Intervention Video).....	140
4.3.7. Script.....	142
4.4. Data Analysis.....	144
4.5. Results and Discussion	145
4.5.1. Demographics.....	146
4.5.2. Descriptive Statistics	148
4.5.3. The General Linear Univariate Model (GLM).....	151
4.5.4. Open-Ended Questions.....	155
4.6. Conclusions and Future Work.....	158
4.7. Limitations.....	163
REFERENCES	165

CHAPTER 5: A 3D “PAPER DOLL” OF *YOU*: AN EXPLORATORY STUDY OF
3D AVATARS FROM BODY SCANS AS MEDIATORS OF SELF-
DESIGNED DIGITAL APPAREL AND SUSTAINABLE
CONSUMPTION... ..

170	
5.1. Background and Justification	170

5.2. Commercial Applications of Virtual Try-On	172
5.3. Interactive and Collective Usage of Virtual Try-On on the Internet.....	173
5.4. Emerging Digital Apparel Technologies and Sustainability	176
5.5. Objectives	178
5.6. Methodology.....	179
5.6.1. Participants	179
5.6.2. Instrument.....	180
5.6.3. Data Collection.....	181
5.6.4. Online Questionnaire.....	184
5.6.5. Data Analysis.....	185
5.6.6. Trustworthiness	186
5.7. Results and Discussion	187
5.7.1. Self-Reports on Pro-Environmental Behaviors-Environmental Concern Levels of the Study Participants	190
5.7.2. Class Interaction	191
5.8. Themes Emerging from Observation and Interview Data.....	192
5.8.1. Themes Related to Software Usage.....	192
5.8.2. Themes Related to the Designed Object	202
5.8.3. Other Thoughts on Actual Usage	205
5.9. Conclusion and Future Work.....	208
5.10. Limitations.....	214
REFERENCES	217
CHAPTER 6: SUMMARY, CONCLUSION AND RECOMMENDATIONS	222
6.1. Summary and Conclusion.....	222
6.1.1. Analysis of the Framework Designed by Employing the Theory of Planned Behavior	227
6.1.2. Further Analysis of the Intervention.....	231
6.1.3. Qualitative Study for Investigating Actual Behaviors.....	233
6.1.4. Final Model	236
6.2. Limitations and Further Study.....	241
6.2.1. Population.....	241
6.2.2. Instrument and Study Design	242
6.2.3. Projections for Future Study Settings.....	246
REFERENCES	248
APPENDIX A: IRB Approval Form-Concurrence of Exemption	252
APPENDIX B: IRB Approval Form- Notice of Expedited Approval	253
APPENDIX C: Instrument- Pretest.....	254
APPENDIX D: Instrument- Posttest	259

LIST OF FIGURES

Figure 2.1 Technology Enabled Sustainable Fashion System	16
Figure 2.2. Screenshot from Fits.me	20
Figure 2.3. Demonstration of i-Fashion at Shinsegae Department Store	21
Figure 2.4. Two Examples of Bloggers Discussing the Fit (a) Gigi (b) Bahannas	24
Figure 2.5. Causal Diagram of the Theory of Planned Behavior	29
Figure 3.1. Technology Enabled Sustainable Fashion System.....	45
Figure 3.2. Causal Diagram of the Theory of Planned Behavior	52
Figure 3.3. Distribution of the Study Participants to Control and Intervention Groups	56
Figure 3.4. Extended Theory of Planned Behavior.	57
Figure 4.1. Distribution of the Study Participants to Control and Intervention groups	133
Figure 5.1. Avatar examples at Appassion.com with Different Ethnicities and Gender.	175
Figure 5.2. Jen’s Initial Designs	194
Figure 5.3. Bill’s Design.	198
Figure 5.4. (a) Initial sketch. (b) Virtual design. (c) Muslin prototype. (d) Actual pants designed by Bill.....	203
Figure 5.5. (a) Virtual dress. (b) Actual dress designed by Beth.	204
Figure. 6.1. Extended Final Model	238

LIST OF TABLES

Table 3.1. Definitions of the Variables Used in the Model and Sources of Latent Constructs	65
Table 3.2. Frequency Distribution for Respondents' Demographics	75
Table 3.3. Technology Usage	76
Table 3.4. Purchase Frequency	77
Table 3.5. Internet Purchasing	77
Table 3.6. Garment-Discard Behaviors	78
Table 3.7. Factor Analyses of Variables after Varimax Rotation and Cronbach's Alpha Values	82
Table 3.8. Mean Comparisons of Independent and Dependent Variables	84
Table 3.9. Summary of Hierarchical Multiple Regressions (Final Model)	87
Table 3.10. Multiple Regression Results for Influence of Attitude	92
Table 3.11. Expected Duration of Customized Garments	97
Table 3.12. Summary of the Themes, Codes, Effect Sizes	98
Table 3.13. List of Other Comments Related to Technology, Garments, and Consumption	104
Table 4.1. Modified Environmental Apparel Knowledge Scale	134
Table 4.2. Green Consumer Assessment Scale (GCA)	135
Table 4.3. Descriptive Statistics for Main Constructs	136
Table 4.4. Extracts from Open-Ended Questions Related to the Environmental Apparel Knowledge Scale Items	143
Table 4.5. Distribution of the Participants	146
Table 4.6. Descriptive Statistics for the Pretest and Posttest Knowledge Scale Means	149
Table 4.7. Knowledge Scale Item Means for Pretest and Posttest	150

Table 4.8. Descriptive Statistics for the Pretest and Posttest Green Consumer Assessment Scale Means	152
Table 4.9. Green Consumer Assessment scale item means for pretest and posttest ..	153
Table 5.1. Characteristics of the participants, from the first part of the online survey	188

CHAPTER 1

INTRODUCTION

The textile industry is one of the largest carbon dioxide (CO₂) emitters on Earth and it is the major industrial polluter of water in the world (Zaffalon, 2010). The environmental consequences of humanity's textile consumption are enormous. The industry contributes greatly to climate change through energy use and waste generation during manufacture, and produces CO₂ emissions during transportation. Moreover, fast fashion has been promoted by the industry, resulting in increased consumption. Consumers make individual contributions to climate change by purchasing many more garments than they need, and laundering and disposing of them frequently (Allwood, Laursen, Malvido, & Bocken, 2007).

Textile waste is one of the biggest problems of the current industrial ideology and the artificial needs created by it. Currently around 35 kilograms of clothing and textiles per person are purchased and disposed of each year. Twenty-six kilograms of clothing per person are buried in landfills annually (Allwood et al., 2007). A current Environmental Protection Agency [EPA] report states that in 2009, 12.7 million tons of textiles (5.2 percent of total municipality solid waste or garbage) were generated in the U.S. (EPA, 2009). All the energy embodied in the garments during raw material production, fabric and garment manufacture, and transportation of the materials going to landfills and is wasted. Moreover, synthetic fibers do not decompose in landfill, and the materials that do decompose, such as wool, emit methane gases into the atmosphere.

In a process that has intensified greatly since 1970, the human population is consuming renewable resources faster than the ecosystem can regenerate them, while also releasing more CO₂ into the atmosphere than the ecosystem can absorb, thus

changing the climate (World Wildlife Fund [WWF], 2010). A current World Health Organization [WHO] report (2010) points out the fundamental effects of climate change on human health. According to the report, it is estimated that since the 1970s, approximately 140,000 people die every year because of global warming. Ozone depletion (UV exposure), desertification and land degradation (floods), freshwater decline, and loss of biodiversity and ecosystem function are cited as a few of the consequences of global warming affecting human health (WHO, 2010)

Reduce, reuse and recycle are three major strategies proposed to address these problems (Fletcher, 2008). In the context of sustainable textile and fashion design, approaches within these three major strategies can be broadly described as follows: reducing chemical impacts and minimizing waste in the manufacturing process, reducing energy use and water use in manufacture and care of garments, exploring clean/better technologies overall, committing to ethical and fair trade production, designing for recycling/ upcycling, replacing the need to consume, dematerializing and developing systems, services, and design activism (Textiles Environmental Design [TED], n.d.)

As Loker (2008) argues, modifying consumer norms can be one solution to reduce waste by buying less and using garments longer. Technology can have an effect on consumer involvement to their garments through digital communication tools and accurate product information. Technologies are known to affect human behavior (Verbeek & Slob, 2006), but the actual outcomes of various technologies are more difficult to predict. Scaturro (2008) argues that between manufacture and post consumption; there is a synergy between technology, sustainability, and fashion. She divides the mediating effect of technology on sustainability in fashion into a material level and a digital level. On the material level, technology can be related to developing sustainable textile materials and to recycling. On the digital level, technologies are

connected to the creation of fashion. Current technologies such as product configurators¹ and body scanning for made-to-order or mass customization production systems are two examples of enabling apparel design and virtual try-on technologies (Loker, 2008). Such systems can indirectly affect the consumer use stage by extending the lifespan of products, and/or by adding meaning to garments through increasing consumer involvement. As Loker indicates, they can “balance production and consumption through increased durability, expansion of functional and emotional value” (Loker, 2008, p.100).

This research was designed to explore factors associated with the use of digital technologies, specifically their potential as a change factor motivating people to consume less apparel: *When integrated technologies of 3D garment visualization, custom production and online interaction technologies become realities in the future, what could their effect be on people’s behaviors toward sustainable consumption?* A secondary aim was to determine whether people’s intentions could be altered by environmental messages about consuming less. *What can new technologies offer us that can modify our consumption habits? If people know more about consequences of their behaviors, would they still expect to behave in the same manner?*

The work done in this research project is intended to contribute to a discussion of the interactions between virtual fit and customization technology, online interaction technologies, and product acquisition and usage. The answers sought for “what if?” questions throughout this study examined the potential effects of these technologies. The aim of the study was to seek answers about human consumption and how technology might influence human consumption. In sum, I wish to begin to explore whether the desire for ever increasing rates of purchase of “new” clothing is a learned

¹ Product configurators are interactive computer software allowing consumers to customize their own fashion items by selecting color, style, fabric or size options (Loker, 2008)

behavior enabled by current economic and technological conditions in the apparel industry, and whether different outcomes can be expected from different technologies.

This dissertation was structured as dissertation by paper: while Chapter 2 presents an overall literature review, Chapters 3, 4 and 5 were formatted around different segments of the project, with more focused literature reviews and individual results and discussion. Chapter 6 then returns to an overall discussion of the work.

According to Chapman (2009), the sustainability crisis is a behavioral issue and behaviors steering material consumption are complex. However, understanding them is at the core of developing a sustainable engagement with materials. In Chapter 3 (following the literature review in Chapter 2) these issues are explored by using a well-established social psychological model, the Theory of Planned Behavior [TPB], (Ajzen, 1985, 1991). For this research, the TPB model was extended beyond its main focus (the effects of attitudes, subjective norms and perceived behavioral control) by including several factors (attachment, uniqueness, and green consumerism) to the model to examine all these factors' effects on keeping and wearing customized garments for multiple seasons.

No existing studies have used TPB to understand the determinants of sustainable apparel consumption within a domain of technologies, which allow users to customize their own garments, and get feedback from their peers before acquiring these particular garments. Also, the effect of a treatment video is examined in Chapter 4. The video intervention used in this study was designed to introduce concepts related to sustainability and to technology, and to briefly inform participants about current environmental challenges in relation to clothing production and use. It was expected that introduction of these concepts might influence their personal beliefs and stimulate the intention to modify their patterns of consumption to some extent.

The use of video as a tool to convey information about environmental issues around clothing use and technology is another unique contribution of this study.

To predict how people might react to similar software in the future online shopping environment, participants' actual interactions with virtual try-on technology and their 3D body scan avatars were examined in Chapter 5. Possible effects of using these technologies on people's intentions to use garments created and designed online are also explored and explained in Chapter 5.

Although previous studies have examined factors related to responsible apparel consumption or factors related to consumers' reactions towards technologies such as the 3D body scanner and virtual try-on applications, none of them looked at the issue of the potential impact of these particular technologies on sustainable consumption of their end products. In this sense, the aim of this study was initializing discussions around technology consumption, taking actions toward promoting sustainable consumption, and exploring ways to connect the two. This study operationalized the term "sustainable consumption" as the act of using a fashion object for many seasons. This term was chosen to imply the opposite of the overconsumption, or throwaway nature of "unsustainable consumption". Moreover, this study was designed to obtain a richer understanding of the issue by conducting it within the context of persuasive messages provided by the video. Considering the need for more interventional research in this area, the video was used to convey apparel-specific sustainability knowledge and to pose questions about technology.

Overall in this dissertation apparel consumption-related attitudes were examined in a controlled manner using a theoretical social-behavioral model. It should be noted that the focus of this study is the exploration of new themes, variables, and their relationships in order to predict behavioral intentions toward sustainable apparel consumption by using a robust and reliable theoretical model. This study explores how

the technology can transform the apparel consumption patterns we are familiar with, and investigates if there is a way to subvert possible unsustainable consumption effects of these technologies by providing the consumers of these technologies with new understanding of the problems and processes of apparel production and consumption.

REFERENCES

- Ajzen I. (1985). From intentions to actions: A theory of planned behavior. In J. Kuhl & J. Beckmann (Eds.), *Action-control: From cognition to behavior* (pp. 11-39). Heidelberg, Germany: Springer-Verlag.
- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Making Processes*, 50(2), 179-211.
- Allwood, J. M., Laursen, S. E., Malvido, C., & Bocken, N. M. P. (2007). *Well dressed? The present and future sustainability of clothing and textiles in the United Kingdom*. Retrieved from http://www.ifm.eng.cam.ac.uk/sustainability/projects/mass/UK_textiles.pdf
- Chapman, J. (January 01, 2009). Design for (Emotional) Durability. *Design Issues*, 25, 4, 29-35.
- Fletcher, K. (2008). *Sustainable fashion and textiles: Design journeys*. London; Sterling, VA: Earthscan.
- Loker, S. (2008). A technology-enabled sustainable fashion system: Fashion's future. In C. Ulasewicz & J. Hethorn (Eds.), *Sustainable fashion, why now?* (pp. 95-126). New York, NY: Fairchild Books.
- Scaturro, S. (2008). Eco-tech fashion: Rationalizing technology in sustainable fashion. *Fashion Theory: The Journal of Dress, Body & Culture*, 12(4), 469-488.
- Textiles Environmental Design. (n.d.). *TED's ten sustainable textile design strategies*. Retrieved May 12, 2011 from <http://www.tedresearch.net/>
- U.S. Environmental Protection Agency. (n.d.). *Textiles*. Retrieved from <http://www.epa.gov/wastes/conserves/materials/textiles.htm>
- Verbeek, P. P., & Slob, A. (2006). Analyzing the relations between technologies and user behavior: Towards a conceptual framework. In P. P. Verbeek & A. Slob (Eds.), *User behavior and technology development: Shaping sustainable relations between consumers and technologies* (pp. 385-399). Dordrecht, The Netherlands: Springer.
- World Health Organization. (2010). *Climate change and health* (Fact sheet No. 266). Retrieved from <http://www.who.int/mediacentre/factsheets/fs266/en/>
- World Wildlife Fund. (2010). *Living planet report 2010*. Retrieved from <http://assets.panda.org/downloads/lpr2010.pdf>

Zaffalon, V. (2010, July 19). Climate change, carbon mitigation and textiles. *Textile World*. Retrieved from http://www.textileworld.com/Articles/2010/July/July_August_issue/Features/Climate_Change_Carbon_Mitigation_In_Textiles.html

CHAPTER 2

LITERATURE REVIEW

2.1. Overview: Environmental Impact of the Textiles and Apparel Industry

Humanity's ecological impact on our ecosystem has been increasing due to our overconsumption of resources (United Nations [UN], 2010), evolving into the present global environmental crisis (Weidenboerner, 2008). Individuals from more developed countries tend to consume more and have a far more major effect on resources and environment than individuals from less developed countries. (World Wildlife Fund [WWF], 2010; Peattie & Collins, 2009). According to the most recent WWF report, "Living Planet", by 2030 the capacity of two Earths will be needed to absorb carbon dioxide emissions and keep pace with natural resource consumption (WWF, 2010).

At an accelerating rate since 1970, the human population began consuming renewable resources faster than the ecosystem can regenerate them, while also releasing more CO₂ into the atmosphere than the ecosystem can absorb, thus changing the climate (WWF, 2010). A current World Health Organization [WHO] report (2010) points out the fundamental effects of climate change on human health. According to the report, it is estimated that since the 1970s, approximately 140,000 people die every year because of global warming. Ozone depletion (UV exposure), desertification and land degradation (floods), freshwater decline, and loss of biodiversity and ecosystem function are cited as a few of the consequences of global warming affecting human health (WHO, 2010)

As Welters (2008) stated, prior to the Industrial Revolution, textiles and apparel production was costly and laborious process, which took a lot of time. For this reason, fabrics were saved, garments were refashioned or the elite's garments were sold in the secondhand market. Also, since textile production was located in certain

places (for example fine cotton fabrics were painted and printed India), such fabrics had to be exported long distances using limited transportation technology to the consumer and they were precious. The fashion system was sustainable. With the Industrial Revolution, devices mechanized the textile and apparel production and distribution and garments became affordable and abundant. Since then, the fashion industry has been one of the biggest industries affecting our economy, environment and ecology. Especially the current mass-produced fashion system, including ‘fast fashion’ which introduces new styles to the market with great frequency, has proved itself to be wasteful. This wastefulness is not inherent to fashion, but rather how we have decided to define it in the years following the Industrial Revolution.

To be able to produce fiber, textiles, and apparel; a vast amount of fossil fuels and water are consumed (Zaffalon, 2010). Approximately 1 trillion kilowatt hours of electricity and up to 9 trillion liters of water are used every year to produce 60 billion kilograms of fabrics, causing the industry to account for approximately 10 percent of the total carbon impact (OEcotextiles, 2011). The environmental consequences of humanity’s textile consumption are enormous. People impact the environment at several phases of a garment’s life from fiber production/cultivation to apparel production, usage, laundering, and discard (Allwood, Laursen, Malvido & Bocken, 2007). The industry contributes highly to climate change through energy use and waste generation during manufacture, and produces CO₂ emissions during transportation.

Secondary Materials and Recycled Textiles Association [SMART] classified textile waste as either pre-consumer (by-product materials from the fiber, textile, and apparel industries) or post-consumer (garments or household articles that no longer needed and are therefore discarded). Post-consumer waste results when items are worn out, damaged, or have gone out of fashion (Secondary Materials and Recycled

Textiles Association, 1997). Although some unwanted items are donated to charities, charities sell a large proportion of these donations to the textile recycling firms. These textiles are either recycled into industrial products and cleaning cloths or sold to developing countries (Hawley, 2008), and perhaps ending up in landfills there if those countries do not have a good textile recycling systems.

Schor (2005) stated that recent consumption practices have evolved toward the acquisition of more luxurious items and multiple versions of products that consumer already own, thereby increasing the consumer's environmental effect significantly. Vezzoli and Manzini (2008) pointed out that consumers of today became "lazy and disinterested users" of products that are marketed to them (p.33). It is not because consumers were born wasteful, but rather were influenced by the industry to become that way (Chapman, 2005). Even though current practices of buying are not inherent to fashion itself, this is the way we define and advertise it now.

2.2. Definition of Sustainability and Various Strategies for a Sustainable Fashion System

A change in consumption patterns is one of the transformations necessary to decrease humanity's negative environmental impact and achieve sustainability. There are many approaches by which to tackle this transition. Sustainable consumption is one of the most important solutions and focuses on "understanding of all the social and environmental impacts that occur throughout the entire production and consumption cycle of a product.... This requires an understanding of consumption, not as the activity of purchase, but as a process of decisions and actions that include purchasing, product use and...dealing with product after use" (Peattie & Collins, 2009, p.170)

Sustainability covers a broad range of approaches, so in the literature it is defined from the multiple points of views. As a general definition, sustainability is

"...meeting the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987). A community is not sustainable when it consumes its resources faster than they are renewed, or produces more wastes than natural systems can process.

Consumers make individual contributions to climate change by purchasing a lot of garments, and laundering and disposing of them frequently (Allwood et al., 2007). Schor (2002) explained that decrease in apparel items' prices has led to a pressure on manufacturers and retailers to sell more; as a result consumers of the fast fashion system spend more. When the product is rare and expensive, it is valued. Its value decreases when the product gets more affordable.

Reduce, reuse and recycle are three major strategies proposed to address these problems (Fletcher, 2008). In the context of sustainable textile and fashion design, some approaches within these three major strategies can be broadly described as follows (Textiles Environmental Design [TED], n.d.):

1-Minimizing waste: Zero waste approach by creating garment patterns, which fit like puzzle pieces. Contemporary designers such as Timo Rissanen, Mark Liu (jigsaw cut), Julian Roberts (subtraction cutting), and Holly McQuillan are known for using this technique for exploring sustainability through waste minimization during garment production (Rissanen, 2008). Reusing garments by acquiring garments on eBay or vintage clothing can help to minimize waste as well (Fletcher, 2008).

2-Recycling/ upcycling (transforming a disposable object into something of a greater value): Patagonia's Common Threads garment recycling programme, and designer Carol Young's "Undesigned" study (Young, Jirousek, & Ashdown, 2004) for designing apparel from post-consumer recycled clothing and textiles can be given as two examples of this approach.

3-Reducing chemical impacts: The textile and apparel industry's chemical impact can be minimized by reducing the large quantities of pesticides needed to produce for cotton (Fletcher, 2008), and reducing carbon emissions by shifting from non-renewable oil based synthetic fibers (polyester, nylon) to renewable natural fibers and biodegradable synthetics such as polylactic acid (PLA) (Fletcher, 2008)

4-Reducing energy and water use: This approach explores changing the way we care for garments. For instance, designer Kate Fletcher's No Wash project identifies laundering as one of clothing's biggest impact on environment and therefore suggests designing a "no wash" shirt (Fletcher, 2008)

5- Exploring clean/better technologies: Technologies for developing biodegradable materials (Fletcher, 2008), or for personalized garment production, such as body configurators and virtual fit (Loker, 2008) can be given as two examples.

6- Replacing the need to consume: Developing durable/ emotional design to extend product lifetime through increased involvement (Chapman, 2005), or increasing product attachment by creating unique designs and/or creating designs collaboratively can change consumption patterns that result in frequent disposal of garments into landfills.

7- Developing new systems and services: Several approaches include Re-thinking consumption systems such as cradle-to cradle where waste equals food (McDonough & Braungart, 2002); changing ownership by developing garment lending programs for less frequently worn garments such as wedding gowns, suits (Allwood et al., 2007); lengthening the lifespan of garments by building multiple lives into designs, such as Connie Chen's "Five Lives" projects (Chen & Lewis, 2006). Furthermore, switching into smaller volume of products and production, adopting slow fashion to reduce fast fashion's wastefulness and negative impact on environment (Clark, 2008); or giving visibility and transparency to sustainable

products with logos and eco-labeling, as embraced by Made-By and Patagonia's Footprint Chronicles, could be useful approaches for developing more sustainable fashion systems (Fletcher, 2008).

8- Design activism: Some examples of this approach include participatory design (co-design); open-source design by using web, blogs, YouTube to interact, share ideas and collaborate (Fletcher, 2008); and Otto von Busch's projects (for example Italian Avlusu) to hack current fashion system and to empower people by involving them with their garments. The collective process of enablement, DIY practice, community-shared methods and experiences, and developing new forms of craftsmanship as examples of several ways to assign new roles to consumers and designers.

Fletcher and Tham (2003) suggest that, it is impossible to ignore fashion's presence, but a healthier and less destructive way should be found to engage with the products we acquire. Developing a long-lasting relationship with a fashion item through increasing a garment's emotional value by user engagement into the creation of the garment is one of the methods for defining a new way of promoting sustainability in fashion. In the industrial design area, Schifferstein and Zwartkruis-Pelgrim (2008) argue that lengthening product life is one of the ways to achieve sustainability. Stronger emotional bonds between a consumer and his/her product could decrease the consumer's tendency to dispose of it.

As Thorpe (2010) summarized: "Design strategies that help us meet needs with fewer purchased solutions could lead to more sustainable consumption. Although this approach is not guaranteed to eliminate the development of new products and services—to do away with "stuff"—it could reduce the quantity of stuff and go some way toward changing our lifestyles, potentially by making stuff easier to share,

produce locally, repair, or do yourself, which also could have social and psychological benefits" (p.16).

2.3. Sustainability in the Digital Age: Enabling Technologies and Sustainability in the Apparel Industry

Scaturro (2008) argues that between manufacture and post consumption; there is a synergy between technology, sustainability, and fashion. She divides the mediating effect of technology on sustainability in fashion into a material level and a digital level. On the material level, technology can be related to developing sustainable textile materials and to recycling. On the digital level, which is also connected to the creation of fashion, the Internet is offered as an example of a technology for playing an important role in sustainability in fashion though "the enabling of socially conscious consumption and information dispersion" (Scaturro, 2008, p.476). According to Scaturro (2008), technology is a major factor at the root of the negative patterns of fashion consumption. However, she states that when a right technology is strategically planned and developed, "thoughtful manufacturing processes and consumption patterns" can be created within a sustainable fashion system. Scaturro names this concept as eco-tech fashion (p. 475).

Technology's facilitating effect on consumer involvement through powerful communication tools and accurate product information was also discussed by Loker (2008). Loker (2008) developed a conceptual model known as the Technology-Enabled Sustainable Fashion System (Figure 2.1). Using this model, she categorized sustainability approaches for each stage from the creation of materials to disposal, recycling, and reuse. In the garment design and production stage of the model, current technologies such as product configurators and body scanning as enablers of made-to-

order or mass customization production systems are offered as examples of enabling technologies (Loker, 2008).

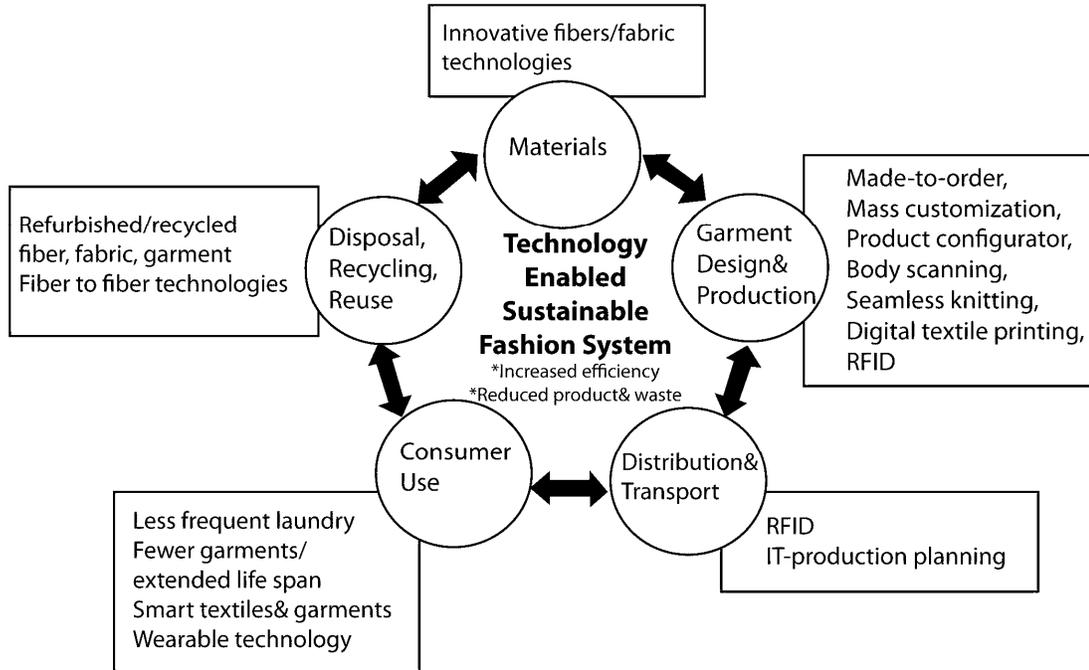


Figure 2.1 Technology Enabled Sustainable Fashion System (Loker, 2008)

Such systems can indirectly affect the consumer use stage by extending the lifespan of products. They do this in the way that they "balance production and consumption through increased durability, expansion of functional and emotional value" (Loker, 2008, p.100). Integrated technologies can be used to add meaning to the garments and their consumption through increased involvement by the consumer in their design.

Therefore, in this study, two empowering technologies, 3D body scanning and virtual try-on (as a version of a product configurator), were selected and combined with Scaturro's (2008) ideas on using Internet technology as an enabler of information dispersion. These three aspects of Loker's (2008) future Technology Enabled Sustainable Fashion System are discussed below in more detail.

2.3.1. 3D Body Scanning Applications in Apparel Design

Three-dimensional (3D) body scanners are one of the emerging technologies that can be widely used in the near future for both producing customized apparel products and assessing fit. Three-dimensional body scanners are used to create a "virtual clone" of the original model through non-contact capture of the body-surface data with the help of laser-based or white light-based scanning technologies (Ashdown, Loker, Schoenfelder, & Lyman-Clarke, 2004; Magnenat-Thalmann, 2010). Approximately 300,000 data points are captured in about 12 seconds, giving accurate and reliable measures of a human body (Ashdown & Loker, 2010). Software designed for use with the scanner turns the points into a realistic 3D virtual avatar representing the scanned person. Although currently this technology targets clothing designers, pattern makers, and technical designers, a wider range of users will eventually benefit from it.

Other than providing avatars to be used for virtual try-on applications, the set of measurements, which can be derived from the 3D body scan, can be transferred to CAD patternmaking software to create patterns that fit individuals (Ashdown & Loker, 2010). Kim and Damhorst (2010) state that 3D body scan data in an online shopping environment would be beneficial in helping customers to choose the best-fitting garments for themselves. From the retail point of view, Ashdown and Loker (2010) stated that the availability of virtual try-on using 3D-scan avatar technology on the Internet will increase interactions between the customer and the retail company, and that it will communicate the fit and preferred size of garments effectively. Loker (2008) stated that 3D body scan technology has the potential to provide better-fitting customized garments and thereby to decrease both the flow of product and waste in the system.

2.3.2. Virtual Try-on and Customization

Providing an opportunity for customers to virtually try-on garments during online shopping, virtual avatars may be one of the most important agents for augmenting the effects of this new commerce channel. By definition, an avatar is a graphical representation of a person and its name comes from Hindu mythology. An avatar created for virtual try-on can be used to provide consumers the knowledge of how garments would look on them before they buy these products, helping them make better purchase decisions.

Virtual try-on can be defined as a software tool for 3D visualization of garments that uses two-dimensional patterns (digitized or created in a CAD system) and virtually stitches them together to simulate the garment on a 3D body. It allows consumers to choose garments, apply fabric properties, and try the garments on their avatars. These avatars may be either artistically created parametrics, for which the overall appearance and body measurements can be adjusted by the user (Istook, 2008; Loker, Ashdown & Carnrite, 2008; Calhoun, Ashdown, & Lyman-Clarke, 2009), or the user's own exact digital body, acquired using a 3D body scanner. The avatar then can be imported into the virtual-try-on environment. Once the garment has been visualized in three dimensions, users can zoom in and out, and rotate their 3D models to get a better idea of the clothing fit.

Kim and Forsythe (2007) argue that virtual try-on can deliver exact product information and technologies such as virtual try-on have the potential to revolutionize online apparel shopping. Virtual try-on environments can present an effective telepresence. Klein (2003) describes telepresence as an individual's "sense of presence in a mediated environment" and finds that the intensity of attitudes towards advertised products increases based on the level of telepresence experienced in a computer-mediated environment. Studies on the relationship between telepresence and consumer

response (e.g., willingness to purchase) show that telepresence affected consumer response indirectly by facilitating product assessment (utilitarian value) and creating pleasurable consumer experiences (hedonic value) (Fiore, Jin, & Kim, 2005; Fiore, Kim, & Lee, 2005).

Wang, Lu, Chen, Geng and Deng (2011) stated that with the development of 3D body scan and computer graphics, 3D garment CAD for virtual try-on and mass personalization could become popular in the next five years. Accurate 3D body scans can provide the basis for a better virtual try-on application and a more effective telepresence.

Currently, there are several companies offering a commercial virtual try-on experience using parametric avatars, shape-shifting mannequins, or magic mirrors. Some major apparel software and 3D body scanning companies (OptiTex, [TC]² and Human Solutions) are currently working on finding ways to use 3D body scan avatars in online shopping environments. Other virtual fit companies that are developing CAD technologies driving virtual fit include Browzwear, Lectra, Gerber Technology, and Tukatech. Each of these companies has developed 3D visualization and/or design tools for the apparel industry. V-Stitcher (developed by Browzwear and sold by Gerber Technology as the Accumark V-Stitcher), 3D Runway Suite (OptiTex), e-fit Simulator (Tukatech), Modaris 3D Fit (Lectra), Vidya (Assyst/Bullmer, recently acquired by Human Solutions), and V Dresser by [TC]² are the current leading virtual try-on software systems in this arena.

Fits.me allows users try on garments before buying on the Internet. The platform, developed by a partnership between two Estonian research universities and Human Solutions, a German company which is one of the leading 3D body scanning systems. Shape-shifting mannequins with adjustable surfaces allow the user to virtually try on apparel to see the fit (Figure 2.2).

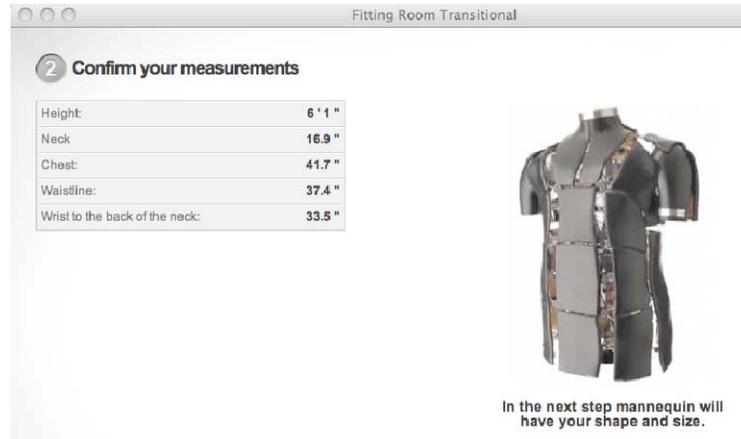


Figure 2.2. Screenshot from Fits.me

Magic mirrors are designed to allow people to see how they look in garments virtually. A large mirror installed in October 2010 at Macy's New York location allowed visitors to use a large mirror that was linked to a touch screen tablet computer, scroll through their options, and then digitally try on clothes in the mirror. A user of such technology can also get quick feedback from friends by posting their image to Facebook or sending it in an e-mail or text (Gross, 2010).

Companies such as OptiTex and [TC]² are developing generic avatars for virtual try-on. The OptiTex 2D to 3D CAD system is flexible enough to use avatars generated by different types of body scanners as well as to use generic avatars. While the OptiTex 2D to 3D CAD system can virtually drape the garments on a body, [TC]²'s software, VDresser, morphs front and back images of an existing garment on the avatar.

The i-Fashion system, which was developed in South Korea and tested at the Shinsegae Department Store in Seoul, South Korea, can allow users to virtually try on in-store clothing (Figure 2.3). Consumers can scan the RFID tag on the item and, using their smart card, which has their measurements, users can see their personalized avatars on a large screen (Trendhunter, 2007).



Figure 2.3. Demonstration of i-Fashion at Shinsegae Department Store (Trendhunter, 2007)

According to Loker, Ashdown, Cowie and Schoenfelder (2004), consumers are interested in the commercial applications of body scan data, such as virtual try-on and custom fit, because of the accurate fit information it can provide. Cho and Fiorito (2009) define customization as a beneficial tool for the customers. There have been growing numbers of studies on apparel customization in online shopping context (Fiore, Lee, & Kunz, 2003; Loker et al., 2004). In a study of 72 female university students conducted by Kamali and Loker (2002), a majority of participants involved in a mass customization process using web configurators to design T-shirts were found to be interested in this custom design process and willing to purchase the T-shirt they had designed. Within the context of apparel customization, several studies examined the usage of 3D body scanners as one of the enabling technologies to be used for custom fit. Some researchers investigated the willingness of users to use the technology (Fiore et al., 2003; Loker, Cowie, Ashdown, & Lewis, 2004). Other researchers were more interested in consumers' responses toward co-design, which they tested by developing CAD-supported scenarios (Ulrich, Anderson-Connell, & Wu, 2003).

For co-design by using simple product configurators, commercial web sites offer their users the ability to co-create their own clothing. Some companies provide product configurators for use in producing shirts (Blank Label and Proper Cloth), to allow young girls to configure their garments (Fashion Playtes), or to help consumers codesign design sportswear and sneakers (NikeID). Others, for example eShakti, do not provide product configurators to their customers, but users can still specify garment shapes and lengths, in varying body measurements, from among the company's existing garments. Levi's launched its CurveID program in 2010, which requires online customization to some degree to design the shapes, not the sizes (Levi's CurveID, 2011).

2.3.3. The Internet and Online Social Networking

Our society is becoming increasingly networked and the Internet plays an important role in shaping our social relations, norms, and regular activities, such as shopping. Online social networks can be useful for both increasing product knowledge and influencing purchase, or co-design decisions. In their in-depth case study analysis, Piller, Schubert, Koch, and Moslein (2005) found that online communities are influential when it comes to customizing a design. It can be argued that, such interaction might also increase engagement with a co-designed product.

Social interaction is essential for human beings. Increased online and mobile social interactivity serves as an enabling technology for communicating ideas and opinions. boyd and Ellison (2008) found that many social network sites (SNSs) exist to facilitate communication between people who are already members of the same social network, rather than to help people start new relationships. Thomas, Peters and Tolson (2007) argue that virtual communities provide a free public forum where users can connect with friends and share information. Social networking is a potentially

powerful medium for educating consumers and motivating personal change (Mankoff, Matthews, Fussell, & Johnson, 2007). Fiore (2008) describes that digital consumers look frequently to their peers rather than to traditional advertising sources for product information and advice. Recent research conducted by Treehouse Logic with 200 online shoppers showed that 86 percent of the customers would be hoping to get recommendations from the vendors or from experts and that 90 percent of them wanted to see customers' product ratings. Seventy-seven percent of the participants claimed that they wanted to see creations of the other participants (Treehouse Logic, 2010).

Interactive digital data and Internet technology are changing our engagement with dress (Loker et al., 2008). As indicated by Ashdown and Loker (2010), Internet tools can be used to augment communications around apparel and fit as recommendation devices or as conversation initiators in a social networking domain. Fashion-conscious individuals have also been increasingly using new digital fashion design platforms that offer other features besides online shopping and virtual try-on, such as Polyvore and other similar online services to create collages from existing fashion pieces, mix and match garments and accessories, share their taste with other members, and get feedback on their choices from their online peers. Fast fashion retailer Target launched a new style application, Merona My Look Maker, which is quite similar to what Polyvore is offering, via Facebook in June 2010 (Elliott, 2010). This application allows potential customers to mix and match the pieces in Target's own Merona brand and then share their looks with Facebook friends.

Online co-creation portals like Polyvore, and Merona My Look Maker, allow people to create collages and to communicate with their circle of friends or a community of like-minded people through social networking tools such as Facebook or Twitter. The increased usage of mobile applications has sped up this process of

sharing information. The online shopping experience is promising to become more interactive, creative, and social. Currently there are many fashion advice web sites, such as Fashism, Go try it on, and Honestly now, where users can upload photos of themselves in their latest outfits and allow others to rate your look and leave comments, including compliments and quick style tips. Users' communities can use smart phone applications and vote "like" or "hate", or they can vote on the Web site.

Blog examples also show some degree of sharing information with friends and getting opinions about products. Figure 2.4 shows two examples of bloggers discussing the fit and look of the garments they are considering whether to buy. In Figure 2.4 (a), Gigi (2010) discusses the fit of the garment from several views and asking her fellows to vote on the garments she is considering buying. Figure 2.4 (b) shows Bahannas (2010) who asks about the fit of the garment, which she was trying on in a fitting room (ellipses drawn by the blogger herself to draw attention to fit). Smart phones, which can take pictures and connect to the Internet, are staple devices for sharing information in such setting.

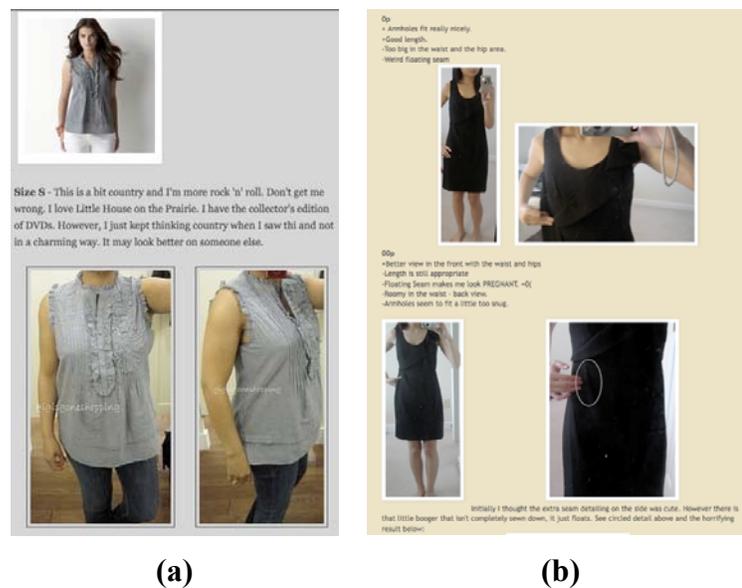


Figure 2.4. Two examples of Bloggers Discussing the Fit (a) Gigi (b) Bahannas

These are some examples of the trend of using social networking for discussions about the fit, or other features of a garment by looking at wearer's pictures. In this dissertation study users of the proposed integrated technologies of virtual try-on and product configurator could share their 3D images, instead of sharing actual pictures, and could therefore share the fit and suitability of proposed styles, and even design garments together.

2.4. Transition Towards Sustainable Apparel Consumption in a Digitally Networked Age: Video Intervention

Vezzoli and Manzini (2008) argue that a transition towards sustainability would require a learning process, which would enlighten people how to live better through consuming less. According to the authors, communicating issues around ecological problems is one of the fundamental necessities of such a transition. This would allow people to understand the consequences of their actions and to learn how to implement alternative solutions. Learning about something can be important in developing the motivation to make a change. Therefore, understanding environmental issues and how social and physical environments can support behavioral change may provide motivation for consuming differently (Allen et al., 2002).

The idea of sustainable consumption has been referred to as oxymoronic by definition (Chapman, 2005). It has been labeled as a new sociocultural paradigm as well (Didham & Choi, 2010). For this reason, increasing self-awareness and a sense of social responsibility in consumers, as well as motivating them to take an active role in sustainable consumption through education is critical (Didham & Choi, 2010).

Video is a powerful medium, which "stimulates, engages and entertains people, triggering them to think, feel and do things differently" (Addison, 2009, p.21). According to Addison (2009), the storytelling nature of video makes the process of

conveying messages easier while bringing learners together via the same "common frame of reference" (p. 21) Video-sharing services became especially popular after the foundation of YouTube™ in 2005 (Burke, Synyder, & Rager, 2009; Heldman, 2007). The younger population, known as Generation Y or the Net Generation, has been particularly active in adopting and using online technologies such as video sharing (Nielsen, 2010; Heldman, 2007). From this, it can be assumed that the importance of these mediums as methods of communication for the younger generation is increasing.

Video-based intervention studies used for training and educational research in various areas have demonstrated the effectiveness of video as a learning tool (Choi & Johnson, 2005; Collins, Higbee, & Salzber, 2009; Nikopoulou-Smyrni & Nikopoulos, 2010, Snelson & Elison-Bowers, 2009, Zossou, Van Mele, Vodouhe, & Wanvoeke, 2009). The report of the Sustainable Development Commission, "I Will If You Will" (2006), stressed that mass communications (advertising, marketing, and the media) powerfully shape a society's consumption patterns. In an early study, Iozzi (1989a, 1989b) reported that media (such as broadcasting messages and television) are powerful sources for positively affecting environmental attitudes and values.

Eagly and Kulesa (as cited in Poolay & O'Connor, 2000) stressed that knowledge of environmental issues alone does not encourage positive environmental attitudes. According to Iozzi (1989a, 1989b), the affective domain, not the cognitive domain, is the key to environmental education for developing an environmentally conscious behavior. Scaturro (2008) emphasized digital technologies (cameras, home computers, and the Internet) as tools for subverting the conventional fashion system. However, the use of video to persuade and educate has not been widely investigated in the area of sustainability in apparel design. The intervention video used in this study was designed to briefly inform participants about current environmental challenges in relation to clothing production and use with the help of a ten-minute video. It was

expected that introduction of these concepts might influence their personal beliefs and stimulate the intention to modify their patterns of consumption to some extent. For more information, please see Chapter 4.

2.5. Theoretical Framework

As suggested by Fink (2009) to conduct a reliable and valid study examining behavioral intentions, a model that is grounded in theory and that can guide the research is necessary. Among current behavioral theories in the social sciences, the Theory of Reasoned Action [TRA] (Fishbein & Ajzen, 1975) and the Theory of Planned Behavior [TPB] (Ajzen, 1985, 1991) received great support in wide variety of behavioral contexts (Eagly & Chaiken, 1993; Armitage & Conner, 2001). Broadly, both models propose that an individual's intention to perform a particular behavior is the most important determinant of the behavior. People's attitudes, their feelings about social pressure/approval, and perceived control best predict behavioral intentions.

The theory of reasoned action was developed by Martin Fishbein and Icek Ajzen in 1975 to examine volitional behaviors (Fishbein & Ajzen, 1975; Ajzen, & Fishbein, 1980). As Hale, Householder, and Greene (2002) explain, TRA looks at behavioral intentions rather than attitudes as the main predictors of behavior (p. 260). According to TRA, behavioral intentions can be expressed as the function of a limited group of constructs: A person's attitude and subjective norms about performing a particular behavior (Fishbein & Ajzen, 1975; Ajzen, & Fishbein, 1980). Fishbein and Ajzen (1975) describe attitude as an overall assessment (positive or negative) of what people feel towards performing a behavior. While it is possible to observe actions (behaviors), attitudes are to be inferred from what people say (East, 1990). Subjective norms are based on individuals' perceptions of whether important people in their lives would want them to perform the behavior or not (Ajzen, 1991).

In following years, Ajzen (1985) extended this theory by adding the third component, perceived behavioral control, as a determinant of both behavioral intention and behavior. Figure 2.5 illustrates how Ajzen positioned the perceived behavioral control in his model. Eagly and Chaiken (1993) define perceived behavioral control as "one's perception of how easy or difficult it is to perform the behavior" (p.185). It can be also described as one's perception of the availability of the skills, resources, and opportunities necessary for performing the behavior (Taylor & Todd, 1997) In sum, the TPB takes people's attitudes towards a behavior, corresponding subjective norms, and perceived control as significant predictors of their intentions to perform the behavior in question. Armitage and Christian (2003) indicate that the TPB is possibly the dominant model of attitude-behavior relations, as it extends its precursor and explains the substantial amount of the variance between intention and behavior.

As illustrated in the model, these determinants of intention can be measured directly or indirectly (Francis et al., 2004). Indirect measurement entails asking people about specific beliefs concerning the target behavior, as well as the evaluative component of their beliefs (how important they think their beliefs are), and then combines these answers by using formulas described in the theory. Direct measurement involves asking people to state their overall attitudes about the behavior. (Francis et al, 2004). Taylor and Todd (1997) analyzed direct measures without using the evaluative components associated with the belief structures. Following Taylor and Todd's arguments, in this dissertation the intent is to isolate determinants of consuming less as a result of technologies that facilitate the acquisition of customized garments.

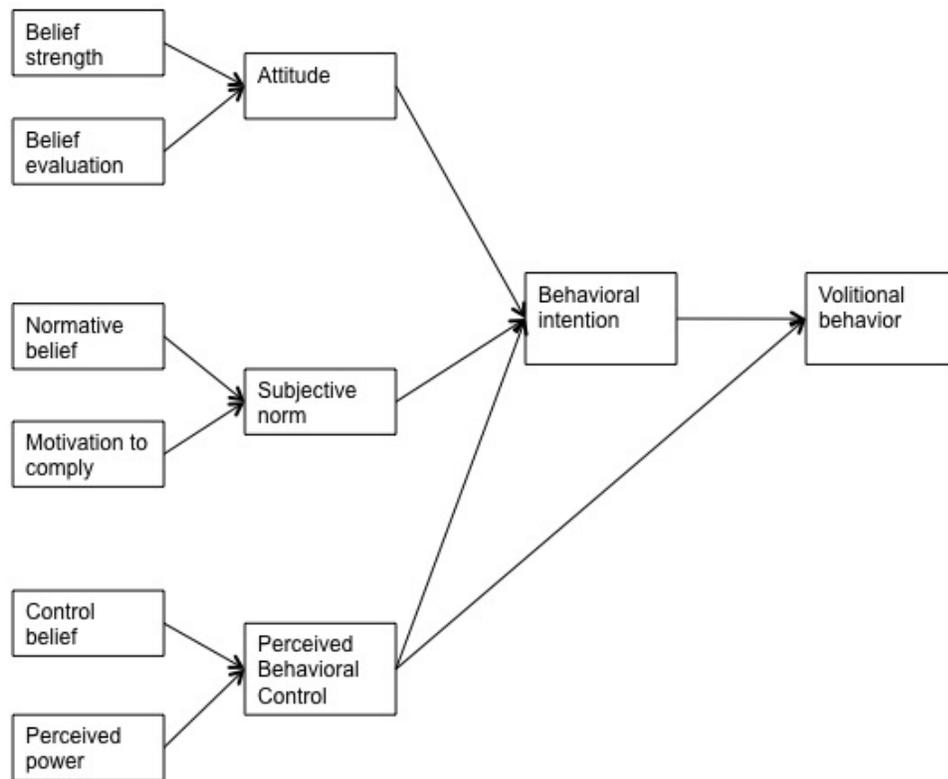


Figure 2.5. Causal Diagram of the Theory of Planned Behavior (Hale, Householder, & Greene, 2002)

Researchers have attempted to identify which attitudes, beliefs, and other factors are most associated with target behaviors in order to develop models that effectively predict such behaviors. The TPB is a very accommodating theory in this regard, as it allows inclusion of other external factors and examines the effects of a selection of factors. In this way, it may be possible to increase the model’s predictive capacity (Ajzen, 2002).

To date, a growing body of research has demonstrated that the TPB has been successfully used to explain or predict newly introduced behaviors (Armitage & Conner, 2001; De Canniere, De Pelsmacker, & Geuens, 2009), or to understand a range of environmentally responsible behaviors such as recycling (Taylor & Todd, 1997). Studies and meta-analyses have demonstrated broad and robust support for the

TPB (Armitage & Conner, 2001). The TPB is an effective model for identifying the predictors of these types of environmental behaviors. In this context, Ajzen's Theory of Planned Behavior was used as a framework for this study and it provided a useful theoretical background.

For this present study, some might argue that asking "what if" questions may not provide reliable data. Converse and Presser (1986, p. 23) reported that, although asking hypothetical questions, such as, "to imagine what if/ what you might do if...", challenge participants and make it difficult for them to feel totally embedded in hypothetical realities, such questions are valuable in the sense that they can be used to relate attitudes to realistic incidents. With the help of video intervention, this present study attempted to add more reality to the "what if" questions by showing some actual experience with the current 3D body scanning and virtual try-on technologies.

REFERENCES

- Addison, M. (2009, August). Enlivening learning with digital video. *Training Journal*. Retrieved from <http://www.trainingjournal.com/feature/2009-08-01-enlivening-learning-with-digital-video/>
- Ajzen I. (1985). From intentions to actions: A theory of planned behavior. In J. Kuhl & J. Beckmann (Eds.), *Action-control: From cognition to behavior* (pp. 11-39). Heidelberg, Germany: Springer-Verlag.
- Ajzen, I. (2002, September). *Constructing a TpB questionnaire: Conceptual and methodological considerations* (Revised January 2006). Retrieved September 6, 2010, from <http://people.umass.edu/aizen/pdf/tpb.measurement.pdf>
- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Making Processes*, 50(2), 179-211.
- Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Englewood Cliffs, NJ: Prentice-Hall.
- Allen, W., Kilvingston, & M., Horn, C. (2002, May). Using participatory and learning-based approaches for environmental management to help achieve constructive behavior change. Retrieved from http://www.landcareresearch.co.nz/research/sustainablesoc/social/par_rep.asp
- Allwood, J. M., Laursen, S. E., Malvido, C., & Bocken, N. M. P. (2007). *Well dressed? The present and future sustainability of clothing and textiles in the United Kingdom*. Retrieved from http://www.ifm.eng.cam.ac.uk/sustainability/projects/mass/UK_textiles.pdf
- Armitage, C. J., & Christian, J. (2003). From attitudes to behaviour: Basic and applied research on the theory of planned behaviour. *Current Psychology*, 22(3), 187-195.
- Armitage, C. J., & Conner M. (2001). Efficacy of the theory of planned behaviour: A meta-analytic review. *British Journal of Social Psychology*, 40(4), 471-499.
- Ashdown, S., & Loker, S. (2010). Mass-customized target market sizing: extending the sizing paradigm for improved apparel fit. *Fashion Practice The Journal of Design, Creative Process & the Fashion Industry*, 2(2), 147-174.
- Ashdown, S., Loker, S., Schoenfelder, K. A., & Lyman-Clarke, L. (2004). Using 3D scans for fit analysis. *Journal of Textiles and Apparel, Management and Technology*, 4(1). Retrieved from <http://www.tx.ncsu.edu/jtatm/>
- Bahannas. (2010, October 27). Blazers, dress LOFT review. Retrieved from <http://banhannas.blogspot.com/2010/10/blazers-dress-loft-review.html>

- Blank Label. (n.d.). Retrieved September 5, 2010, from <http://www.blanklabel.com/>
- boyd, D. M., & Ellison, N. B. (2008). Social network sites: Definition, history, and scholarship. *Journal Computer-Mediated Communication, 13*(1), 210-230.
- Browzwear. (n.d.). Retrieved September 5, 2010, from www.browzwear.com/
- Burke, S., Synyder, S., & Rager, R. C. (2009). An assessment of faculty usage of YouTube as a teaching resource. *The Internet Journal of Allied Health Sciences and Practice, 7*(1), 1-8.
- Calhoun, E., Ashdown, S. P., & Lyman-Clarke, L. (2009). Virtual fit of apparel on the internet: Current technology and future needs. In F. T. Piller & M. M. Tseng (Eds.), *Handbook of research in mass customization and personalization Volume 2: Applications and cases* (pp. 731-748). Hackensack, NJ, London and Singapore: World Scientific Press.
- Chapman, J. (2005). *Emotionally durable design: Objects, experiences and empathy*. London, UK: Earthscan.
- Chen, C., & Lewis, V. D. L. (2006). The life of a piece of cloth: Developing garments into a sustainable service system. *International Journal of Environmental, Cultural, Economic and Social Sustainability, 2*(1), 197-208.
- Cho, H., & Fiorito, S. S. (2009). Acceptance of online customization for apparel shopping. *International Journal of Retail & Distribution Management, 37*(5), 389-407.
- Choi, H.J., & Johnson, S. D. (2005). The effect of context-based video instruction on learning and motivation in online courses. *The American Journal of Distance Education, 19*(4), 215-227.
- Clark, H. (2008). SLOW + FASHION—an Oxymoron—or a Promise for the Future?. *Fashion Theory: the Journal of Dress, Body & Culture, 12*(4), 427-446.
- Collins, S., Higbee, T. S., & Salzber, C. L. (2009). Implementation of a problem-solving intervention with adults with developmental disabilities. *Journal of Applied Behavior Analysis, 42*(4), 849-854.
- Converse, J. M., & Presser, S. (1986). *Survey questions: Handcrafting the standardized*. Beverly Hills, CA: Sage Publications.
- De Canniere, M. H., De Pelsmacker, P., & Geuens, M. (2009). Relationship quality and the theory of planned behavior models of behavioral intentions and purchase behavior. *Journal of Business Research, 62*(1), 82-92.

- Didham, R. J., & Choi, M. Y. (2010). Education for sustainable consumption: Effective strategies to promote responsible consumer behaviour. Paper presented at the 9th Asia-Pacific Roundtable for Sustainable Consumption and Production (APRSCP), Colombo, Sri Lanka. Retrieved from http://enviroscope.iges.or.jp/modules/envirolib/upload/2870/attach/didham_and_choi-full_paper_aprscp.pdf
- Eagly, A. H., & Chaiken, S. (1993). *The Psychology of attitudes*, Fort Worth, TX: Harcourt Brace Jovanovich College Publishers.
- East, R. (1990). *Changing consumer behaviour*. London, England: Cassell.
- Elliott, S. (2010, June 25). Target wants you to friend their sweaters [Web log comment]. Retrieved from <http://mediadecoder.blogs.nytimes.com/2010/06/25/target-wants-you-to-friend-their-sweaters/>
- eShakti. (n.d.). Retrieved September 5, 2010, from <http://www.eshakti.com/>
- Fashion Playtes. (n.d.). Retrieved September 5, 2010, from <http://www.fashionplaytes.com/>
- Fashism. (n.d.). Retrieved September 5, 2010, from <http://fashism.com/>
- Fink, A. (2009). *How to conduct surveys* (4th ed.). Thousand Oaks, CA: Sage Publications.
- Fiore, A. M. (2008). The digital consumer valuable partner for product development and production. *Clothing and Textiles Research Journal*, 26(2), 177-190.
- Fiore, A. M., Jin, H., & Kim, J. (2005). For fun and profit: Hedonic value from image interactivity and responses towards an online store. *Psychology & Marketing*, 22(8), 669-694.
- Fiore, A. M., Kim, J., & Lee, H. (2005). Effects of image interactivity on approach responses towards an online retailer. *Journal of Interactive Marketing*, 19(3), 38-53.
- Fiore, A. M., Lee, S., & Kunz, G. (2003). Psychographic variables affecting willingness to use body-scanning. *Journal of Business and Management*, 9(3), 271-287.
- Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention and behavior: An introduction to theory and research*. Reading, MA: Addison-Wesley.
- Fits.me. (n.d.). Retrieved September 5, 2010, from <http://fits.me/>

- Fletcher, K. (2008). *Sustainable fashion and textiles: Design journeys*. London; Sterling, VA: Earthscan.
- Fletcher, K., & Tham, M. (2003). Clothing lives!. In Tim Cooper (Ed.), *Proceedings from an Academic Workshop of Product Life and the Throwaway Society* (pp. 49-56). Sheffield Hallam University, England. Retrieved from www.ntu.ac.uk/research/document_uploads/108814.pdf
- Francis, J. J., Eccles, M. P., Johnston, M., Walker, A., Grimshaw, J., Foy, R., Kaner, E. F. S., Smith, L., & Bonetti, D. (2004). *Constructing questionnaires based on the theory of planned behaviour: A manual for health services researchers*. Retrieved from <http://www.rebeqi.org/ViewFile.aspx?itemID=212>
- Gerber Technology. (n.d.). Retrieved September 5, 2010, from www.gerbertechnology.com/
- Gigi Gone Shopping. (2010, October 24.). Loft-dresses (irl pics). Retrieved from <http://www.gigisgoneshopping.com/2010/10/loft-dresses.html>
- Go try it on. (n.d.). Retrieved September 5, 2010, from <http://www.gotryiton.com/>
- Gross, D. (2010, October 14). Macy's 'magic mirror' lets shoppers don virtual clothes. Retrieved from http://articles.cnn.com/2010-10-14/tech/macys.virtual.mirror_1_macys-christopher-enright-magic-mirror?_s=PM:TECH
- Hale, J. L., Householder, B. J., & Greene, K. (2002). The theory of reasoned action. In J. P. Dillard & M. Pfau (Eds.), *The persuasion handbook: Developments in theory and practice* (pp. 259-286). Thousand Oaks, CA: Sage Publications.
- Hawley, J. (2008). Economic impact of textile and clothing recycling. In C. Ulasewicz & J. Hethorn (Eds.), *Sustainability fashion, why now?* (pp. 207-232). New York, NY: Fairchild Books.
- Heldman, C. (2007, January), YouTube nation. Retrieved from <http://www.apsanet.org/~lss/Newsletter/jan07/Heldman.pdf>
- Honestly Now. (n.d.). Retrieved September 5, 2010, from <http://honestlynow.com/>
- Human Solutions. (n.d.). Retrieved September 5, 2010, from http://www.human-solutions.com/apparel/technology_scanning_en.php
- Iozzi, L. A. (1989a). What research says to the educator. Part one: Environmental education and the affective domain. *Journal of Environmental Education*, 20(3), 3-9.

- Iozzi, L. A. (1989b). What research says to the educator. Part two: Environmental education and the affective domain. *Journal of Environmental Education*, 20(4), 6-13.
- Istook, C. L. (2008). Three-dimensional body scanning to improve fit. In C. Fairhurst (Ed.), *Advances in apparel production* (pp. 94-116). Cambridge, England: Woodhead Publishing.
- Kamali, N., & Loker, S. (2002). Mass customization: On-line consumer involvement in product design. *Journal of Computer-Mediated Communication*, 7(4). Retrieved from <http://www.ascusc.org/jcmc/vol7/issue4/loker.html>
- Kim, H., & Damhorst, M. L. (2010). The relationship of body-related self-discrepancy to body dissatisfaction, apparel involvement, concerns with fit and size of garments, and purchase intentions in online apparel shopping. *Clothing and Textiles Research Journal*, 28(4), 239-254.
- Kim, J., & Forsythe, S. (2007). Hedonic usage of product virtualization technologies in online apparel shopping. *International Journal of Retail & Distribution Management*, 35(6), 502-514.
- Klein, L.R. (2003). Creating virtual product experiences: The role of telepresence. *Journal of Interactive Marketing*, 17(1), 41-55.
- Lectra. (n.d.). Retrieved September 5, 2010, from www.lectra.com/
- Levi's CurveID. (2011, March 25). *Find your perfect fitting jeans with levi's® curve id*. Retrieved from <http://explore.levi.com/news/levis-curve-id/>
- Loker, S. (2008). A technology-enabled sustainable fashion system: Fashion's future. In C. Ulasewicz & J. Hethorn (Eds.), *Sustainability fashion, why now?* (pp. 95-126). New York, NY: Fairchild Books.
- Loker, S., Ashdown, S., & Carnrite, E. (2008). Dress in the third dimension: Online interactivity and its new horizons. *Clothing and Textiles Research Journal*, 26(2), 164-176.
- Loker, S., Ashdown, S., Cowie, L., & Schoenfelder, K. A. (2004). Consumer interest in commercial applications of body scan data. *Journal of Textiles and Apparel, Management and Technology*, 4(1), <http://www.tx.ncsu.edu/jtatm/>
- Loker, S., Cowie, L., Ashdown, S., & Lewis, V. D. (2004). Female consumers' reactions to body scanning. *Clothing and Textiles Research Journal*, 22(4), 151-160.
- Made-By. (n.d.), Retrieved June 5, 2011 from <http://www.made-by.org/content/made-bys-blue-button-and-swing-tag>

- Magnenat-Thalmann, N. (Ed.). (2010). *Modeling and simulating bodies and garments*. London, England: Springer-Verlag London Limited.
- Mankoff J., Matthews, D., Fussell, S. R., & Johnson, M. (2007). Leveraging social networks to motivate individuals to reduce their ecological footprints. *Proceeding of IEEE HICSS'07: 40th Annual Hawaii International Conference on System Sciences*. Hawaii, HA.
- McDonough, W., & Braungart, M. (2002). *Cradle to cradle: Remaking the way we make things*. New York: North Point Press.
- Nielsen. (2010, August). How people watch: A global Nielsen consumer report. Retrieved from <http://www.nielsen.com/content/dam/corporate/us/en/reports-downloads/Global%20Video%20Report%20How%20People%20Watch.pdf>
- NikeID. (n.d.). Retrieved September 5, 2010, from <http://nikeid.nike.com/nikeid/index.jsp>
- Nikopoulou-Smyrni, P., & Nikopoulos, C. (2010). Evaluating the impact of video-based versus traditional lectures on student learning. *Educational Research*, 1(8), 304-311.
- OEcotextiles. (2011, January 19). *Estimating the carbon footprint of a fabric*. Retrieved from <http://oecotextiles.wordpress.com/2011/01/19/estimating-the-carbon-footprint-of-a-fabric/>
- OptiTex. (n.d.). Retrieved September 5, 2010, from <http://www.optitex.com/>
- Patagonia. (n.d.). *Introducing the common threads initiative*. Retrieved June 12, 2011, from <http://www.patagonia.com/us/patagonia.go?assetid=1956>
- Patagonia. (n.d.). *The footprint chronicles*. Retrieved June 12, 2011, <http://www.patagonia.com/us/footprint/index.jsp>
- Peattie, K., & Collins, A. (2009). Guest editorial: perspectives on sustainable consumption. *International Journal of Consumer Studies*, 33(2), 107-112.
- Piller, F., Schubert, P., Koch, M., & Moslein, K. (2005). Overcoming mass-confusion: Collaborative customer co-design in online communities. *Journal Computer-Mediated Communication*, 10(4), 1-25.
- Pooley, J. A., & O'Connor, M. (2000). Environmental education and attitudes: Emotions and beliefs are what is needed. *Environment and Behavior*, 32(5), 711-723.
- Proper Cloth. (n.d.). Retrieved September 5, 2010, from <http://propercloth.com/>

- Rissanen, T. (2008). Creating fashion without the creation of fabric waste. In C. Ulasewicz & J. Hethorn (Eds.), *Sustainability fashion, why now?* (pp. 184-206). New York, NY: Fairchild Books.
- Scaturro, S. (2008). Eco-tech fashion: Rationalizing technology in sustainable fashion. *Fashion Theory: The Journal of Dress, Body & Culture*, 12(4), 469-488.
- Schifferstein, H. N. J., & Zwartkruis-Pelgrim, E. P. H. (2008). Consumer-product attachment: Measurement and design implications. *International Journal of Design*, 2(3), 1-13.
- Schor, J. B. (2005). Prices and quantities: Unsustainable consumption and the global economy, *Ecological Economics*, 55(3), 309-320.
- Secondary Materials and Recycled Textiles Association. (1997). *Council for textile recycling*. Retrieved from <http://www.smartasn.org/textilerecycle/index.htm>
- Snelson, C., & Elison-Bowers, P. (2009). Using YouTube videos to engage the affective domain in e-learning. In A. Mendez-Vilas, A. S. Martin, J. A. Mesa Gonzalez & J. Mesa Gonzalez (Eds.), *Research, reflections and innovations in integrating ICT in education* (Vol. 3, pp. 1481-1485). Badajoz, Spain: Formatex. Retrieved from <http://www.formatex.org/micte2009/book/1481-1485.pdf>
- Sustainable Development Commission. (2006, May). *I will if you will- Towards sustainable consumption*. Retrieved from <http://www.sd-commission.org.uk/publications.php?id=367>
- [TC]². (n.d.). Retrieved September 5, 2010, from <http://www.tc2.com/>
- Taylor, S., & Todd, P. (1997). Understanding the determinants of consumer composting behavior. *Journal of Applied Social Psychology*, 27(7), 602-628.
- Textiles Environmental Design. (n.d.). TED's ten sustainable textile design strategies. Retrieved May 12, 2011 from <http://www.tedresearch.net/>
- Thomas, J. B., Peters, C. O., & Tolson, H. (2007). An exploratory investigation of the virtual community MySpace.com: What are consumers saying about fashion?. *Journal of Fashion Marketing and Management*, 11(4), 587-603.
- Thorpe, A. (January 01, 2010). Design's Role in Sustainable Consumption. *Design Issues*, 26, 2, 3-16.
- Treehouse Logic. (2010, September 2). Customer co-creation includes community interaction [Web log comment]. Retrieved October 6, 2010 from <http://blog.treehouselogic.com/2010/09/02/customer-co-creation-includes-community-interaction/>

- Trendhunter. (2007) Get your avatar to try it on first. Retrieved September 5, 2010, from <http://www.trendhunter.com/trends/shinsegae>
- Tukatech. (n.d.). Retrieved September 5, 2010, from www.tukatech.com/
- U. N. Department of Economic and Social Affairs. Division for Sustainable Development. (2010). *Trends in sustainable development: Towards sustainable consumption and production*. Retrieved from http://www.un.org/esa/dsd/resources/res_pdfs/publications/trends/trends_sustainable_consumption_production/Trends_in_sustainable_consumption_and_production.pdf
- U.S. Environmental Protection Agency. (n.d.). *Textiles*. Retrieved from <http://www.epa.gov/wastes/conserves/materials/textiles.htm>
- Vezzoli, C., & Manzini, E. (2008). *Design for environmental sustainability*. London, UK: Springer.
- Von Busch, O. (Self-Passage) (n.d.). Italian Avlusu. Retrieved May 5, 2011 from <http://www.kulturservern.se/wronsov/italyanavlusu/italyanAvlusu.htm>
- Ulrich, P.V., Anderson-Connell, L.J., Wu, W. (2003). Consumer co-design of apparel for mass customization, *Journal of Fashion Marketing and Management*, 7(4), 398-412.
- Wang, J., Lu, G., Chen, L., Geng, Y., & Deng, W. (2011). Customer participating 3D garment design for mass personalization. *Textile Research Journal*, 81(2), 187-204.
- Weidenboerner, K. (2008). Correlation of affect, verbal commitment, knowledge, locus of control and attitude to environmentally responsible behavior in designers of the built environment: Is knowledge enough?. *Forum on Public Policy*. Retrieved from <http://forumonpublicpolicy.com/summer08papers/archivesummer08/Weidenboerner.pdf>
- Welters, L. (2008). The fashion of sustainability. In C. Ulasewicz & J. Hethorn (Eds.), *Sustainability fashion, why now?* (pp. 7-29). New York, NY: Fairchild Books.
- World Commission on Environment and Development. (1987). *Our common future*. Oxford; New York: Oxford University Press.
- World Health Organization. (2010). *Climate change and health* (Fact sheet No. 266). Retrieved from <http://www.who.int/mediacentre/factsheets/fs266/en/>
- World Wildlife Fund. (2010). *Living planet report 2010*. Retrieved from <http://assets.panda.org/downloads/lpr2010.pdf>

- 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, 1-2.
- Zaffalon, V. (2010). Climate change, carbon mitigation and textiles. *Textile World*. Retrieved from http://www.textileworld.com/Articles/2010/July/July_August_issue/Features/Climate_Change_Carbon_Mitigation_In_Textiles.html
- Zossou, E., Van Mele, P., Vodouhe, S. D., & Wanvoeke, J. (2009). The power of video to trigger innovation: Rice processing in central Benin. *International Journal of Agricultural Sustainability*, 7(2), 119-129.

CHAPTER 3
THE EFFECTS OF DIGITAL TECHNOLOGIES ON BEHAVIORAL
INTENTIONS OF APPAREL DESIGN STUDENTS TOWARD
CONSUMING LESS

3.1. Overview

This study was designed to explore factors associated with the use of digital technologies, specifically their potential as a change factor in motivating people to consume less apparel. A secondary aim is to determine whether people's intentions can be altered by environmental messages about consuming less. What can new technologies offer us that may modify our consumption habits? If people know more about the consequences of their behaviors, will they still behave in the same manner?

A well-established social psychological model, the Theory of Planned Behavior [TPB], (Ajzen, 1985, 1991), was used to explore these questions. For this research, the TPB model was extended to examine the impact of related external factors (attachment, uniqueness, and green consumerism) on decisions regarding keeping and wearing garments for multiple seasons, with the intention of reducing the impact of clothing on the environment. No existing studies have used TPB to understand the determinants of sustainable apparel consumption within a domain of technologies, which allow users to customize their own garments and get feedback from their peers before acquiring these particular garments. Also, the use of video as a tool to convey information about environmental issues around clothing use and technology is another unique contribution of this study.

In this study, the aim was to explore answers to some "what if?" questions. For example: *When integrated technologies of 3D garment visualization and custom production along with online interaction technologies become realities in the future,*

what will be their effect on people's behaviors toward sustainable consumption? This research project was intended to contribute to the literature with a discussion of the interactions between emerging digital apparel technologies and product acquisition and usage.

3.2. Sustainability

Chapman (2005) defines sustainability as a blanket term that strives to cover everything related to reducing "negative social and environmental impacts of contemporary life" (p. 173). Weidenboerner (2008) stated that technology, population increase, and consumption are the root causes of the deterioration of the natural environment. At an accelerating rate since 1970, the human population not only began consuming renewable resources faster than the ecosystem can regenerate them, but also began releasing more CO₂ into the atmosphere than the ecosystem can absorb, thus changing the climate (World Wildlife Fund [WWF], 2010). A current World Health Organization [WHO] report (2010) points out the fundamental effects of climate change on human health. According to the report, it is estimated that since the 1970s, approximately 140,000 people die every year because of global warming. Ozone depletion (UV exposure), desertification and land degradation (floods), freshwater decline, and loss of biodiversity and ecosystem function are cited as a few of the consequences of global warming affecting human health (WHO, 2010)

The textile industry is one of the biggest CO₂ emitters on Earth and it is the major industrial polluter of water in the world. In the production of fiber, textiles, and apparel a vast amount of fossil fuels are consumed (Zaffalon, 2010). Approximately 1 trillion kilowatt hours of electricity and up to 9 trillion liters of water are used every year to produce 60 billion kilograms of fabrics, causing the industry to account for approximately 10% of the total carbon impact (OEcotextiles, 2011). The

environmental consequences of humanity's textile consumption are enormous. People impact the environment at several phases of a garment's life from fiber production/cultivation to apparel production, usage, laundering, and discard (Allwood, Laursen, Malvido & Bocken, 2007). The industry contributes highly to climate change through energy use and waste generation during manufacture, and produces CO₂ emissions during transportation. Current mass-produced fashion systems, especially fast fashion which has shortened the time frame for making garments from three to four months to 12 days, frequently introduce new styles to the market, and have proved to be wasteful. This wastefulness is not necessarily inherent to fashion, but rather how we have decided to define it in the years following the Industrial Revolution.

Waste is one of the biggest problems of the current industrial ideology and the artificial needs it creates. Secondary Materials and Recycled Textiles Association [SMART] classified textile waste as either pre-consumer (by-product materials from the fiber, textile, and apparel industries) or post-consumer (garments or household articles that no longer needed and are therefore discarded). Post-consumer waste results when items are worn out, damaged, or have gone out of fashion (Secondary Materials and Recycled Textiles Association, 1997). DEFRA reported that currently around 35 kilograms of clothing and textiles per person are purchased and disposed of each year. Twenty-six kilograms of clothing per person are buried in landfills (Allwood et al., 2007). A current Environmental Protection Agency [EPA] report states that in 2009, 12.7 million tons of textiles (5.2% of total municipality solid waste or garbage) were generated in the United States (EPA, 2009). All the energy embedded in the garments therefore goes to landfills and is wasted. Although some unwanted items are donated to charities, charities sell a large proportion of these donations to the textile recycling firms. These textiles are either recycled into

industrial products and cleaning cloths, or sold to developing countries (Hawley, 2008), and perhaps ending up in landfills there if those countries do not have a good textile recycling systems.

In fashion design, the issue of sustainability is relatively new. From the viewpoint of sustainability, a high product turnover is in many cases undesirable because it produces waste and uses more resources. Reduce, reuse and recycle are three major strategies proposed to address these problems (Fletcher, 2008). In the context of sustainable textile and fashion design, approaches within these three major strategies can be broadly described as follows: reducing chemical impacts and minimizing waste in the manufacturing process, reducing energy use and water use in manufacture and care of garments, exploring clean/better technologies overall, committing to ethical and fair trade production, designing for recycling/ upcycling, replacing the need to consume, dematerializing and developing systems and services, design activism (Textiles Environmental Design [TED], n.d.). As Thorpe (2010) summarized: "Design strategies that help us meet needs with fewer purchased solutions could lead to more sustainable consumption. Although this approach is not guaranteed to eliminate the development of new products and services—to do away with "stuff"—it could reduce the quantity of stuff and go some way toward changing our lifestyles, potentially by making stuff easier to share, produce locally, repair, or do yourself, which also could have social and psychological benefits" (p.16).

Fletcher and Tham (2003) suggest that, it is impossible to ignore fashion's presence, but a healthier and less destructive way should be found to engage with it. Developing a long-lasting relationship with a fashion item through increasing a garment's emotional value by user engagement into the creation of the garment is one of the possible methods for finding a new way of promoting sustainability in fashion. In industrial design area, Schifferstein and Zwartkruis-Pelgrim (2008) argue that

lengthening product life is one of the ways to achieve sustainability. Stronger emotional bonds between a consumer and his/her product would decrease the consumer's tendency to dispose of it. As Loker (2008) argues, modifying consumer norms can be one way to reduce waste by increasing the awareness of consumers to buy less and use garments longer.

3.3. Enabling Technologies and Sustainability in the Apparel Industry

Scaturro (2008) argues that between manufacture and post-consumption, there is a synergy between technology, sustainability, and fashion. She divides the mediating effect of technology on sustainability in fashion into a material level and a digital level. On the material level, technology can be related to developing sustainable textile materials and to recycling. On the digital level, which is also connected to the creation of fashion, the Internet is offered as an example of a technology. She argues that the Internet can play an important role in sustainability in fashion through "the enabling of socially conscious consumption and information dispersion" (Scaturro, 2008, p. 476).

Technology's facilitating effect on consumer involvement through powerful communication tools and accurate product information was also discussed by Loker (2008). Loker (2008) developed a conceptual model known as the Technology Enabled Sustainable Fashion System (Figure 3.1). Using this model, she categorized sustainability approaches for each stage from the creation of materials to disposal, recycling, and reuse. In the garment-design and production stage of the model, current technologies such as product configurators and body scanning as enablers of made-to-order or mass-customization production systems are offered as examples of enabling technologies (Loker, 2008). Such systems can indirectly affect the consumer-use stage by extending the lifespan of products. They do this in the way that they "balance

production and consumption through increased durability, expansion of functional and emotional value" (Loker, 2008, p. 100). Integrated technologies can be used to add meaning to the garments and their consumption through increased involvement by the consumer in their design.

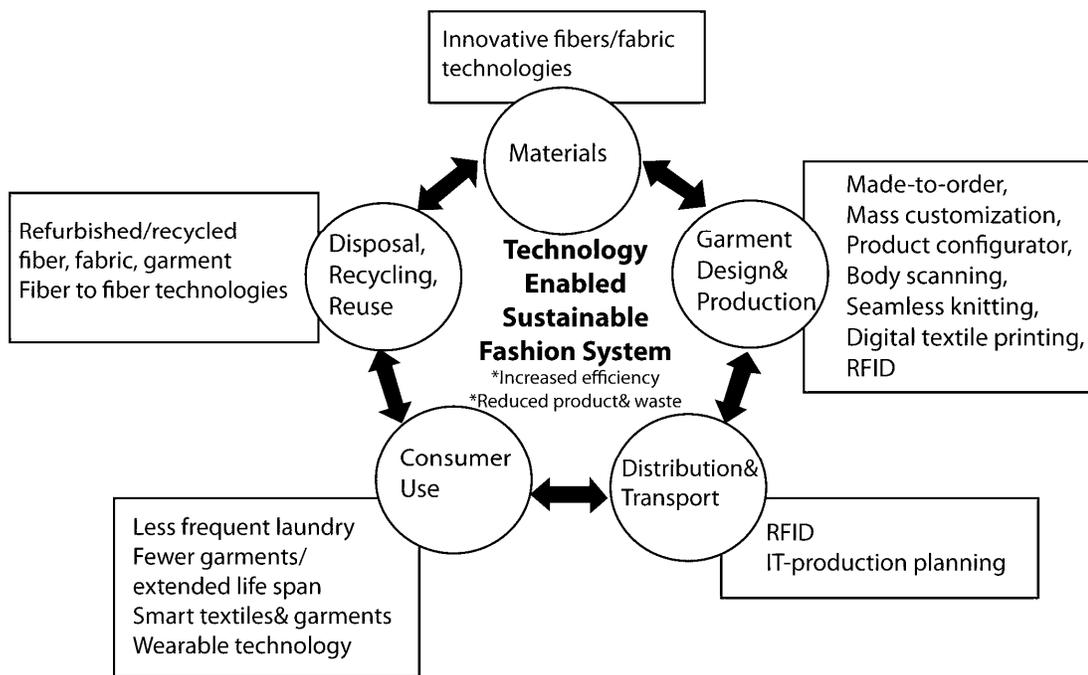


Figure 3.1. Technology Enabled Sustainable Fashion System (Loker, 2008).

Therefore, in this study, Loker’s (2008) examples of 3D body scanning and virtual try-on (as a version of a product configurator) were selected and combined with Scaturro’s (2008) ideas on using Internet technology as an enabler of information dispersion.

3.3.1. 3D Body Scanning Applications in Apparel Design

Three-dimensional (3D) body scanners are one of the emerging technologies that are predicted to be widely used in the near future for both producing customized apparel products and assessing fit. Three-dimensional body scanners operate by using

various light sources or radio frequencies to capture the shape of the body. Approximately 300,000 data points are captured in about 12 seconds, giving accurate and reliable measures of a human body (Ashdown & Loker, 2010). Software designed for use with the scanner turns the points into a realistic 3D virtual avatar representing the scanned person. Other than providing avatars to be used for virtual try-on applications, the set of measurements, which can be derived from the 3D body scan can be transferred to CAD patternmaking software to create patterns that fit individuals (Ashdown & Loker, 2010). Kim and Damhorst (2010) state that 3D body-scan data in an online shopping environment would be beneficial in helping customers to choose the best-fitting garments for themselves. According to Loker, Ashdown, Cowie, and Schoenfelder (2004), consumers are interested in the commercial applications of body-scan data, such as virtual try-on and custom fit, because of the accurate fit information it can provide. Loker (2008) explains that 3D body-scan technology has the potential to provide better-fitting garments by helping to customize them from an individual's body-scan data and thereby to decrease both the flow of product and waste in the system.

3.3.2. Virtual Try-On and Customization

Kim and Forsythe (2007) argue that virtual try-on can deliver exact product information and that technologies such as virtual try-on have the potential to revolutionize online apparel shopping. Virtual try-on environments can present an effective telepresence. Klein (2003) describes telepresence as an individual's "sense of presence in a mediated environment" and finds that the intensity of attitudes toward advertised products increases based on the level of telepresence experienced in a computer-mediated environment. Studies on the relationship between telepresence and consumer response (e.g., willingness to purchase) show that telepresence affected

consumer response indirectly by facilitating product assessment (utilitarian value) and creating pleasurable consumer experiences (hedonic value) (Fiore, Jin, & Kim, 2005; Fiore, Kim, & Lee, 2005).

Wang, Lu, Chen, Geng and Deng (2011) stated that with the development of 3D body-scan and computer graphics, 3D garment CAD for virtual try-on and mass personalization could become popular in the next five years. Accurate 3D body scans can provide the basis for a better virtual try-on application and a more effective telepresence.

Currently, there are several companies offering a commercial virtual try-on experience using parametric avatars, shape-shifting mannequins, or magic mirrors. Some major apparel software and 3D body scanning companies (OptiTex, [TC]² and Human Solutions) are currently working on finding ways to use 3D body scan avatars in online shopping environments. Other virtual fit companies that are developing CAD technologies driving virtual fit include Browzwear, Lectra, Gerber Technology, and Tukatech. Each of these companies has developed 3D visualization and/or design tools for the apparel industry. V-Stitcher (developed by Browzwear and sold by Gerber Technology as the Accumark V-Stitcher), 3D Runway Suite (OptiTex), e-fit Simulator (Tukatech), Modaris 3D Fit (Lectra), Vidya (Assyst/Bullmer, recently acquired by Human Solutions), and VDresser by [TC]² are the current leading virtual try-on software systems in this arena.

While these 2D to 3D CAD systems can virtually drape the garments on a parametric body or on a body-scan, [TC]²'s software, VDresser, morphs front and back images of an existing garment onto the avatar. The i-Fashion system, which was developed in South Korea and tested at the Shinsegae Department Store in Seoul, Korea, allows users to virtually try on in-store clothing. Users can scan the RFID tag

on the item and, using their smart card, which has their measurements, see their personalized avatars on a large screen (Trendhunter, 2007).

There are a growing numbers of studies on apparel customization in the context of online shopping (Fiore, Lee, & Kunz, 2003; Loker et al., 2004). In a study of 72 female university students conducted by Kamali and Loker (2002), a majority of participants, who were involved in a mass customization process using Web configurators to design T-shirts, were found to be interested in this custom design process and willing to purchase the T-shirt they had designed. Within the context of apparel customization, several studies examined the usage of 3D body scanners as one of the enabling technologies to be used for custom fit. Some researchers investigated the willingness of users to use the technology (Fiore et al., 2003; Loker, Cowie, Ashdown, & Lewis, 2004). Other researchers were more interested in consumers' responses toward co-design, which they tested by developing CAD-supported scenarios (Ulrich, Anderson-Connell, & Wu, 2003).

For co-design by using simple product configurators, commercial web sites offer their users the ability to co-create their own clothing. Some companies provide product configurators for use in producing shirts (Blank Label and Proper Cloth), to allow young girls to configure their garments (Fashion Playtes), or to help consumers codesign design sportswear and sneakers (NikeID). Others, for example eShakti, do not provide product configurators to their customers, but users can still specify garment shapes and lengths, in varying body measurements, from among the company's existing garments. Levi's launched its CurveID program in 2010, which requires online customization to some degree to design the shapes, not the sizes (Levi's CurveID, 2011).

3.3.3. The Internet and Online Social Networking

Social interaction is essential for human beings. Increased online and mobile social interactivity serves as an enabling technology for communicating ideas and opinions. Thomas, Peters and Tolson (2007) argue that virtual communities provide a free public forum where users can connect with friends and share information. Social networking is a potentially powerful medium for educating consumers and motivating personal change (Mankoff, Matthews, Fussell, & Johnson, 2007). Fiore (2008) describes that digital consumers looking frequently to their peers rather than to traditional advertising sources for product information and advice. Recent research conducted by Treehouse Logic with 200 online shoppers showed that 86 percent of the customers hoped to obtain recommendations from vendors or from experts and that 90 percent of them wanted to see customers' product ratings. Seventy-seven percent of the participants claimed that they wanted to see the creations of the other participants (Treehouse Logic, 2010). Scaturro (2008) mentioned the usage of the Internet in our daily lives as an actualized embodiment of technology. According to her, online networking platforms, as well as retail Web sites and blogs, enable people to involve themselves in a techno-fashion system (Scaturro, 2008). Online social networks can be useful for both increasing product knowledge and influencing purchase, or co-design decisions. In their in-depth case study analysis, Piller, Schubert, Koch, and Moslein (2005) found that online communities are influential when it comes to customizing a design. It can be argued that, such interaction might also increase engagement with a co-designed product.

Interactive digital data and Internet technology are changing our engagement with dress (Loker et al., 2008). As indicated by Ashdown and Loker (2010), Internet tools can be used to augment communications around apparel and fit as recommendation devices or as conversation initiators in a social networking domain.

Fashion-conscious individuals have also been increasingly using new digital fashion design platforms that offer other features besides online shopping and virtual try-on, such as Polyvore and other similar online services, to create collages from existing fashion pieces, mix and match garments and accessories, share their taste with other members, and obtain feedback on their choices from their online peers. Fast-fashion retailer Target launched a new style application, Merona My Look Maker, which is quite similar to what Polyvore is offering, via Facebook in June 2010. This application allows potential customers to mix and match the pieces in Target's own Merona brand and then share their looks with Facebook friends (Elliott, 2010).

Online co-creation portals such as Polyvore and Merona My Look Maker allow people to create collages and communicate with their circle of friends or a community of like-minded people through social networking tools such as Facebook or Twitter. The increased use of mobile applications has sped up this process of sharing information. The online shopping experience is promising to become more interactive, creative, and social. Currently there are many fashion advice web sites, such as Fashism, Go try it on, and Honestly now, where users can upload photos of themselves in their latest outfits and allow others to rate your look and leave comments, including compliments and quick style tips. Users' communities can either use smart phone applications and vote "like" or "hate" or they can vote on the Web site. Blog examples also show some degree of sharing information with friends and obtaining opinions about products. Bloggers discuss the fit and look of the garments they consider buying. Smart phones, which can take pictures and connect to the Internet, are staple devices for sharing information in such settings.

These are some examples to the trend for using social networking for discussing fit or style features of a garment by looking at wearer's pictures. In the current study a system is proposed with which users of virtual try-on and product

configurator could share their 3D images of clothing on a fit avatar, instead of sharing actual pictures, and could therefore share the fit and suitability of proposed styles, and even design garments together.

3.4. Theoretical Framework

As suggested by Fink (2009) to conduct a reliable and valid study examining behavioral intentions, a model that is grounded in theory and that can guide the research is necessary. The Theory of Planned Behavior, a theory of social psychology, was selected as a framework. The TPB proposes that an individual's intention to perform a particular behavior is the most important determinant of the behavior. People's attitudes, their feelings about social pressure/approval, and perceived control best predict behavioral intentions (Ajzen, 1991).

According to TPB, behavioral intentions can be expressed as the function of a limited group of constructs: attitudes, subjective norms and perceived behavioral control norms about performing a particular behavior (Fishbein & Ajzen, 1975; Ajzen, & Fishbein, 1980). Fishbein and Ajzen (1975) describe attitude as an overall assessment (positive or negative) of what people feel towards performing a behavior. While it is possible to observe actions (behaviors), attitudes are to be inferred from what people say (East, 1990). Subjective norms are based on individuals' perceptions of whether important people in their lives would want them to perform the behavior or not (Ajzen, 1991). Eagly and Chaiken (1993) define perceived behavioral control as "one's perception of how easy or difficult it is to perform the behavior" (p.185). It can be also described as one's perception of the availability of the skills, resources, and opportunities necessary for performing the behavior (Taylor & Todd, 1997) In sum, the TPB takes people's attitudes towards a behavior, corresponding subjective norms, and perceived control as significant predictors of their intentions to perform the

behavior in question. Armitage and Christian (2003) indicate that the TPB is possibly the dominant model of attitude-behavior relations, as it explains the substantial amount of the variance between intention and behavior. Figure 3.2 illustrates the causal diagram of the TPB.

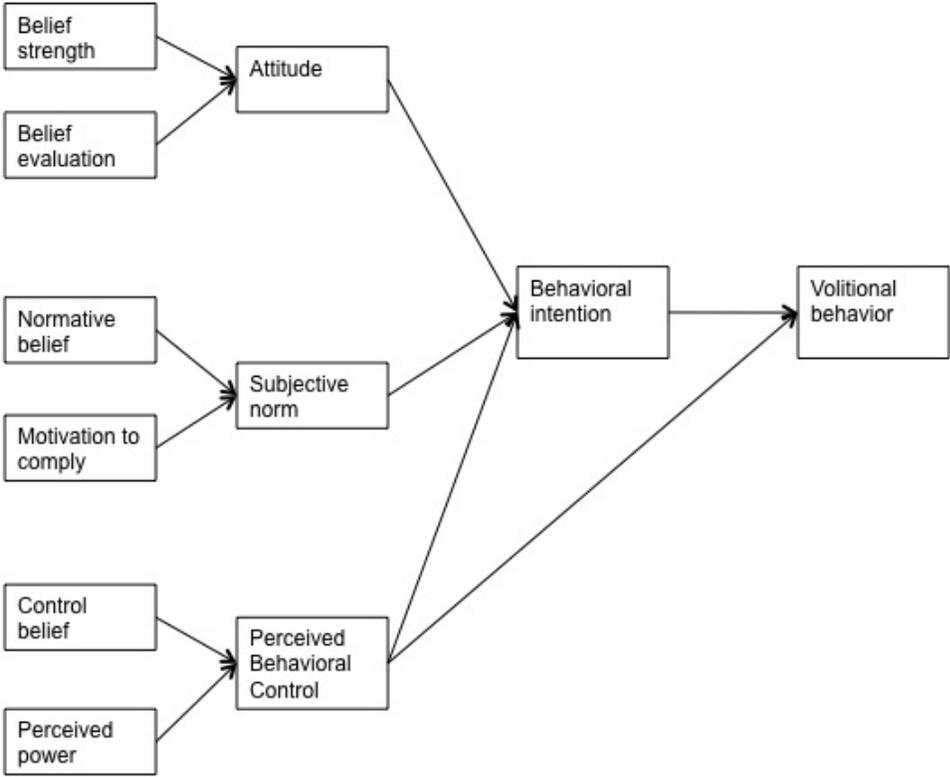


Figure 3.2. Causal Diagram of the Theory of Planned Behavior (Hale, Householder, & Greene, 2002)

Researchers have attempted to identify which attitudes, beliefs, and other factors are most associated with target behaviors in order to develop models that effectively predict such behaviors. The TPB is a very accommodating theory in this regard, as it allows inclusion of other external factors and examines the effects of a selection of factors. For this dissertation, the TPB model was extended beyond its main focus (the effects of attitudes, subjective norms and perceived behavioral

control) by including several factors (attachment, uniqueness, and green consumerism) to the model to examine all these factors' effects on keeping and wearing customized garments for multiple seasons, i.e., sustainable consumption.

3.5. Video Intervention

Video is a powerful medium, which "stimulates, engages and entertains people, triggers them to think, feel and do things differently" (Addison, 2009, p.21). According to Addison (2009), the storytelling nature of video makes the process of conveying messages easier while bringing learners together via the same "common frame of reference" (p.21). The ten-minute intervention video used in this study was designed to briefly inform participants about current environmental challenges in relation to clothing production and use. It was expected that introduction of these concepts might influence their personal beliefs and stimulate the intention to modify their patterns of consumption towards sustainability so that when they go to shopping; the participants might think about what they saw in the video to some extent and make smart purchases. For more information, please see the following Chapter 4.

3.6. Justification for the Present Study

Technologies are known to affect human behavior (Verbeek & Slob, 2006), but the actual outcomes of various technologies are more difficult to predict. Latour (2005) theorized that non-human entities (artifacts/technology/organizations) and humans form multiple associations through their interactions, transform in each mode of associations, and become outcomes of the networks they create. The answers sought throughout this study for questions such as, *"What would happen if digitally networked people were introduced to actual design tools for apparel? (i.e., their own virtual bodies as avatars and a try-on software application with tools that make it*

possible to actually design or modify garments). How would such tools affect people's interaction with their commodities? Would such digitally mediated environments encourage them to consume more, or would they turn them into more selective consumers?" examine potential effects of these technologies.

Although previous studies have examined the factors related to responsible apparel consumption and to consumers' reactions to technologies such as the 3D body scanner and virtual try-on applications, none have looked at the issue of the potential impact of these particular technologies on sustainable consumption of their end products. In this sense, the aim of this study is to initiate discussions around technology consumption, taking actions toward promoting sustainable consumption, and exploring ways to connect the two. This study operationalized the term "sustainable consumption" as the act of using a fashion object for many seasons. This term was chosen to imply the opposite of the overconsumption/ throwaway nature of unsustainable consumption.

This study is the first known study the apparel design area to use video as a tool to influence people's beliefs about sustainable consumption. Considering the need for more interventional research in this area, video was used to convey apparel-specific sustainability knowledge and to pose questions about technology.

In this relatively new topic of the effects of digital technologies on sustainable behaviors, the focus was to find some answers to "what if?" questions and to contribute to the literature by providing evidence of, rather than making futuristic assumptions about, the effect of technology on consumption behaviors.

3.7. Sample Selection

This study was aimed at understanding the use of enabling technologies in an environment in which seeing body–garment relationships is important. Considering

the use of design terminology as well as the concept of using enabling technologies for garment design and creation, participants with apparel design knowledge were recruited. Furthermore, as these enabling technologies are new, and the study was intended to discuss the findings for technology-savvy populations, recruiting was focused on a younger population (i.e., undergraduate and graduate students).

Participants for this study were drawn from the pool of the students enrolled in apparel design programs in North America. Apparel design students in particular were selected because of their education and basic apparel knowledge; they would provide more specific answers for the open-ended section. Moreover, at this initial step, design students were deemed the best participants for the study because of their desire to participate in the design and creation process, and because of their greater design and terminology knowledge, which would shorten the participant response time. Participants with design background were also thought capable of providing "to the point" answers, compared with general consumers.

In this pretest–posttest experimental study, all participants first completed an 8- to 10-minute pretest survey. In addition to providing demographic information, respondents rated statements about their knowledge of sustainability issues (seven statements, 5-point Likert scale), and their environmental concerns as consumers (seven statements, 7-point Likert scale). After responses were received for the pretest survey, the participants were divided into two groups: intervention and control. Participants were assigned to a group based on their responses to the green consumer assesment scale (GCA) to ensure that the more sustainability-conscious people were distributed evenly across both groups for the sake of controlling the study. Depending on their average scores from these particular scales, respondents were stratified into two groups: a Low Environmental Concern (LEC) group and a High Environmental Concern (HEC) group. Respondents were identified as showing LEC if the self-

reported GCA results were lower than the midpoint (3). If respondents' scale results fell between 2.5 and 3, and if they indicated having previously taken a class on sustainability, or showed garment-recycling behaviors (by not choosing a "throw away" option), they were considered to be in the HEC group. The similar number of environmentally conscious participants was in each group (Figure 3.3).

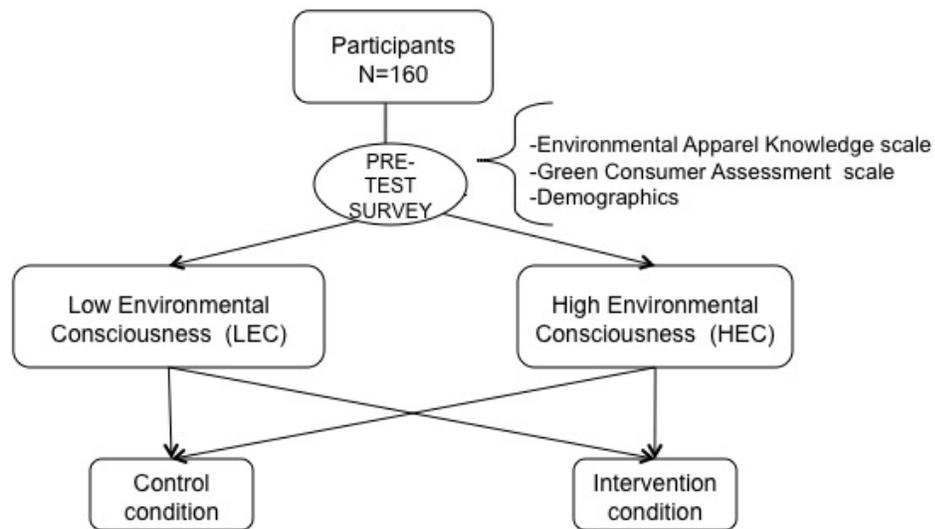


Figure 3.3. Distribution of the Study Participants to Control and Intervention groups

3.8. Hypotheses

Hypotheses were developed using variables from the TPB and the planned use of video intervention. The variables examined in the hypotheses are rooted in the existing literature and were applied to this new domain. The model of the extended TPB with the hypotheses is illustrated in Figure 3.4.

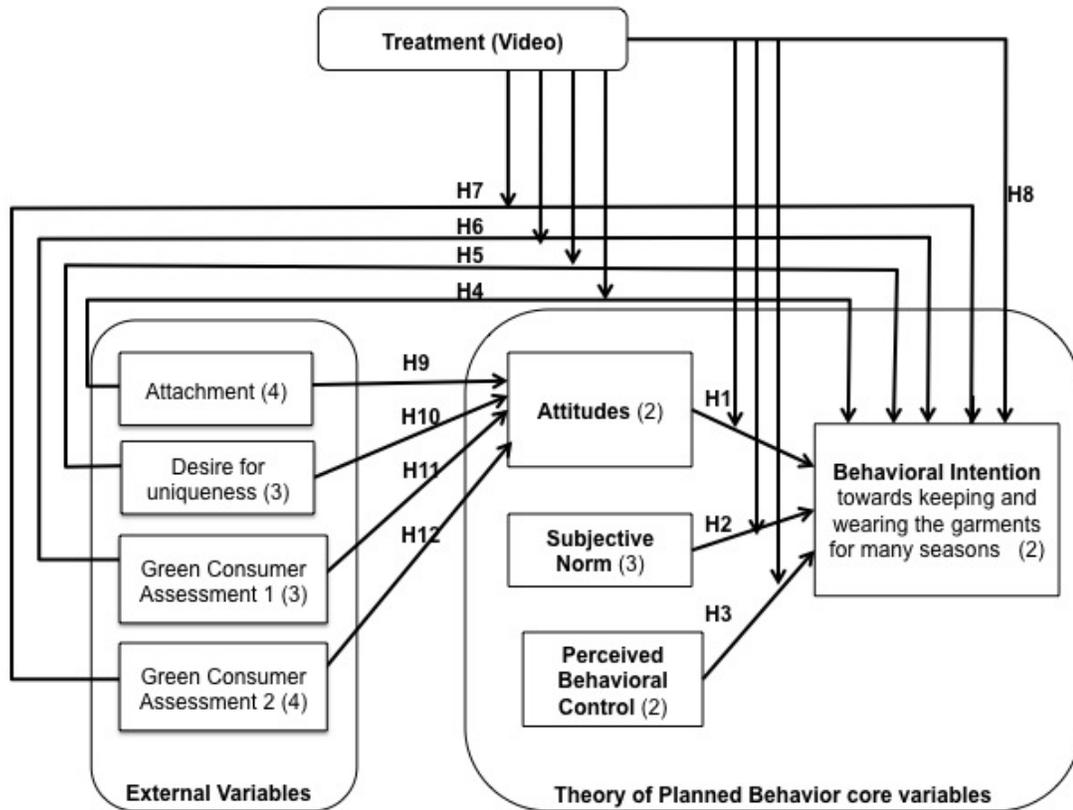


Figure 3.4. Extended Theory of Planned Behavior.

H1: Attitude toward keeping the garments for many seasons will positively predict a behavioral intention to keep the garments for many seasons and will be positively moderated by the treatment.

The Theory of Planned Behavior explains that positive attitudes toward performing a behavior result in an individual being more likely to perform that behavior (Ajzen, 1991). Therefore, people who reported positive attitudes toward a target behavior were expected to show positive behavioral intentions to use customized garments for many seasons.

By providing education in area-related knowledge (Hines, Hungerford, & Tomera, 1987), and messages about sustainability (Fogg, 2009), treatment was expected to have a positive effect on attitudes toward using garments for many seasons

H2: Subjective norm (SN) will positively predict behavioral intention to keep the garments for many seasons and will be positively moderated by the treatment.

Subjective norms are based on individuals' perceptions of whether important people in their lives would want them to perform the behavior or not (Ajzen, 1991). Reflecting on the discussions on the effect of peers on decision making (Mankoff et al., 2007; Fiore, 2009); it was hypothesized that people who reported positive subjective norms would show positive behavioral intentions toward using the garments for many seasons. This component relates well with Sproles's statement of how norms are adopted within social groups, where friendship and a mutuality of interests have a more powerful effect on the individual than do societal norms (Sproles, 1979).

H3: Perceived behavioral control (PBC) will positively predict behavioral intentions to keep the garments for many seasons and will be positively moderated by the treatment.

Arbunott (2009) noted that perceived control is important in influencing behaviors in two ways. First, when people believe that they cannot control a particular behavior, they will not attempt to do so, regardless of attitude. Second, they are less likely to make behavioral changes when they believe that their efforts will not make a

difference, especially when the changed behavior in question is effortful, costly, or inconvenient.

Participants' intentions to use the designed item for many seasons can be related to this variable, since a feeling of independence in using the technology to design garments would be associated with positive memories of the experience of using the technologies. PCB is also associated with participants' perceived content with fewer apparel items that are worn over many years and with their belief that their actions in designing, purchasing and wearing clothing can make a difference in using resources more sustainably.

Along these lines, it is hypothesized that people who report positive feelings of behavioral self-control will show positive behavioral intentions toward using the garments for many seasons.

By showing the capabilities of the integrated technologies and providing ideas about design/refashioning garments, the intervention will have a positive effect on viewers, so that users will want to use garments for many seasons in a sustainable way.

H4: Attachment will have a significant direct effect on behavioral intention to keep the garments for many seasons and will be positively moderated by the treatment.

From a broader point of view, Mugge, Schifferstein, & Schoormans (2004) argue that some products are cherished to their owners more than the other products, which shows a sign of product attachment. The authors describe product attachment as an emotional bond between the user and the product and argue that especially when users invest time and energy during customizing a product, they reflect themselves in the products they customize. As an outcome, the product functions as a mirror

reflecting its designer's identity back to the designer and to others, leading to an elevated bond between the owner and the product. In their 1981 study, Csikszentmihalyi and Rochberg-Halton found that products are valued because they communicate information about their owners.

For this reason, attachment was included in the model as one of the descriptors. It is hypothesized that people who reported positive attachment toward customized garments would show positive behavioral intentions toward using the garments for many seasons.

H5: Uniqueness will have a significant direct effect on behavioral intention to keep the garments for many seasons and will be positively moderated by the treatment.

According to Lynn and Harris (1997), consumers want "goods, services and experiences that few others possess" (pp. 602-603). The authors indicated that people "need for uniqueness" as they want to be different than the other individuals. Customization might increase feelings of uniqueness. In this regard, it is expected that people who reported positive attitudes toward uniqueness will show positive behavioral intentions toward using the garments for many seasons.

H6–H7: Perceived consumer effectiveness (GCA1) and behaviors toward green consumerism (GCA2) will have a significant direct effect on behavioral intention to keep the garments for many seasons and will be positively moderated by the treatment.

In a meta-analysis of previous studies, Hines et al. (1987) found a significant positive correlation between measures of environmental concern and environmentally

responsible behaviors. The relationship was stronger for specific contexts than for general protective actions. According to Schaefer and Crane (2005), "green consumption" focuses on the consumer's environmental concerns and defines less environmentally harmful consumption patterns and products. The authors define green consumers as those "motivated by strong environmental values and attitudes" (p.79), exhibiting behaviors toward green consumerism. Perceived consumer effectiveness is defined as a representation of "an evaluation of the self in the context of the issue. For instance, an individual may feel very concerned about an issue (pollution in space) and at the same time totally helpless in his or her ability to have an impact on the problem through his or her own consumption" (Berger & Corbin, 1992, p.80).

It is expected that people who report positive attitudes toward environmental concerns will show positive behavioral intentions toward using the garments for many seasons.

H8: Treatment will have a significant direct impact on behavioral intention.

As Arbunott (2009) and Hines et al. (1987) point out, knowledge about the consequences of environmental degradation, discussions around such problems, and information campaigns about the benefit of individual action can potentially influence the environmental-concern levels of individuals, and thus their behaviors. Behaviors also may be affected when communication directly modifies attitudes, as in the example of advertising (East, 1990). In this context, treatment is expected to have a significant positive effect on behavioral intentions toward using garments for many seasons.

3.8.1. Mediating Effect of Attitudes

H9: Attachment toward digitally designed and evaluated garments will be mediated by attitudes favoring keeping the garments for many seasons, and this mediation will be positively influenced by treatment.

H10: Uniqueness will be mediated by attitudes favoring keeping the garments for many seasons, and this mediation will be positively influenced by treatment.

H11: GCA1 will be mediated by attitudes favoring keeping the garments for many seasons, and this mediation will be positively influenced by treatment.

H12: GCA2 will be mediated by attitudes favoring keeping the garments for many seasons, and this mediation will be positively influenced by treatment.

Behavioral research also suggests that the effects of external variables on the target behavior are mediated through attitudes (Kim & Forsythe, 2007). There is limited evidence regarding the mediating role of TPB constructs in the belief constructs–intention relationship. Therefore, the findings of the current study are expected to contribute to TPB research by providing a rigorous test of the mediation. Beyond the theoretical implications of this issue, applying the findings may be helpful for survey studies designed to assess the determinants of intention.

Armitage and Christian (2003) reported that the second approach to understanding attitude/behavior relations is to examine whether variables mediate the attitude–behavior relationship. By "mediator", for this study Baron and Kenny's (1986, p.1173) definition was adapted: "[mediator] represents the generative

mechanism through which the focal independent variable is able to influence the dependent variable of interest". Desrichard, Roché, and Begue (2007) argued that, in addition to direct factors, the effects of external factors can follow an indirect path and be mediated through TBP core factors (Attitude, SN, and PBC) and thereby influence intention, which in turn influences behavior. Vogel, Wetser, Wei and Boysen (2005) examined the role of attitudes in mediating the relationship between eleven psychological factors.

3.9. Methodology

3.9.1. Instrument Development

Online questionnaires (pre-treatment and post-treatment) were developed using Checkbox 4.6 and used as the research instrument. Checkbox was provided free by Cornell Information Technologies to build online surveys. With this service, it is possible to create invitation-only surveys for increased security. Likert-scale questions were designed that use radio buttons, allowing respondents to choose only one option, and questions requiring users to select one or more options were designed that use checkboxes. For each question line, two different colors were used alternately to discourage respondents from skipping questions. Each page included "Next" and "Previous" tabs at the bottom, allowing respondents to move forward or backward. Questions were placed in the survey so as to minimize scrolling as much as possible. Including the consent form, the pre-treatment survey was eight pages long, and the post-treatment survey was fourteen pages long. Checkbox 4.6 made it easy to export the results for further analysis to Microsoft Excel, in the .csv format, or to SPSS, in the .sav format, which prevented any errors that might result from manual data entry.

The constructs were measured through 7-point and 5-Point Likert-type scales (1 = strongly disagree, 5 (or 7) = strongly agree). Twenty-one items were used to

measure seven latent constructs as independent variables measuring attitude, subjective norms, perceived behavioral control, attachment, uniqueness, green consumerism, and behavioral intention.

Constructs of this study, which were used to investigate the effects of proposed technologies, were mainly adapted from relevant prior studies in the initial stage of designing our questionnaire. Minor wording changes were performed to tailor the questions to the targeted context.

3.9.2. Variables in the Study

Conceptual definitions of each of the constructs examined in this study and sources for the definitions are given below and in Table 3.1. Since this study was intended to measure a phenomenon that thus far barely exists, and was therefore difficult to observe directly, possible boundaries and causes for the phenomenon were examined to determine the content of the scales. Relevant social science theories were examined since they were helpful for guidance.

Attitude: This has been characterized as a person's inclination to exhibit a certain response toward a concept or object. It was measured using a 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*) and by using global measures of attitude, which are explained in Ajzen and Fishbein (1980).

Subjective norm: The scale items from De Canniere, De Pelsmacker, & Geuens (2009) were applied. This construct was measured using a 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*).

Perceived behavioral control: The scale items from Shish and Fang (2004) were used. PBC was measured using a 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*).

Table 3.1. Definitions of the Variables Used in the Model and Sources of Latent Constructs

Variable	Definition	Original source
Attitude	<ol style="list-style-type: none"> 1) Keeping and wearing these customized garments for many seasons would a good idea 2) I would like to keep and wear these customized garments for many seasons 	Ajzen & Fishbein (1980)
Subjective Norm	<ol style="list-style-type: none"> 1) Most people who are important to me would think it would be a good idea to keep and use these garments for many seasons 2) My friends would keep and use these garments for many seasons 3) My friends would think that I should keep and use these garments for many seasons 	De Canniere, De Pelsmacker, & Geuens (2009)
Perceived Behavioral Control	<ol style="list-style-type: none"> 1) I am confident that I would be capable of keeping and using these garments for many seasons 2) I have the design knowledge to keep and wear these customized garments for many seasons 	Shish & Fang (2004)
Attachment	<ol style="list-style-type: none"> 1) I believe that I would feel emotionally connected to these customized garments 2) I believe that these garments would be very dear to me 3) These garments would have no special meaning for me 4) I believe that I would have a bond with these customized garments 	Schifferstein & Zwartkruis-Pelgrim (2008)
Uniqueness	<ol style="list-style-type: none"> 1) I would be more likely to keep and use these garments for many seasons because they would be hard to replace 2) I would enjoy keeping and using these garments for many seasons because they would be different and unusual 3) I would enjoy keeping and using these garments for many seasons because it is easier to have them custom-made rather than to buy them ready-made 	Lynn & Harris (1997)

Table 3.1. (Continued) Definitions of the Variables Used in the Model and Sources of Latent Constructs

Variable	Definition	Original source
Green consumer assessment	1) My local environment would really deteriorate before I would consider altering the way I consume 2) If I had more money, I would definitely buy more and more things 3) I buy fewer things than the average person my age 4) When I go shopping, I usually plan out what I am going to buy beforehand and I usually end up buying only what I planned 5) I do not feel I have enough knowledge to make well-informed decisions on environmental issues 6) I read and compare labels to look for environmentally safe ingredients/practices 7) I consider myself as an ‘environmentally conscious’ consumer	Dombek-Keith (2008)
Behavioral Intention	1) I would plan to keep and wear these customized garments for many seasons. 2) I would keep and use these customized garments for many seasons if the technology was available	Ajzen & Fishbein (1980)

Attachment: Participants were asked to indicate their agreement with four attachment statements on 5-point Likert scales ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). The scale items were adapted from Schifferstein and Zwartkruis-Pelgrim (2008).

Uniqueness: Participants were asked to indicate their agreements with three uniqueness statements on a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*) derived from Lynn and Harris (1997). The statements were changed so that in addition to self-uniqueness, the scale reflected the unique properties of the products as well.

Green consumer assessment (GCA): The scale was adopted from Dombek-Keith’s (2008) Green Consumer Assessment Scale (GCAS). The seven-item, 5-point Likert-type scale for this construct mainly measured participants’ evaluation of

themselves in the context of sustainability, and their behaviors and attitudes towards excessive and impulsive consumption intentions (1 = *strongly disagree*, 3 = *neither agree nor disagree*, 5 = *strongly agree*).

Behavioral intention: Ajzen and Fishbein's (1980) 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*) was used to measure behavioral intention toward keeping and wearing the customized garments designed by using the integrated technologies of 3D body scanning, virtual fit, and an online collaboration environment.

3.9.3. *Pretesting and Pilot Testing*

First, the questionnaires were pretested among Fiber Science and Apparel Design (N=6) and Design and Environmental Analysis (N=2) graduate students at Cornell University. They were asked to comment on the relevance of the items, wording, accessibility of the survey, ease of survey use, length of the survey, and time taken to complete it. Based on feedback from this pretest, some questions were modified, some terms were explained in more detail, and additional visual information on the integrated technologies (3D body scanner, virtual fit, online social networking) was presented. In addition, some items were dropped, and the design of the survey, typefaces, and colors were improved. The survey was divided into subsections, which allowed the respondents to answer the questions with a minimum of scrolling. Additionally, three professors in the apparel design area reviewed the chosen scale items for wording and redundancy problems and provided their feedback. Changes were made according to their feedback.

As a pilot test to measure the clarity of the modified surveys, they were tested with a group of apparel design students (N=21) who had graduated one semester before this study. Generally, good comments on the items and the duration of the

survey were received. However, some items still appeared to be redundant, so they were dropped for the final questionnaire. Cronbach's alpha values were calculated for each scale as a measure of reliability and internal consistency. As a global rule, a Cronbach's alpha value of more than .70 indicates a reliable measure.

There was only one item, Item 3, in the Perceived Behavioral Control scale that did not provide high reliability and thus reduced the scale's internal consistency. This was retained during the data collection and dropped after the main data collection was completed because factor analysis results acquired from participants who took the actual questionnaire (N=160) than the participants in the pilot test (N=21) would be more reliable. The results of the pilot study helped to determine whether the instrument would work well under different operating systems (Microsoft Windows and Mac OS). The pilot-test results also indicated the duration of the pre- and post-treatment survey sections (8–12 minutes and 20–30 minutes, including the treatment, respectively).

3.9.4. Survey Administration

Following the pilot test and necessary corrections, a professor in another university's apparel design department was contacted and asked whether she would distribute the recruitment message to her students. At first, a raffle was given as an incentive, but only one student responded to the message. Therefore, the incentive was changed to a \$10 online gift card from Amazon.com for every participant. This greatly improved the response rate.

After obtaining an exemption from the Institutional Review Board (IRB) (Appendix A), professors in apparel design programs across North America were contacted to and request help in recruiting their students to this study. The video link was sent to the professors as an e-mail attachment, and their assistance in advertising

the study to their students was solicited. Some of the universities required a second IRB application from their own institutions, so before any data collection could occur; separate IRB approvals were acquired from these institutions. Official recruiting started on April 24, 2010, and lasted until September 30, 2010. Each participant received a \$10 online gift card from Amazon.com. Some participants received extra credit for participating in this study, which was given as an option by their professors. The participants generally contacted me directly through e-mail. For some of the smaller participant populations, e-mail addresses were collected from the students' professors.

After the e-mail addresses were acquired, an automated email was sent, including a copy of a consent form with information on the study and a contact number, with the link to the pre-test at the end of the message.

Intervention-group members viewed the ten-minute video, which was uploaded to a video-sharing website (www.vimeo.com) and protected by a password. Then, participants completed a 10- to 15-minute posttest survey that contained knowledge and green consumer assessment scales. Control-group members were immediately directed to the posttest survey, but they were given an opportunity to view the video at the end of the study. The same scales that were used in the pretest were administered at the end of the posttest survey (Appendix D).

3.9.5. Survey Structure

The final survey consisted of two parts: pretest and posttest. Data collected during the pretest were used to assign participants to two groups in a homogenous manner based on their environmental knowledge and concern levels (high or low)

In the pretest survey, respondents were required to read a consent form, which briefly described the research and consent to participate in the study, before they

began (Appendix C). Then they were asked to provide demographic data to indicate their age, gender, ethnicity, grade, particular classes they had taken (sustainability, pattern making, classes including usage of new technologies), garment-purchase frequency, Internet purchase frequency, garment-discard behaviors, and technology and social networking use. The pretest survey included scales, which measured the environmental orientations of the participants (Green Consumer Assessment Scale), as well as their knowledge of apparel industry–related environmental issues (General Knowledge Scale). Responses to these scales were used to determine the effect of treatment on participants’ environmental knowledge and behavior and were examined in another study in more detail (see Chapter 4). As soon as a response was received, scale items were summed and averages were calculated; then the respondents were assigned to one of the posttest survey groups within 24 hours in a stratified manner. This decision was made based on reducing the time frame that participants can be exposed to other external effects, which might affect their responses.

The posttest survey (Appendix D) included five sections:

In Section One, intervention group participants, who would watch the video intervention, were directed to a Web site via an html link where they could watch the short treatment video on sustainability and technology’s possible effect on garment design and consumption. The video was ten-minute long, and was uploaded to a video-sharing website (www.vimeo.com) and protected by a password. The focus of the video was on how technology can engage users of the technology in apparel design and how environmental responsibility can be a part of apparel design. It was designed to encourage study participants to generate ideas on this issue, as well as to encourage them to think about their own garment use by narrating the experiences of a fictional character, Maggie Wu, who was an apparel design undergraduate. This was the character that the viewers could relate to as she underwent a metamorphosis after

realizing the environmental effects of excess apparel consumption. The video clip went on to present issues surrounding environmental responsibility in the apparel industry, an expert's views on living in a sustainable community environment, advances in digital apparel design that could lead to change, and other suggestions for change. The video was intended to tell a story, not to give a lecture. Video was selected as the intervention delivery vehicle because of its visual qualities.

In addition to general environmental information about the apparel industry, the video introduced participants to demonstrations of a 3D body scanner and 3D virtual-fit technology using 3D body-scan avatars, and were also shown an online social networking example of sharing design ideas and obtaining feedback (My Virtual Model). This approach ensured that all respondents had a basic knowledge about the technologies so as to be able to understand the questions about them. The research questions were posed at the very end of the video, which allowed intervention-group participants to reflect on the information that was provided in the video.

Section Two included a written introduction and brief definitions of all three technological enablers, with visuals. The participants were directed to think of all three enablers as an integrated system that would allow them to design garments for themselves and obtain feedback from their peers. They were asked to answer each question based on this hypothetical system.

Section Three included scales to measure the hypothesized relationships of the expanded theory of planned behavior model including 1) Attitudes; 2) Subjective Norms; 3) Perceived Behavioral Control; 4) Attachment; 5) Uniqueness; and 6) Green consumerism (GCA1 and GCA2).

Section Four addressed one topic, a prediction of how long participants expected to use these garments; this topic was divided into four time frame categories.

There were also five open-ended questions at the end of this section on the usability of the integrated technologies and garments, respectively. These open-ended questions were as follows:

- 1- Would you be willing to wear "these customized garments" compared to the way you wear other garments that you purchase?
- 2- After having received information about the new technological possibilities, how do you think that these "Integrated Technologies" might affect your choices about the number of the garments you buy and the way you consume them?
- 3- How might using these "Integrated Technologies" change the meaning that your clothing has for you?
- 4- How would using these "Integrated Technologies" help you to design clothing more easily and successfully for yourself?
- 5- Do you have any other comments about these integrated technologies, for example regarding their use in designing clothing in the future or your use of these technologies, or ways in which the technologies might change the number of clothing items you buy or the frequency and length of time that you wear them?

Section Five included the same green-consumerism and environmental-knowledge scales, as those used in the pretest. This section also posed two open-ended questions to the intervention group participants regarding the treatment video (see Chapter 4). Finally, the video was shown to control group participants. This was to give professors an opportunity to discuss topics in video with all study participants in their classes.

3.10. Data Analysis

The data were analyzed using SPSS 19.0. In the first step, descriptive statistics (frequency, percentage, mean, standard deviation, visual tests for normality using histograms) were computed to obtain an overall picture of the data. Scales' reliability and validities were calculated by Cronbach's alpha and factor analyses before using variables in further analyses. Then, a variety of data analyses were used to examine relationships between the independent and dependent variables. For example, a one-way ANOVA was used to compare the means across both groups for each of the extended TPB variables. General Linear Model [GLM] univariate analysis was employed for the multiple regression analyses.

Scales contained both negative and positive items to avoid agreement bias. For the evaluation, negative items were reverse-scored. Higher scaled means showed positive attitude toward the behavior.

Respondents who had not answered a particular question were excluded from the analyses involving that question. For instance, if a respondent did not answer a question regarding demographics, his/her responses were left out of the analysis of demographic data, but his/her responses to scales were used for the analysis.

3.11. Results

A total of 327 invitations were initially sent out to students. One hundred and eighty students responded to the pretest (response rate: 55.05%), and 160 of these respondents completed the second part of the survey. Therefore, the overall completion rate among the participants who were willing to take the survey was 88.9%. A maximum of two reminders were sent in the three weeks after the first invitation e-mail. Reminders resulted in 14 more participants completing the second survey. At the end of the data collection, there were 78 people in the control group and

82 people in the intervention group. Data analyses showed that both of the groups were also nearly identical to each other in terms of the participants' educational background, interests, environmental concerns, and garment-purchase and disposal behaviors.

Toward the end of the survey, many of the control-group participants did not complete the Section Five questions. Only 46 (58.9 %) of the control group completed this section while all of the intervention group participants completed the survey.

3.11.1. Respondent Profile

Among the respondents, there were 150 (93.8%) females and 10 (6.2%) males. The participants were sophomore (29.4%), junior (28.7%), and senior (39.4%) apparel design students ranging in age from 18 to 26 with a mean age of 20.81 and a standard deviation of 1.83 (Table 3.2) Caucasians made up the majority of the study population (74.7%), followed by Asian (15.2%) and African American (5.7%) participants.

Results indicated that 51.2% of the respondents had taken a sustainability-related class. Of the participants 21.3% (mostly Cornell participants who had used the technology in a class) indicated that they knew how to use patternmaking software with a virtual-fit function (2D/3D), whereas only 16.9% of the participants reported that they had used a 3D body-scanning system during their classes.

Table 3.2. Frequency Distribution for Respondents' Demographics

		Frequency	Percentage (%)
Gender	Female	150	93.8
	Male	10	6.2
Age	18	4	2.5
	19	29	18.1
	20	51	31.9
	21	30	18.8
	22	31	19.4
	23 and older	15	9.3
Ethnicity	Caucasian	118	74.7
	Asian	24	15.2
	African American	9	5.7
	Hispanic or Latino	2	1.3
	Other	5	3.1
Grade	Sophomore	47	29.4
	Junior	46	28.7
	Senior	63	39.4
	Masters	2	1.3
	Ph.D	2	1.2
University	University of Missouri	38	23.8
	Cornell University	31	19.4
	Iowa State University	25	15.6
	Drexel University	18	11.3
	Colorado State University	14	8.8
	Ryerson University	13	8.1
	Fashion Institute of Technology	7	4.4
	Framingham University	5	3.1
	University of Minnesota	3	1.9
	SUNY Oneonta	2	1.3
	University of Delaware	2	1.3
	University of Hawaii	1	0.6
	Oklahoma State University	1	0.6

Note: N=160

In order to understand how frequently the respondents were using the increasing number of available technology channels, the frequency data regarding technology use were examined (Table 3.3). The majority of the respondents were technologically proficient. All of the participants were Internet users; 96.1% of the control group and 95.2% of the intervention group used YouTube™ and over fifty percent of the total group owned PDAs (50.6%). The majority of participants

responding to the survey (77.6% of the control group, 82.1% of the intervention group) reported that they used gaming systems (e.g., Nintendo's Wii), and almost all of the participants (99.4%) were social network (e.g., Facebook) users. Only a very few (6.9%) reported using virtual worlds (e.g., Second Life)

Table 3.3. Technology Usage

	Frequency	Percentage (%)
Personal computer	160	100
MP3 Player/iPod	158	98.8
Cell phone	159	99.4
PDA/Blackberry	81	50.6
Gaming System (Playstation, Wii)	128	80
Social Networks (Facebook, MySpace)	159	99.4
Virtual worlds (Second Life)	11	6.9
YouTube™	153	95.6

Note: N=160

3.11.2. Purchasing and Discard Behaviors

The questions about participants' garment purchase frequencies, had six choices including several times a week, once a week, two to three times a month, once a month, once every three months, and less than once every three months. When intervention and control groups were analyzed individually, it was apparent that both groups purchased frequently, many purchasing garments two to three times a month (intervention = 42.9%, control = 37.3%). For both of the groups, the next most popular option was "once a month" (intervention = 27.3%, control = 24.1%). The least popular option was "less than once every three months" (intervention = 3.9 %, control = 0%) (Table 3.4)

Table 3.4. Purchase Frequency

	Frequency	Percentage (%)
Several times a week	4	2.5
Once a week	21	13.1
2-3 times a month	64	40.0
Once a month	41	25.6
Once in every 3 months	27	16.9
Less than once every 3 months	3	1.9

Note: N=160

Around sixty seven percent (66.9%) (N=107) of the respondents shopped using the Internet. When both groups were examined regarding the frequency of their Internet purchasing of clothing, the most participants reported that they shop once every three months (intervention = 27.5%, control = 30.7%). This frequency was followed by "once every six months (intervention = 23.3%, control = 17.3%). The frequency of purchasing more than once a month was the lowest option for both groups (intervention = 4.3%, control = 3.5%). (See Table 3.5)

Table 3.5. Internet Purchasing

	Frequency	Percentage (%)
More than once a month	5	3.1
Once a month	27	16.9
Once in every 3 months	42	26.3
Once in every 6 months	29	18.1
Once a year	11	6.9
Less than once a year	12	7.5
Never	18	11.3

Note: N=144

As for shopping preferences, the respondents reported that they mostly shop from specialty stores (82.5%), department stores (74.4%), and the Internet (66.9%). Only 27.5% of the respondents reported using thrift stores for their garment purchases.

When the behaviors regarding discarding clothing were examined, 78.8% of the respondents reported that they donate their garments to thrift stores (intervention = 85.7%, control = 72.3%) (Table 3.6). Passing clothing on to friends and relatives was also a frequent choice, as indicated by the high percentage of 71.9% (intervention = 71.4%, control = 72.3%). Storing the garments in a closet was the third most frequent behavior at 58.8% (intervention = 63%, control = 54.2%). The percentage of respondents reporting throwing the garments away was lower, 22.5% (intervention = 19.5%, control = 25.3%). Refashioning was not a high concern for either of the groups (intervention = 41.6%, control = 37.3%). Only 20.6% of the participants were interested in selling the garments to a thrift store.

Table 3.6. Garment-Discard Behaviors

	No. of respondents	Percentage (%)
Throw away	36	22.5
Donate to a thrift store	126	78.8
Pass on to friends/relatives	115	71.9
Refashion	63	39.4
Sell to a vintage store	33	20.6
Store in a closet	94	58.8

3.11.3. Preliminary Data Analysis for Multiple Regression

Each of the variables illustrated in the research model (Figure 3.4) was measured with scales derived from prior literature and modified to fit in the context of this study to predict the sustainable usage of customized garments in the digital era. Those variables used to measure attachment and uniqueness were measured on a 5-point Likert scale, anchored by 1 (*strongly disagree*) and 5 (*strongly agree*). The

scales used to capture attitudes, subjective norms, perceived behavioral control, and behavioral intention were measured on a 7-point Likert scale, anchored by 1 (*strongly disagree*) and 7 (*strongly agree*).

Because some of the measurement scales were adapted from the original scales with modified wording, all of the variables underwent factor analyses prior to the multiple regression analyses.

3.11.4. Reliability (Chronbach's Alpha) and Internal Consistency (Factor Analysis) of the Scales

In order to measure the internal consistency of the research variables of the extended theory of planned behavior model, a principal component factor analysis and Varimax rotation was conducted on seven measurement scales. The responses of both groups were integrated to analyze their consistency (N~160). The scales' reliabilities were measured by calculating Cronbach's alpha values. All scales were presented in the second questionnaire (after the treatment); the green consumer assessment scale was also presented in the first questionnaire, in order to assign groups and analyze the effect of the treatment alone (see Chapter 4). For the multiple regression analysis, results of the green consumer assessment scale collected in the second questionnaire were used.

The green consumerism scale loaded in two components after the rotation. Since the original scale was composed of items measuring both behaviors and perceived consumer effectiveness, this partitioning was not surprising. As explained by Berger and Corbin (1992), perceived consumer effectiveness is a measure of an individual's total evaluation of the self (e.g., whether s/he thinks her or his consumption patterns have an impact on an environmental problem or not). The researchers claimed that it could function as a direct predictor of behavior. Emerging

factors reflected behaviors toward green consumerism (GCA2) and perceptions toward consumer effectiveness (GCA1), respectively. For the model, these two factors were included separately instead of using one scale.

Reliability of the scales was analyzed by computing Cronbach's alpha scores. The scores were above .65 for almost all of the scales. One of the PCB items was dropped from the scale to improve its reliability (given in brackets in Table 3.7).

The detailed results for the variables are explained below and are summarized in Table 3.7.

Attitude: Factor analysis revealed one factor without undergoing any rotation. Factor loadings were .97 for each factor and explained 93.89% of the total variance. This factor had a Cronbach's alpha of .94.

Subjective norm: A single factor was extracted, explaining the total variance of 85.66%. Cronbach's alpha was calculated as .92.

Perceived behavioral control (PBC): This scale originally consisted of three items. Although one factor was revealed, the third item (which was not included in the previous table of variables), "I would not fully control the fact that I can keep and wear these customized garments for many seasons," had a low consistency with the factor, and thus reduced the reliability of the scale. This problem was detected during the pilot testing as well, but our sample size was small and did not give sufficient information to make a decision about inclusion of this item. The decision was made to keep it and to remove it, if necessary, prior to analysis. Based on the findings, this item was removed from further analysis, which increased the variable's reliability from .53 to an acceptable level, Cronbach's alpha = .75.

Behavioral intention: One factor was found to explain 90.47% of the variance, with a Cronbach's alpha of .89.

Attachment: One factor was found to explain 72.26% of the variance, with a Cronbach's alpha of .86.

Uniqueness: One factor was found to explain 74.73% of the variance, with a Cronbach's alpha of .83.

Green consumer assessment (GCA): Factor analysis revealed two factors indicating behavioral beliefs. Eigen values were greater than 1 for each of the factors. Individually, they explained 62.73% (*GCA1*, Perceived consumer effectiveness) and 52.14% (*GCA2*, Behaviors toward green consumerism) of the total explained variance; Cronbach's alpha for the whole scale was calculated as .73. Both factors individually yielded alpha values higher than .60, (*GCA1*=.64, *GCA2*=.68). These factors are acceptable (De Vellis, 2003) and are a reliable measure of two aspects of green consumerism.

Factor scores were obtained from the factor analysis and used in multiple regressions. As the variables in the model were Varimax rotated during the factor analysis and when their factor scores were calculated, they were already uncorrelated by definition. But as factor analyses were run separately for each scale, the data were double-checked for multicollinearity by running linear regression analyses and no multicollinearity was found within the data.

Table 3.7. Factor Analyses of Variables after Varimax Rotation and Cronbach's Alpha Values

Factor Items	Factor Loading 1	Factor Loading 2	Eigen Value	% of Total Variance	Cronbach's Alpha (α)
Attitude 1	.97		1.88	93.9%	.94
Attitude 1	.97				
Subjective norm 1	.92		2.56	85.7%	.92
Subjective norm 2	.93				
Subjective norm 3	.93				
PBC1	.89 (.90)*		1.67	55.6%	.53 (.75)*
PBC2	.86 (.90)*		(1.61)*	(80.3%)*	
[PBC3 –removed]	.38				
Behavioral intention 1	.95		1.81	90.5%	.89
Behavioral intention 2	.95				
Attachment 1	.92		2.89	72.3%	.86
Attachment 2	.94				
Attachment 3	.59				
Attachment 4	.90				
Uniqueness 1	.83		2.24	74.7%	.83
Uniqueness 2	.90				
Uniqueness 3	.85				
Perceived consumer effectiveness (GCA1) 1	.61		52.14	27.6%	.64
Perceived consumer effectiveness (GCA1) 6	.81		(Factor Loading 1)	(Factor Loading 1)	
Perceived consumer effectiveness (GCA1) 7	.76				
Behaviors toward green consumerism (GCA2) 2		.60			.68
Behaviors toward green consumerism (GCA2) 3		.73			
Behaviors toward green consumerism (GCA2) 4		.72	62.73	28.6%	
Behaviors toward green consumerism (GCA2) 5		.67	(Factor Loading 2)	(Factor Loading 2)	

*Note: Parentheses indicate the final values after removal of the inconsistent items.

Note: PBC = perceived behavioral control. GCA1= Green consumer assessment- Perceived consumer effectiveness, GCA2= Green consumer assessment- Behaviors toward green consumerism)

The linearity between dependent and independent variables was assessed by looking at the scatter plots. The plots indicated that all variables met the assumption of linearity. Normality was checked in the same manner, by visual inspection. Plots of

standardized and studentized residuals were examined for all deviations from the norm.

Bivariate correlations for measured variables showed that all variables except the green consumerism assessment variables intercorrelated, showing that these measures partially overlap. However, significant Pearson correlation values were lower than .8 ($r < .8$), indicating that the variables can be used to determine their unique contributions to the model (Field, 2009, p. 648).

3.11.5. Mean Comparisons

Mean comparisons were calculated to describe the data and compare responses of the control and intervention groups with one-way ANOVAs in SPSS 19.0.

Mean scores for each variable in the extended model (*attitude*, *subjective norm*, *perceived behavioral control*, *behavioral intention*, *attachment*, *uniqueness*, and *GCA1* and *GCA2*) indicated very high ratings for the TPB variables, from 5.09 to 5.62 on a 7-point scale. The ratings on the external variables were much higher for *attachment* and *uniqueness* (3.47–4.04), moderate for *GCA1* (2.75–3.35), and slightly below the neutral point (=3) for *GCA2* (2.69–2.95). It was apparent that core TPB variables' means were higher than the neutral point (=4) for all conditions. In the case of external variables, means were barely above the neutral point (=3) for *attachment* and *uniqueness*, while for *GCA1* and *GCA2* means were generally below the neutral point (=3), except for *GCA1* after the intervention ($M=3.35$, $SD=.93$). High behavioral intention means for both control and intervention groups ($M > 5$, $SD \geq 1.11$) indicated that participants would like to keep and wear custom-designed garments for a longer time than they would keep and wear garments purchased through traditional channels.

Table 3.8. Mean Comparisons of Independent and Dependent Variables

Variables ^b		N ^a	Mean (M)	Std. Dev. (SD)	Std. Error (SE)	F
Attitude	Control	78	5.62	1.07	.12	.139
	Intervention	81	5.55	1.22	.13	
	Total	159	5.58	1.145	.09	
Subjective norm	Control	77	5.30	1.14	.13	1.09
	Intervention	81	5.09	1.32	.15	
	Total	158	5.19	1.24	.09	
Perceived Behavioral Control	Control	78	5.38	1.09	.12	.08
	Intervention	82	5.33	1.23	.14	
	Total	160	5.36	1.16	.09	
Behavioral intention	Control	78	5.42	1.11	.13	.040
	Intervention	82	5.38	1.16	.13	
	Total	160	5.39	1.13	.09	
Attachment	Control	77	3.47	.99	.11	4.56*
	Intervention	81	3.78	.83	.09	
	Total	158	3.63	.92	.07	
Uniqueness	Control	77	3.89	.89	.10	1.21
	Intervention	81	4.04	.67	.07	
	Total	158	3.97	.78	.06	
Perceived consumer effectiveness (GCA 1)	Control	46	2.75	.67	.10	14.77**
	Intervention	82	3.35	.93	.10	
	Total	128	3.14	.89	.08	
Behaviors toward green consumerism (GCA 2)	Control	46	2.69	.80	.12	2.73
	Intervention	82	2.95	.81	.09	
	Total	128	2.86	.82	.07	

^a Ns vary due to missing cases.

^b The core variables of the TPB model were measured on a 7-point Likert scale (1 = *strongly disagree*, 4 = *neither disagree or agree*, 7 = *strongly agree*), whereas the other four items (*attachment*, *uniqueness*, and *GCA1* and *GCA2*) were measured on a 5-point Likert scale (1 = *strongly disagree*, 3 = *neither disagree or agree*, 5 = *strongly agree*).

Note: GCA1 = Perceived consumer effectiveness, GCA2 = behaviors toward green consumerism).

**Results are significant at the .001 level (p<.001)

*Results are significant at the .05 level (p<.05)

One-way ANOVA results showed that although the means of the intervention and control groups were different from each other, these differences were not significant for most of the variables. The exceptions were *attachment* and *green consumerism*, which measured perceived consumer effectiveness (*GCA1*). For *attachment*, the mean increased from M=3.47 (SD=.99) to M=3.78 (SD=.83),

significant at the .05 level. For *GCA1*, the mean increased from $M=2.75$ ($SD=.67$) to $M=3.35$ ($SD=.92$), significant at the .001 level.

Mean differences (that is, the treatment's effect) between the intervention and control groups were significantly different for *attachment*, $F(1, 158) = 4.56$, $p < .05$, and *GCA1*, $F(1, 128) = 14.77$, $p < .05$. None of the core model variables were significantly different. Other remaining external variables also did not yield a significant difference between the two groups.

3.11.6. Multiple Regressions

Hierarchical multiple regressions were run by using general linear model (GLM) univariate analysis to detect the most significant variables and evaluate the relationships among the variables to test hypotheses. Variables were entered into the model all together, and nonsignificant variables were removed from the model one by one, until a significant result was achieved from the model. By doing this, factors that had significant effects on the dependent variable (BI) and that best predict behavioral intention were analyzed.

For all of the GLM analyses, the references for the treatment were defined as (0=intervention, 1=control).

3.11.6.1. *Extended Theory of Planned Behavior Model (Hierarchical Multiple Regression Analysis by General Linear Model to Measure Main and Moderated Effects of Core and External TPB Variables)*

Attachment, *Uniqueness*, *GCA1*, and *GCA2* were added to the TPB model to examine their effects in the context of apparel usage. These variables were examined for their effects within the extended TPB model along with the core model variables (*attitude*, *subjective norms*, and *perceived behavioral control*). To measure the direct

effects of the core model variables, external variables, and whether the treatment had a direct or moderating effect on behavioral intention, GLM univariate analysis was used to run hierarchical multiple regressions. GLM allowed the comparison of the results of multiple regression analyses and to determine whether treatment has an effect on the results. In the first step, all the variables were entered to see their main effects as well as to examine the interaction terms. The variables were *treatment*, *attachment*, *uniqueness*, *GCA1*, *GCA2*, *attitude*, *SN*, *PBC*, and *treatment* × each of these categories. The final model and its predictors are displayed in Table 3.9.

Consistent with intention-based models and remarks by Hale, Householder, and Greene (2002) regarding the predictive strength of the model, core model variables were found to be significantly associated with the intention to keep and wear customized garments for many seasons. As indicated by significance and ordered by *B* values, the final model revealed that there were five significant predictors of main effects and one significant predictor of the moderating effect of the treatment. All of the latent variables positively affected the behavioral intention. The final model explained 73.4% of the variance between subjects.

Hypothesis 1

Attitude was one of the significant predictors of intention ($B = .29$, *partial* $\eta^2 = .13$) among the other determinants and had a direct (positive) relationship to *behavioral intention*, $F(1,122) = 17.36$, $p < .001$. A partial eta-squared value of 0.131 indicates that 13.1% of the variance between subjects in behavioral intention was accounted for by attitudes. Moderating effects of treatment were nonsignificant, so Hypothesis 1 was partially accepted.

Table 3.9. Summary of Hierarchical Multiple Regressions (Final Model)

Variables	B	SE _B	F	Sig.	Partial Eta Squared
Intercept	-6.637E-5				
Attitude	.29	.07	17.36	.00**	.13
Subjective norm	.24	.07	11.07	.001*	.09
PBC	.15	.08	13.14	.00*	.10
Uniqueness	.25	.07	13.13	.00**	.10
Behaviors toward green consumerism (GCA 2)	.11	.05	5.07	.03*	.04
Treatment x PBC	.24	.11	4.94	.03**	.04

Note: Dependent variable = *BI* (behavioral intention); *PBC* = Perceived behavioral control; *GCA2* = behaviors toward green consumerism.

Note: N=122

Note: $R^2=.75$, Adjusted $R^2=.73$

**Results are significant at the .001 level ($p<.001$)

*Results are significant at the .05 level ($p<.05$)

Hypothesis 2

Subjective norm was another significant predictor of *behavioral intention*, $F(1,122) = 11.07$, $p < .001$, $B = .24$, *partial* $\eta^2 = .09$. As treatment did not have a moderating effect on *subjective norm*, Hypothesis 2 was partially supported.

Hypothesis 3

Another significant effect was the interaction terms of *treatment* and *perceived behavioral control*. Treatment significantly moderated *perceived behavioral control* in the model, indicating that treatment had a moderating effect on *behavioral intention*, $F(1,122) = 4.94$, $B = .24$, $p < .05$. The effect of the treatment moderation on *PBC* was fairly low (4.1%). Besides being moderated by treatment, *PBC* also had a significant positive effect on *behavioral intention*, $F(1,122) = 13.14$, $p < .001$, $B = .149$, *partial* $\eta^2 = .103$, thus fully supporting Hypothesis 3.

Hypothesis 4

Attachment was found to have no effect on *behavioral intention* and was removed from the final model. Therefore, Hypothesis 4 was rejected.

Hypothesis 5

One of the other significant effects was found as *uniqueness*. Uniqueness of the customized product significantly affected its usage for many seasons, $F(1,122) = 13.13, p < .05, B = .248, \text{partial } \eta^2 = .102$. Moderating effects of *treatment* were nonsignificant, so Hypothesis 5 was partially supported.

Hypothesis 6

Perceived consumer effectiveness (*GCA1*) was found to have no effect on *behavioral intention* and was removed from the final model. Hypothesis 6 was therefore rejected.

Hypothesis 7

Finally, behaviors toward green consumerism (*GCA2*) shared a low, but significant amount of variance in the final model, $F(1,122) = 5.07, p < .05, B = .110, \text{partial } \eta^2 = .042$. Similar to the *uniqueness, attitude, and subjective norm* variables, there was no moderating effect of treatment on *GCA2*, so Hypothesis 7 was partially supported.

Hypothesis 8

Treatment had no direct effect on *behavioral intention* to keep and use customized garments for many seasons, $F(1,122) = 33.64, p > .05$, so Hypothesis 8 was rejected.

All of the significant variables positively predicted behavioral intention. This result shows that as people's attitude, subjective norms, and personal behavioral control towards their intention using customized garments for many seasons, and beliefs about the uniqueness of a product increase, people might consume more sustainably. The results also revealed that use of a stimulus consisting of various messages about the target behavior can positively affect perceived behavioral control and therefore affect behavioral intention to keep and use the customized products for many seasons. A large portion of the variance (73.2%) in the dependent variables were explained by the chosen independent variables (*uniqueness, behaviors toward green consumerism (GCA2), attitude, subjective norm, PBC, Treatment × PBC*) in the final model (indicated by the adjusted R^2). Because the universally accepted standard for the variance (R^2) is above .70, this result shows promise for explaining behavioral intentions through the selected variables.

3.11.6.2. Mediation Effects of External Variables on Behavioral Intention through Attitude

Several studies have examined the issue of mediating roles of TPB core constructs. (Desrichard, Rochém, & Begue, 2007; Vogel, Wetsler, Wei, & Boysen, 2005; Baron & Kenny, 1986). These studies all argued that, aside from affecting behavioral intentions as a latent variable, attitudes can also mediate the relationship between behavioral intentions and other variables.

The mediation effect was assessed with Baron and Kenny's (1986) steps approach for intervention and control groups individually. GLM univariate analyses were run to see whether these two groups were significantly different from each other under the effect of the treatment. In the first step, all external variables were entered into the model (dependent variable = *attitude*) and none of the non-significant ones

were removed. In subsequent steps, non-significant variables were removed from the model one at a time, testing results at each stage to find the mediation effect.

Step 1: The effects of external variables on *attitude* were assessed to see whether they share variance with *attitude* or not.

Step 2: The effects of external variables alone on the dependent variable (behavioral intention toward keeping and using customized garments for many seasons) were assessed.

Step 3: The effects of external variables with the mediator (*attitude*) on the dependent variable (behavioral intention toward keeping and using customized garments for many seasons) were assessed.

The combination of Step 2 and Step 3 indicates whether *attitude* fully mediates, partially mediates or does not mediate² the impact of the external variables on *behavioral intention*.

To compare the effects of variables, a linear regression analysis for all of the independent variables on the dependent variable was run. SPSS produces multiple regression results using unstandardized *B* coefficients. To explain mediation by comparing two different groups, standardized Beta (β) regression coefficients were needed.³ For this purpose, regression analyses were run to find the relationships between the standardized and unstandardized regression coefficients. Because Beta-coefficients (β) were found to be very close to the *B* coefficients, *B* values obtained by

² When the external variables influence the behavioral intention directly while attitudes are not taken into account, and when this impact disappears when attitude is introduced as an extra variable, it is called full mediation. If the impact does not disappear completely but decreases significantly, it indicates partial mediation (Baron & Kenny, 1986).

³ Princeton University's online tutorial for regression analysis explains two types of regression coefficients as *B* (unstandardized) and beta (standardized). While the *B* is given in terms of the units of associated variables, the beta is explained to use "a standard unit that is the same for all variables in the equation". Beta weights are useful when one wants to compare two variables that are measured in different units. (Abrams, 2007)

the multiple regression analyses could be used for each group at every step to examine mediation.

Hypotheses 9, 11, and 12

Multiple regression analyses for Step 1 showed that *uniqueness* was the only factor positively influencing *attitude* significantly for both the control, $F(1,45) = 4.95$, $p < .05$, $B = .32$, and intervention groups, $F(1,81) = 17.37$, $p < .05$, $B = .66$, showing a larger effect on *attitude* in the intervention group than in the control group (Table 3.10). This means that *uniqueness* should be the variable used in Step 2. *Attachment*, *GCA1*, and *GCA2* had no significant direct influence on *attitude* for both groups; therefore, Hypotheses 9, 11, and 12 were rejected.

For Step 2, *uniqueness* had a direct influence on *behavioral intention* for both the control, $F(1,45) = 9.80$, $p < .001$, $B = .26$, and intervention groups, $F(1,81) = 11.40$, $p < .001$, $B = .41$, having a larger effect on the intervention group. This means that in addition to its effect on *attitude*, *uniqueness* also showed a significant impact on *behavioral intention*. This finding led to the next step to analyze whether inclusion of *attitude* in the model in Step 3 would show a significant effect on *behavioral intention*.

Hypothesis 10

With the inclusion of *attitude* in Step 3, there was a slight increase of the effect of *uniqueness* for the control group, $F(1,45) = 11.40$, $p < .001$, $B = .28$, while its B coefficient decreased for the intervention group, $F(1,81) = 8.24$, $p < .05$, $B = .31$, indicating the partial mediating effect of *attitude* on the intervention group.

Table 3.10. Multiple Regression Results for Influence of Attitude

		Dependent Variable	Independent Variable	R ²	Adj. R ²	B	SE _B	Beta	F		
Step 1	Control	Attitude	Intercept	.24	.16	-.06	.13		.20		
			Attachment			.10	.14	.13	.53		
			Uniqueness			.32	.14	.39	4.95*		
			GCA 1			-.10	.15	-.10	.44		
			GCA 2			-.03	.12	-.03	.06		
	Intervention		Intercept				-.14	.09		2.34	
			Attachment				.23	.15	.20	2.34	
			Uniqueness	.51	.49	.66	.16	.53	17.37**		
			GCA 1			.09	.09	.10	1.22		
			GCA 2			-.01	.09	-.01	.02		
Step 2	Control	Behavioral intention (without the attitude component)	Intercept	.76	.74	-.02	.07		.11		
			Uniqueness			.26	.08	.25	9.80**		
			Subjective norm			.30	.12	.27	6.75*		
			PBC			.46	.10	.42	19.87**		
			Intercept						-.01	.07	
	Intervention		Uniqueness				.41	.12	.31	12.69**	
			Subjective norm	.68	.66	.32	.09	.34	11.45**		
			PBC			.25	.10	.28	5.64*		
			Intercept				-.01	.07		.024	
			Uniqueness	.75	.74	.28	.08	.17	11.40**		
Attitude	.26	.10	.42			6.39*					
PBC	.47	.10	.42			21.23**					
Step 3	Control	Behavioral intention	Intercept			-.00	.06		.00		
			Uniqueness			.31	.11	.26	8.24*		
			Attitude			.37	.09	.39	17.94**		
	Intervention		Subjective norm	.73	.72	.27	.08	.27	10.06**		
			GCA 2					.16	.06	.15	6.11*

Note: Step 2 and Step 3 included final significant predictors only. PBC = Perceived behavioral control); GCA1 = perceptions about consumer effectiveness; GCA2 = behaviors indicating green consumerism.
 *Results are significant at the .001 level (p<.001)
 **Results are significant at the .05 level (p<.05)

The group who watched the treatment video was different from the control group in terms of attitude. However, as the impact of the *uniqueness* on *behavioral intention* did not disappear completely, but decreased significantly from $B=.53$ to

$B=.39$ for the intervention group (Table 3.10), *attitude* was not strong enough to greatly affect *behavioral intention* by itself. Thus, it can be concluded that *attitude* was partially mediating the impact of *uniqueness* on intentions. Thus, Hypothesis 10 was supported.

3.11.7. Data Analysis of Responses to Open-Ended Questions

Quantitative studies are limited in their ability to provide insights into underlying arguments, feelings, and emotions. Responses to open-ended questions helped to develop an understanding of the concepts investigated in this study.

As suggested by Converse and Presser (1986), open-ended questions were used as follow-ups to closed questions at the end of the survey. Respondents answered six open-ended questions at the end of the questionnaire. These open-ended questions were then analyzed to gain insight into participants' beliefs (Fink, 2005, p. 16).

In total, 722 responses were examined. It was found that answers given to the sixth question ("Do you have any other comments?") mostly repeated answers given to Questions 3, 4, and 5.

A mixed-method approach was followed for data analysis. To find the emergent themes regarding the participants' thoughts on their willingness to use integrated technologies and their end products, qualitative data gathered from open-ended data were analyzed. First, by applying the constant comparative method, codes for each question and each group were obtained (Glaser & Strauss, 1967, p. 102). Each time a text was coded, it was compared with all the texts that had already been coded in the same way (Glaser & Strauss, 1967, pp. 105–113). During the application of the method, previous knowledge, expectations, and prejudices were put aside to let the codes emerge from the data (Glaser & Strauss, 1967).

For reporting the answers, the letter E was used to code the "Experimental (Intervention)" group (E1–E83). Control-group participants were coded from C84 to C160. Respondents' comments are duplicated in quotes in this report including all grammatical and typographical errors.

Question 1: Would you be willing to wear "these customized garments" compared to the way you wear other garments that you purchase?

Sixty-six out of 82 respondents in the intervention group said they would be willing to wear customized garments, and the remaining were not sure (10), or were skeptical (6). Sixty out of 71 (5 not sure, 6 skeptical) in the control group were in favor of the idea (one-word "Yes" responses were counted for this calculation). A few of the intervention group respondents differed from the control group as their answers addressed environmental issues, as well as how they would be proud of the garments they designed.

Sample answers to Question 1 emphasizing Uniqueness

Being fashionable to me means not having items that others have. Being able to customize garments would be extremely appealing. (Participant E65)

[. . .] if the technology is advanced enough to allow me to customize garments that are unique in their style, not just well-fitting . . . (Participant C91)

Sample answers to Question 1 emphasizing Fit

It would be nice to find garments that fit perfectly and I think they'd easily become the most often worn clothes in my wardrobe. As long as they continued to fit well there would be no reason they would lose my favor. (Participant C123)

I think that having something shaped to my body would make me feel better and as a result I would want to wear it as often as possible. (Participant C129)

The respondents would treat these garments differently from the way they treat ready-to-wear garments; customized garments were perceived to be special, unique, valuable, and nice. The respondents emphasized that they would want to be more careful with customized garments so that they would not get damaged. However, customized garments were also predicted to be more expensive than ready-to-wear [RTW] products:

I would probably treat them the same way I would treat my current nice clothes: I would keep them as long as they were still in wearable condition and I would take care of them to keep them wearable for as long as possible. (Participant E44)

I think that any customized garments that I made would be a bit more formal and unique than my everyday wear, and so I would probably wear them less often because they are special and I would want to preserve and save them for special occasions. (Participant E50)

When you know that it is your design and it is one of a kind you feel special and beautiful in it. When your time has been put into a garment it just feels better. I would be more careful in the garment too, because I don't want to ruin it. In my other clothes I'm more likely to beat them up, sit on the sidewalk, ride bikes, or wipe my dirty hands on them. If it was my own design and custom, I would never treat it that way. (Participant C92)

Sample answers to Question 1 emphasizing Environmentalism

I would feel proud that I created them and I would be happy that I was helping to consume less. (Participant E69)

I would struggle with wearing the same thing every season. I'm very active in living green and I try to be as eco-friendly as possible, so I think I would wear these garments like I wear ready-made garments but it would take a little while to adjust. (Participant E41)

Other respondents emphasized that wearing well-fitting garments would give them more confidence about their look:

I would [be willing to wear these customized garments] because I would be able to customize the fit and feel more confident about wearing them out. (Participant C96)

Price was another important issue for both groups. Respondents assumed that these customized garments would cost more than the RTW garments; therefore, they would design staple garments, or fitted garments / special occasion garments, which they would use less frequently.

It really depends on the garment itself and its design. Customization works best on basics or classic items that don't change with the trends. If I were to make a blazer, that would be a perfect opportunity to use the program. And I would therefore wear this blazer for years. (Participant E78)

Question 2: "I believe that 'these customized garments' would be a part of my wardrobe for _____ (seasons)."

These results were parallel with the findings about the expected duration of using these custom-designed garments on a scale ranging from "one season" to "until it is worn out" (Table 3.11) Frequency analysis results showed that most of the respondents (N=78) would prefer using the customized garments (48.8 %) until they wore out regardless of the treatment effect.

When the treatment effect is taken into account, 42 intervention-group participants reported that they would use these garments until they wore out, while 36 of the control-group participants indicated the same thing.

Table 3. 11. Expected Duration of Customized Garments

Seasons	Frequency	Percentage (%)
One season	6	3.8
Two seasons	16	10.0
Three seasons	19	11.9
More than three seasons	28	17.5
Until it is worn out	78	48.8
Other	13	8.1
Total	160	100.0

For the "other" option, participants indicated that the duration of using the customized garments would depend on how the design turned out, users' boredom, garment fit, and fashionableness.

Question 3: How do you think that these “Integrated Technologies” would affect your choices about the number of the garments you buy and the way you consume them?

Question 4: How would using these “Integrated Technologies” change the meaning that your clothing has for you?

Question 5: How would using these “Integrated Technologies” help you to design clothing more easily and successfully for yourself?

For Questions 3, 4, and 5, responses were “quantitized” by coding and creating frequencies (Table 3.12)

Once the codes were generated, they were reviewed and compared to reveal any redundant codes. Similar codes were combined into one code. Then, these codes were reduced to generic categories (themes) as described by Ryan and Bernard (2003). Four main categories emerged: Technology, Garment Design and Use, Perceptions of

Garments, and Environmental Concerns. In total, five themes were found for Technology’s perceived qualities, six themes were found for Garment Design and Use phase, and six themes were detected for the Perceptions of Garments designed by the integrated technologies. Ten out of 78 participants from the control group referred to the treatment video in these responses, reporting that the video messages would be recalled during their future shopping trips for clothing.

Table 3.12. Summary of the Themes, Codes, Effect Sizes

Main categories	Themes (from the most rated to the least)*	Frequency of occurrence		Total frequency of occurrence (Control+ Intervention)
		Control	Intervention	
Technology	Easy decision making	28	45	73
	Enabler	27	38	65
	Efficient	27	26	53
	Accurate and flexible	13	20	33
	Saves resources	13	15	28
Garment design and use	Fit **	35	65	100
	Minimize	27	37	64
	Use longer **	13	30	43
	Use frequently **	6	15	21
	Pride	7	9	16
	Ownership	5	6	11
Perceptions on garments	Personalized features	22	39	61
	Uniqueness	16	27	43
	High-price point	16	12	28
	Better quality **	8	25	33
	Sentimental perceptions **	8	23	31
	Attachment **	5	16	21
Environmental Concerns	Environmental Concerns	3	17	20
Total	18 overall themes	255	431	686

*Note: Themes were counted for both control and intervention groups. One-word answers (Yes/No/Maybe) were not used during the reasoning process.

** Indicates findings that differed in frequency the most between intervention and control participants

Findings tabulated in the Table 3.12 are explained under the following themes:

3.11.7.1. Technology

The first category showed that intervention group participants talked about regarding the benefits of these technologies for easy decision making enabling features, and their accuracy and flexibility. Seeing garments on their own avatars, users felt they could make decisions about the garments more easily.

I would be able to see in avatar form what looks best on me and from various angles and color combinations. This would be greatly helpful in narrowing down or weeding out what looks good and what doesn't. I would have more time to think over my decisions. (Participant E67, Question 5)

As emphasized by one of the intervention-group respondents below, integrated technologies can educate consumers about fit and help them make smart purchases.

I would be less likely to buy formal wear and clothing that didn't fit as well since I would be able to create clothing that fit perfectly instead of having to settle for an imperfect fit, as well as creating my ideal clothing instead of settling for something close to what I like. (Participant E50, Question 3)

Control-group participants tended to perceive the technologies as efficient (21.95%).

I think it would help me look at my closet and find something I want to wear instead of looking at my closet and thinking I don't have anything to wear. (Participant C96, Question 4)

[It would] give my clothes more value and with the feedback from friends it would let me know when I would need to update my look. (Participant C155, Question 4)

3.11.7.2. Garment Design and Use

The control-group participants mentioned the fact that integrated systems can minimize consumption. Some felt that, minimizing consumption is closely related to the personalized features, better fit of garments, and the value acquired by being involved with the process.

Well, as a designer I view clothing in a personal manner, but maybe for other people, they would view clothing as something to be taken care of and maintained, instead of a consumable object worn twice and thrown out. (Participant C156, Question 4)

The only thing that would drop necessarily is the amount of garments bought that were “mistakes” and don’t fit right, and thus never used and thrown away. (Participant C123, Question 3)

I think that using these “Integrated Technologies” would minimize the number of garments that I consume. Because these technologies allow users to put more time and thought into the design of their garments, it seems like users are more likely to be pleased with the outcome and therefore less likely to purchase a high volume of ready-to-wear garments. (Participant E1, Question 3)

I don’t usually go shopping that much, but I think it would be very helpful. I do a lot of my shopping online, so I cannot try items on. I sometimes end up buying things that don’t really fit because of it. Therefore, I would be wasting less with this technology because I would only have clothing in my closet that fits me. (Participant E20, Question 3)

Intervention group participants reported twice as many times as control group participants that they would use the customized garment longer (30 versus 13) and more frequently (15 versus 6). (Table 3.12)

Participants overall reported that ownership caused by the direct involvement in the creation would result in using these garments for a longer period:

I would feel more ownership of the garments and would work even harder to make them last longer because I would have been personally involved in the creation of the garment for every step of the process. (Participant E44, Question 4)

The responses showed that other people’s opinions matter when it comes to creating customized garments. The control-group participants especially felt that it is important to get others’ responses to their outfits.

They would be more personal and I would be sad if people did not like them as much. Also it would be rewarding if people did like them. (Participant C99, Question 4)

It would make my clothing more personal and make me feel happier than usual if someone complimented me on it because I designed it. (Participant C149, Question 4)

In this vein, it might be expected that respondents would be likely to share their images with their peers before purchasing the customized garments; however, none of the participants mentioned this. Overall responses indicated that participants were more engaged with virtual fit than with online interaction technologies.

3.11.7.3. Perceptions of Garments

In the third category, perceptions of garments, fit was given as the most important feature of the customized garments for both groups (Table 3.12)

Having an avatar with my exact dimensions and proportions would make it significantly easier to create clothing that will flatter my body as well as possible. (Participant E56, Question 5)

I don't fit into one size perfectly, there are areas that are bigger and smaller than the size grades they have now. I'd be able to make clothes fit in the right places . . . therefore I'd always have something nice to wear because it fits and looks good. (Participant C156, Question 5)

These garments were considered to be both more valuable and expensive.

I think that at least for the next couple of years, any clothing made with integrated technologies is going to be more expensive than the throwaway clothes made now, because they are more of an investment. Being a poor college student, I'm more inclined to buy more disposable fashions, but as I get older, being financially able to purchase these items would greatly reduce the actual volume of clothing that I purchase. (Participant E56, Question 3)

Intervention-group participants talked about higher quality of the garments (8 versus 25), their possible sentimental feelings (8 versus 23) and attachments towards these garments (5 versus 16) more than twice as many times as control group.

I think I would start purchasing fewer garments from retail stores if I was able to design my own. Also, since they were designed by me I think I would feel more attached to them, making me want to keep them longer. (Participant E32, Question 3)

I would be more sentimental towards any clothing that I had created for myself and would probably never get rid of that clothing, while I would slowly phase out buying the types of clothing that I was creating for myself so eventually almost all of my clothing would be precious to me. (Participant E56, Question 4)

It is possible that when a person first tries these technologies, he or she would be more attached to the first set of garments he or she designs because of the memories related to this first experience. For the other creations, there might be other ways considered to keep the attachment level high:

The first pieces I make might have sentimental value as they were one of my first creations. Other pieces might gain value depending on if they were made for a specific event that was meaningful. (Participant E59, Question 4)

3.11.7.4. Environmental Concerns

Environmental effects (that were presented in the video) were mentioned by the intervention group participants more than the control group participants:

After watching the video, it made me more aware of the impact that the production of clothing has on our environment. When I go shopping, I do think of how many times I will actually wear that item instead of buying something that is just in season. (Participant E9, Question 3)

Seeing the video really made me think about all the apparel that I consume. I buy so much, and hardly wear a good amount of it. Having these technologies

would limit how much I purchase and I would have apparel that I know I would wear and enjoy. (Participant E3, Question 3)

I think that if my clothing was customized I wouldn't be such a victim of "fast fashion" and the waste that comes along with that. I tend to get rid of clothing quickly and I think this would curb some of that. (Participant C105, Question 3)

Question 6: Other Comments

When asked for additional comments, response rates were low. Although most respondents repeated thoughts already given for the previous questions, some other concerns related to implementation of the Integrated Technologies were raised as well. These issues varied from how participants found these technologies exciting and resourceful to fearing the technologies might be difficult to learn and thus hesitant to use them.

Since I am not extremely confident with my technological skills, I would be hesitant to use the program. (Participant C114)

I would like to gain some experience using these "integrated technologies," even though it kind of scares me. (Participant E22)

As listed in Table 3.13, participants commented on the effect of using such systems on the consumption patterns of the public and the fashion industry. Although most of the respondents thought that these consumers would be producing less waste, the rest felt the system could lead to "bad fashion sense" (Participant E35), "take away the design integrity" (Participant E39), "take away the creativity" (Participant C139), lead to "a lot of amateur design and be more wasteful" (Participant E18), and become "another way to spend more money on clothing" (Participant C121).

Table 3.13. Examples of Other Comments Related to Technology, Garments, and Consumption

	Concerns
Intervention (N=45)	Technology would not replace real shopping experience
	Technology would not change purchase behavior
	Technology would cause a negative effect on the garment industry
	Some design integrity would be lost
	Stores would have this technology in the future
	Using real textile samples would be nice
Control (N=36)	Technology needs to be accessible in malls
	Technology will not change behaviors but cut down the production cost
	Great tool to be used in the RTW industry
	Will cause a negative effect on the garment industry
	Design for real people
	Captivating idea
	Take away some creativity

Note: Ns describe usable data. One-word answers (Yes/No/Maybe) were not used during the reasoning process.

As one participant stated, customized garments’ higher price point and the time and energy spent on creating the designs would result in using them longer.

Depending on how much the garments cost to produce will have a huge impact on how long people will keep these garments. The more expensive they are the longer people will keep them. (Participant C155)

It will absolutely change the number of cloth[es] I buy. I often buy clothes that look good on the hanger, but might not fit my type, so that means I bought a decoration, not something I will wear. It is very wasteful. With this technology, I will know what my purpose is. (Participant E14)

The majority of the participants (67 out of 81) in both groups stated that this system has a lot of potential to greatly influence future consumers’ clothing consumptions. As one of the control-group participants stated:

It’s very interesting, that’s for sure. Very futuristic and it’s definitely a captivating idea to introduce to the global clothing market [. . .] If this

technology becomes a hit among regular consumers, it will lead to a possible collapse of trends and a rise in personal stylized garments, thus affecting the retail on commercial goods (since everyone will already have their own satisfying unique garments thanks to the technology). A possible product of this could be a decrease in wasteful clothing, since commercial garments would decrease since consumers would want more personalized garments. (Participant C123)

3.12. Conclusions and Future Study

Since this was the first study of this topic, it was important to analyze the bases of direct and mediated effects of the variables affecting the target behavioral intention (keeping and using customized garments for many seasons) in the model. To more deeply examine the mechanism of factors affecting behavioral intentions, attitudes were also investigated as mediators of the external variables. Results of this investigation suggested that attitudes not only affect behavioral intentions directly, but also mediate the effect of the perception of uniqueness on behavioral intention at the same time. Furthermore, treatment was found to moderate this mediation, as intervention-group participants' attitudes were significantly affected by their perceptions of the uniqueness of customized garments. Considering this finding, it can be suggested that the use of similar videos to raise awareness about sustainable garment consumption could have a positive effect.

As explained in The Sustainable Consumption Roundtable report, "I Will If You Will" (2006), currently there are two directions for sustainable consumption: consuming less and consuming differently. While consuming less advocates that "we would actually be happier and enjoy a better quality of life by consuming less," the second line of thinking suggests that "consuming less would restrict choice and reduce the quality of people's lives," so people should be consuming efficiently instead. The report emphasizes that no single strategy is enough to solve the complex challenges of sustainable consumption, and advocates that both strategies be embraced in order to

achieve it. The present study attempted to embrace both aspects of sustainable consumption. This study is the first study to investigate sustainable consumption within an environment that uses advanced technologies: individual 3D body-scan avatars for virtual try-on and social networking. The study supported the usefulness of enabling technologies for sustainability by providing significant results and proposing several factors on which to focus for the research.

The results from the extended TPB model revealed that behavioral intentions about sustainable consumption such as keeping and using customized garments for many seasons can be positively affected by attitudes, uniqueness of the garments, subjective norms, perceived behavioral control, and behaviors of green consumerism (being an environmentally conscious person). The results also showed that use of a stimuli consisting of various messages regarding the target behavior can positively affect perceived behavioral control, and therefore behavioral intentions of keeping and using the customized products for many seasons. Generally speaking, the results confirmed previous findings that attitudes indeed play an important role when predicting behavioral intentions and contribute most to the explanation of the behavior (De Canniere et al., 2009; Ajzen, 1991). Also, the results proved that the TPB model can comply with predicting behavioral intentions in the context of sustainable consumption. All three TPB constructs (attitude, subjective norm, and perceived behavioral control) should be taken into account in the context of sustainable consumption, as they all contribute to the explanatory power of the model. It appears that unique properties of the customized garments will be one of the most important factors that might give value to the customized garments in keeping and using the garments for a long time in the future. This means that integrated technologies might have the potential to create a sustainable fashion system.

Using both the core and external constructs of the TPB together can help researchers, marketers, and activists in the sustainability field gain insights about predicting future behaviors related to integrated technologies and their by-products (customized garments). For future study, sustainable consumption can be operationalized differently, such as care of the customized garments, intention to refashion them. The same variables used in this study can be used to examine whether different relationships might emerge in different contexts.

The results highlighted the fact that the treatment video had a moderating effect on perceived behavioral control. Design examples, information on sustainability, and explanations of technologies shown in the video might have had an effect on the respondents' perceptions that, with the given information, they could control the number of garments they keep and use. Responses to the open-ended questions showed that the intervention video made some of its viewers aware of the problems of excess consumption and more-sustainable consumption. Some of these that did not watch the video, respondents from the control group expressed a more positive attitude toward use of these technologies. It is possible that they imagined the technological opportunities more than respondents in the intervention group, who actually saw in the video the way the technologies currently work.

The results from the open-ended section were examined in four categories: technology, garment design and use, perception of customized garments and environmental concerns. The integrated technology itself was perceived quite positively. Respondents viewed integrated technologies as efficient, helpful for easy decision-making, enabling, accurate and flexible, having the potential to save resources, and also inspiring their users (social network / sharing designs) to update each other about the designs and obtain their peers' feedback.

Responses to the open-ended questions showed that the intervention-group participants perceived technology as an enabler (increasing knowledge and awareness of the products, involving users, and strengthening their design skills), and they stated that they would be using these garments frequently and for many seasons. Some intervention-group participants mentioned the possible environmental impact of the integrated technologies.

For garment design and use, emerging themes, including the ideas that garment consumption would be minimized, that garments would be used for a longer period and more frequently, that users of this technology would feel proud of their custom creations and feel ownership of them. Respondents perceived that the customized garments would provide a good fit, would have more value, custom features, and unique properties compared with ready-to-wear garments; and would have a high price point, but better quality; and expressed feelings of sentimentality and attachment to the customized garments. In addition to these three categories, the intervention group in particular mentioned the possible environmental impact of using such technologies. This last factor is examined under the environmental concerns category.

In general, both participant groups responded to the open-ended questions by stating that they would design staple garments for special occasions and more form-fitting garments such as blazers and coats using the technologies. The respondents stated that they would be interested in creating formal, fitted (blazer) coats, business suits, timeless basics, and dresses for special occasions, jeans, and other pants. Respondents indicated that such garments would stay in fashion longer. Classic pieces were perceived as able to be used for many seasons, while unique garments were mentioned as being kept longer. However, some respondents indicated that they might not want to wear dresses designed for special occasions for a second time.

Although some respondents to the open-ended questions believed that such integrated systems of technology could increase consumption, most agreed that the technology has the potential to minimize purchase of badly fitting garments, to increase knowledge and awareness prior to purchase of the garments, and to generate more appreciation for the products and thus cause better care to be taken of them. They mentioned that having fewer but better-fitting garments would lead them to feel greater satisfaction with their purchases and cut down their needs to look for more garments. Responses to the open-ended questions reflected ways in which integrated technologies can be useful in terms of making smart purchases and in helping their users to understand fit issues. Intervention-group respondents mentioned the importance of fit more than the control group did. This finding supported Bye and McKinney's (2007) ideas on how virtual try-on during apparel purchase can educate consumers about proper fit, thus helping them to think more about their purchase, as well as about general issues such as garment consumption and discard. Moreover, participants stated that they would use customized garments longer and more frequently, feel more comfortable in personalized garments, be proud of themselves for being involved in creating their own customized garments, and feel more connected to them.

The themes from the open-ended questions were helpful in drawing more detailed conclusions regarding the outcome of the theoretical model, and in detecting new variables that need to be investigated in a model for future studies. Technology can affect both garment design and use, and can also affect perceptions of garment characteristics. In addition, the results implied that there would likely be a relationship between garment design and use and perceived garment characteristics in a custom-garment context. Three categories emerged relating to behavioral intentions to keep and use customized garments for many seasons. The results suggest that a video

treatment would be effective for advertising the enabling features of integrated technologies and for using customized garments frequently and for a longer time. These findings were not tested for statistical significance, but offer much potential for future studies.

Fashion-conscious individuals have been increasingly using new digital fashion design platforms (Polyvore, Merona My Look Maker), that offer features for creating collages from existing fashion pieces, to mix and match garments and accessories, and to share their taste with other members and obtain feedback on their choices from their online peers. Literature shows that retailers are interested in offering this virtual try-on option around virtual communities; this is why they have been offering like/unlike options and collage sharing (Pentina et al., 2008). Therefore, a future experimental study should include an online mock-up shopping environment, with a virtual try-on function, as well as a virtual community around it to examine design and decision-making processes. Researchers should collaborate with business to identify new applications within a context of sustainability. Businesses should also play a role in advertising sustainable consumption as initiatives.

The Sustainable Consumption Roundtable report (2006) proposes that economic consumption should be dissociated from material consumption. As Niinimäki and Hassi (2011) indicated, it is the short-life span of textiles and clothing which makes the apparel industry wasteful, thus a new kind of value creation should be considered when developing a more sustainable business model. New business models, concentrating on service economy, which puts the consumer satisfaction in the center, can be one way to do this. Implementation of emerging digital apparel technologies can help businesses in the fashion industry to distinguish themselves and thus increase their profit. The present study's results would imply that online retailers who are committed to sustainability can attract customers by offering unique garments

and making their customer feel good about their purchases. Moreover, in such an online environment, consumers' behavioral intentions can be steered toward sustainable consumption (purchasing fewer but higher quality garments). In this case, the uniqueness of the products and the effect of using high quality suitable garments longer instead of replacing them frequently can be highlighted. Also, the customers can be given further ideas about how to lengthen the usage life of the garment with the help of tutorials. Because the video intervention moderated the effect of perceived behavioral control on sustainable consumption, and as well as the effect of perception of uniqueness on attitudes, short-but-stimulating videos about the impact of the apparel industry and our consumption habits on climate change can be used to inform costumers. Moreover, as people are affected by what other people are thinking when they perform a behavior, an online social network can be created for the customers and their peers where they can share their designs get feedback, talk about how/when they wear/use the customized garments, and perhaps share garments with each other for special occasions. Another strategy can be implementing a system where companies not only mediate interaction among their clients, but also provide a "personal style advisor" where customers can get style advice by sharing their virtual avatars dressed with various garments. If people can be educated to purchase similar high-value services, a decrease in product consumption will not affect the apparel industry negatively. Inspiring people on environmental sustainability issues, and advertising the quality and value of their products can help businesses to increase their competitive advantage and brand image.

Respondents felt that the price of these garments would be high. Many of them thought that since customized garments will be costly, it would not be possible to purchase too many customized garments. They stated that they would mix ready-to-wear and customized garments. Respondents assumed that the garments would be

more expensive, so this is why they would design garments that they could keep for a longer time. Future studies should be constructed to explore ways to communicate to consumers the concept that they would not be purchasing an 'expensive' product, but a product valued at its true worth which will be valued and treasured more.

In this study, 3D body scanning technology together with virtual try on software were studied as enabling technologies to enhance customer involvement with their garments in the context of online purchasing. Such involvement's effect on consumption intentions was studied as a parameter of sustainability. Further research should investigate other technologies, such as magic mirrors or online social networking through blogging, in more detail.

Because participants in this study were fashion design students, they had more training in fashion design and higher expectations for the use of design technologies than people outside of the apparel design business may have. Using design students as participants limits the generalization of the results to the population as a whole. Further directions for research could be concentrated on diversifying the population. The study of user groups other than design students, different age groups, different locations, and cross-cultural studies could solve the generalization limitation. Other designers (for example, industrial designers) and non-design groups should be examined. A group of people who are interested in do-it-yourself design practices but are not necessarily technologically-savvy or a group of people who are technologically savvy but have a little or no design background can give various ideas on how to design a more general software and how a technologically enabled sustainable fashion system can be implemented for the general public. It can be expected that non-design groups of the same age and technological knowledge might react to the idea of using integrated technologies for designing the garments, virtually trying them on and get the feedback from other before they decide to purchase these customized garments

totally different than this study's participants who chose fashion design as a career and who used to work with body forms.

Studying different age groups, such as a group of technologically-savvy home sewers of 30-60 years old who use Bernina's MyLabel for virtual try-on might give a deeper understanding of ways to develop a software for the general public to design custom clothing and use avatars for testing fit and suitability. This system would be appealing to older or younger consumers depending on how this software was designed and marketed. Studies of consumer behaviors around these questions would benefit the apparel and associated industries.

3.13. Limitations

Data in this present study were acquired from a sample of undergraduate and graduate fashion design students at several universities in North America. Therefore, caution needs to be used when generalizing the findings and interpreting the study's results. Replicating this present study with another target population is therefore necessary. Furthermore, response rates varied from one college to the next because incentives were different for respondents. For example, participants at several colleges received gift cards and extra class credit from their professors, whereas the rest of the respondents received online gift cards only.

Because of the nature of the online surveys, participants gave short answers to the open-ended questions. Two participants informed me that they could not view the video because of some technical problems. One of them was in the control group (and therefore was not able to take advantage of the opportunity given to control group participants to view the video at the end of the study). The other participant was in the intervention group. As a result, her data were analyzed with control group participants.

Also, because of the study setting, it is possible that participants might have been faced with mitigating factors while taking the online survey. Such problems might have included watching the video with a friend, multi-tasking while listening to the video, and so forth. Moreover, it was not possible to control participants' exposure to other media content during the experimental treatment.

It should be also emphasized that the theoretical model may not have incorporated all relevant variables. Further studies should explore other variables derived from the open-ended questions, such as the effect of fit. These new variables can be also tested by using TPB, or other analysis methods, such as by using Structural Equation Modeling [SEM] for both confirmatory and exploratory modeling. Also, for future studies, emergent themes found in the qualitative analysis can be used to modify existing scales.

Nonetheless, this study presents an important initial attempt to conceptualize possible changes in consumption patterns through the use of technologically enabled fashion systems.

REFERENCES

- Abrams, D. R. (2007). Introduction to regression. Retrieved October 2, 2010, from http://dss.princeton.edu/online_help/analysis/regression_intro.htm
- Addison, M. (2009, August). Enlivening learning with digital video. *Training Journal*. Retrieved from <http://www.trainingjournal.com/feature/2009-08-01-enlivening-learning-with-digital-video/>
- Ajzen I. (1985). From intentions to actions: A theory of planned behavior. In J. Kuhl & J. Beckmann (Eds.), *Action-control: From cognition to behavior* (pp. 11-39). Heidelberg, Germany: Springer-Verlag.
- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Making Processes*, 50(2), 179-211.
- Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Englewood Cliffs, NJ: Prentice-Hall.
- Allwood, J. M., Laursen, S. E., Malvido, C., & Bocken, N. M. P. (2007). *Well dressed? The present and future sustainability of clothing and textiles in the United Kingdom*. Retrieved September 5, 2009 from http://www.ifm.eng.cam.ac.uk/sustainability/projects/mass/UK_textiles.pdf
- Arbuthnott, K. D. (2009). Education for sustainable development beyond attitude change. *International Journal of Sustainability in Higher Education*, 10(2), 152-163.
- Armitage, C. J., & Christian, J. (2003). From attitudes to behaviour: Basic and applied research on the theory of planned behaviour. *Current Psychology*, 22(3), 187-195.
- Ashdown, S., & Loker, S. (2010). Mass-customized target market sizing: extending the sizing paradigm for improved apparel fit. *Fashion Practice The Journal of Design, Creative Process & the Fashion Industry*, 2(2), 147-174.
- Ashdown, S., Loker, S., Schoenfelder, K. A., & Lyman-Clarke, L. (2004). Using 3D scans for fit analysis. *Journal of Textiles and Apparel, Management and Technology*, 4(1). Retrieved from <http://www.tx.ncsu.edu/jtatm/>
- Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, 51(6), 1173-1182.

- Berger, I.E. & Corbin, R.M. (1992). Perceived consumer effectiveness and faith in others as moderators of environmentally responsible behaviors. *Journal of Public Policy and Marketing*, 11(2), 79-89
- Blank Label. (n.d.). Retrieved September 5, 2010, <http://www.blanklabel.com/>
- Browzwear. (n.d.). Retrieved September 5, 2010, www.browzwear.com/
- Bye, E., & McKinney, E. (2007). Sizing up the wardrobe: Why we keep clothes that do not fit. *Fashion Theory: The Journal of Dress, Body & Culture*, 11(4), 483-498.
- Chapman, J. (2005). *Emotionally durable design: Objects, experiences and empathy*. London, UK: Earthscan.
- Converse, J. M., & Presser, S. (1986). *Survey questions: Handcrafting the standardized*. Beverly Hills, CA: Sage Publications.
- De Canniere, M. H., De Pelsmacker, P., & Geuens, M. (2009). Relationship quality and the theory of planned behavior models of behavioral intentions and purchase behavior. *Journal of Business Research*, 62(1), 82-92.
- Csikszentmihalyi, M., & Rochberg-Halton, E. (1981). *The meaning of things: Domestic symbols and the self*. Cambridge, UK: Cambridge University Press.
- Desrichard, O., Roche, S., & Begue, L. (2007). The theory of planned behavior as mediator of the effect of parental supervision: A study of intentions to violate driving rules in a representative sample of adolescents. *Journal of Safety Research*, 38(4), 447-452.
- Dombek-Keith, K. M. (2008). *Re-Fashioning the Future: Eco-Friendly Apparel Design*. (Unpublished master thesis). Cornell University, Ithaca, NY.
- Eagly, A. H., & Chaiken, S. (1993). *The Psychology of attitudes*, Fort Worth, TX: Harcourt Brace Jovanovich College Publishers.
- East, R. (1990). *Changing consumer behaviour*. London, England: Cassell.
- Elliott, S. (2010, June 25). Target wants you to friend their sweaters [Web log comment]. Retrieved from <http://mediadecoder.blogs.nytimes.com/2010/06/25/target-wants-you-to-friend-their-sweaters/>
- eShakti. (n.d.). Retrieved September 5, 2010, <http://www.eshakti.com/>
- Fashion Playtes. (n.d.). Retrieved September 5, 2010, <http://www.fashionplaytes.com/>

- Fashism. (n.d.). Retrieved September 5, 2010, <http://fashism.com/>
- Field, A. P. (2009). *Discovering statistics using SPSS: (and sex and drugs and rock 'n' roll)*. Thousand Oaks, CA: SAGE Publications.
- Fink, A. (2009). *How to conduct surveys* (4th ed.). Thousand Oaks, CA: Sage Publications.
- Fiore, A. M. (2008). The digital consumer valuable partner for product development and production. *Clothing and Textiles Research Journal*, 26(2), 177-190.
- Fiore, A. M., Jin, H., & Kim, J. (2005a). For fun and profit: Hedonic value from image interactivity and responses towards an online store. *Psychology & Marketing*, 22(8), 669-694.
- Fiore, A. M., Kim, J., & Lee, H. (2005b). Effects of image interactivity on approach responses towards an online retailer. *Journal of Interactive Marketing*, 19(3), 38-53.
- Fiore, A. M., Lee, S., & Kunz, G. (2003). Psychographic variables affecting willingness to use body-scanning. *Journal of Business and Management*, 9(3), 271-287.
- Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention and behavior: An introduction to theory and research*. Reading, MA: Addison-Wesley.
- Fits.me. (n.d.). Retrieved September 5, 2010, <http://fits.me/>
- Fletcher, K. (2008). *Sustainable fashion and textiles: Design journeys*. London; Sterling, VA: Earthscan.
- Fletcher, K., & Tham, M. (2003). Clothing lives!. In Tim Cooper (Ed.), *Proceedings from an Academic Workshop of Product Life and the Throwaway Society* (pp. 49-56). Sheffield Hallam University, England. Retrieved from www.ntu.ac.uk/research/document_uploads/108814.pdf
- Fogg, B. J. (2009). Creating persuasive technologies: An eight-step design process. *Proceedings of the Persuasive '09: 4th International Conference on Persuasive Technology*. New York, NY: Association for Computing Machinery.
- Gerber Technology. (n.d.). Retrieved September 5, 2010, www.gerbertechnology.com/
- Go try it on. (n.d.). Retrieved September 5, 2010, <http://www.gotryiton.com/>
- Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Chicago, IL: Aldine Publishing Company.

- Hale, J. L., Householder, B. J., & Greene, K. (2002). The theory of reasoned action. In J. P. Dillard & M. Pfau (Eds.), *The persuasion handbook: Developments in theory and practice* (pp. 259-286). Thousand Oaks, CA: Sage Publications.
- Hawley, J. (2008). Economic impact of textile and clothing recycling. In C. Ulasewicz & J. Hethorn (Eds.), *Sustainability fashion, why now?* (pp. 207-232). New York, NY: Fairchild Books.
- Hines, J. M., Hungerford, H. R., & Tomera, A. N. (1987). Analysis and synthesis of research on responsible environmental behavior: A meta-analysis. *Journal of Environmental Education*, 18(2), 1-8.
- Honestly Now. (n.d.). Retrieved from <http://honestlynow.com/>
- Human Solutions. (n.d.). Retrieved from http://www.human-solutions.com/apparel/technology_scanning_en.php
- Kamali, N., & Loker, S. (2002). Mass customization: On-line consumer involvement in product design. *Journal of Computer-Mediated Communication*, 7(4). Retrieved from <http://www.ascusc.org/jcmc/vol7/issue4/loker.html>
- Kim, H., & Damhorst, M. L. (2010). The relationship of body-related self-discrepancy to body dissatisfaction, apparel involvement, concerns with fit and size of garments, and purchase intentions in online apparel shopping. *Clothing and Textiles Research Journal*, 28(4), 239-254.
- Kim, J., & Forsythe, S. (2007). Hedonic usage of product virtualization technologies in online apparel shopping. *International Journal of Retail & Distribution Management*, 35(6), 502-514.
- Klein, L.R. (2003). Creating virtual product experiences: The role of telepresence. *Journal of Interactive Marketing*, 17(1), 41-55.
- Latour, B. (2005). *Reassembling the social: An introduction to actor-network theory*. Oxford; New York: Oxford University Press.
- Lectra. (n.d.). Retrieved September 5, 2010, www.lectra.com/
- Levi's CurveID. (2011, March 25). *Find your perfect fitting jeans with levi's® curve id*. Retrieved from <http://explore.levi.com/news/levis-curve-id/>
- Loker, S. (2008). A technology-enabled sustainable fashion system: Fashion's future. In C. Ulasewicz & J. Hethorn (Eds.), *Sustainability fashion, why now?* (pp. 95-126). New York, NY: Fairchild Books.

- Loker, S., Ashdown, S., & Carnrite, E. (2008). Dress in the third dimension: Online interactivity and its new horizons. *Clothing and Textiles Research Journal*, 26(2), 164-176.
- Loker, S., Ashdown, S., Cowie, L., & Schoenfelder, K. A. (2004). Consumer interest in commercial applications of body scan data. *Journal of Textiles and Apparel, Management and Technology*, 4(1), <http://www.tx.ncsu.edu/jtatm/>
- Loker, S., Cowie, L., Ashdown, S., & Lewis, V. D. (2004). Female consumers' reactions to body scanning. *Clothing and Textiles Research Journal*, 22(4), 151-160.
- Loker, S., Ashdown, S., Cowie, L., & Schoenfelder, K. A. (2004). Consumer interest in commercial applications of body scan data. *Journal of Textiles and Apparel, Management and Technology*, 4(1), <http://www.tx.ncsu.edu/jtatm/>
- Lynn, M., & Harris, J. (1997). The desire for unique consumer products: A new individual differences scale. *Psychology & Marketing*, 14(6), 601-616.
- Made-By. (n.d.), Retrieved June 5, 2011 from <http://www.made-by.org/content/made-bys-blue-button-and-swing-tag>
- Mankoff J., Matthews, D., Fussell, S. R., & Johnson, M. (2007). Leveraging social networks to motivate individuals to reduce their ecological footprints. *Proceeding of IEEE HICSS'07: 40th Annual Hawaii International Conference on System Sciences*. Hawaii, HA.
- Mugge, R., Schifferstein, H. N. J., & Schoormans, J. P. L. (2004). Personalizing product appearance: The effect on product attachment. In A. Kurtgozu (Ed.), *Proceedings of the Fourth International Conference on Design and Emotion*. Ankara, Turkey.
- Niinimäki, K. & Hassi, L. (2011). Emerging design strategies in sustainable production and consumption of textiles and clothing. *Journal of Cleaner Production*. doi:10.1016/j.jclepro.2011.04.020.
- NikeID. (n.d.). Retrieved September 5, 2010, <http://nikeid.nike.com/nikeid/index.jsp>
- OEcotextiles. (2011, January 19). *Estimating the carbon footprint of a fabric*. Retrieved from <http://oecotextiles.wordpress.com/2011/01/19/estimating-the-carbon-footprint-of-a-fabric/>
- OptiTex. (n.d.). Retrieved September 5, 2010, <http://www.optitex.com/>
- Peattie, K., & Collins, A. (2009). Guest editorial: perspectives on sustainable consumption. *International Journal of Consumer Studies*, 33(2), 107-112.

- Pentina, I., Prybutok, V.R., & Zhang, X. (2008). The Role of virtual communities as shopping reference groups. *Journal of Electronic Commerce Research*, 9(2), 114-136. Retrieved from <http://www.csulb.edu/journals/jecr/issues/20082/paper3.pdf>
- Piller, F., Schubert, P., Koch, M., & Moslein, K. (2005). Overcoming mass-confusion: Collaborative customer co-design in online communities. *Journal Computer-Mediated Communication*, 10(4), 1-25.
- Proper Cloth. (n.d.). Retrieved September 5, 2010, <http://propercloth.com/>
- Ryan, G. W., & Bernard, H. R. (2003). Techniques to identify themes. *Field Methods*, 15(1), 85-109.
- Scaturro, S. (2008). Eco-tech fashion: Rationalizing technology in sustainable fashion. *Fashion Theory: The Journal of Dress, Body & Culture*, 12(4), 469-488.
- Schaefer, A., & Crane, A. (2005). Addressing sustainability and consumption. *Journal of Macromarketing*, 25(1), 76-92.
- Schifferstein, H. N. J., & Zwartkruis-Pelgrim, E. P. H. (2008). Consumer-product attachment: Measurement and design implications. *International Journal of Design*, 2(3), 1-13.
- Secondary Materials and Recycled Textiles Association. (1997). *Council for textile recycling*. Retrieved from <http://www.smartasn.org/textilerecycle/index.htm>
- Shih, C. (1998). Conceptualizing consumer experiences in cyberspace. *European Journal of Marketing*, 32(7/8), 655-663.
- Shih, Y.-Y., & Fang, K. (2004). The use of a decomposed theory of planned behavior to study Internet banking in Taiwan. *Internet Research: Electronic Networking Applications and Policy*, 14(3), 213-223.
- Sproles, G. B. (1979). *Fashion: Consumer behavior toward dress*. Minneapolis, Minn: Burgess Pub. Co.
- Sustainable Development Commission. (2006, May). *I will if you will- Towards sustainable consumption*. Retrieved from <http://www.sd-commission.org.uk/publications.php?id=367>
- [TC]². (n.d.). Retrieved September 5, 2010, <http://www.tc2.com/>
- Taylor, S., & Todd, P. (1997). Understanding the determinants of consumer composting behavior. *Journal of Applied Social Psychology*, 27(7), 602-628.

- Textiles Environmental Design. (n.d.).TED's ten sustainable textile design strategies. Retrieved May 12, 2011 from <http://www.tedresearch.net/>
- Thomas, J. B., Peters, C. O., & Tolson, H. (2007). An exploratory investigation of the virtual community MySpace.com: What are consumers saying about fashion?. *Journal of Fashion Marketing and Management*, 11(4), 587-603.
- Thorpe, A. (January 01, 2010). Design's Role in Sustainable Consumption. *Design Issues*, 26, 2, 3-16.
- Treehouse Logic (2010, September 2). Customer co-creation includes community interaction [Web log comment]. Retrieved from <http://blog.treehouselogic.com/2010/09/02/customer-co-creation-includes-community-interaction/>
- Trendhunter. (2007) Get your avatar to try it on first. Retrieved September 5, 2010, from <http://www.trendhunter.com/trends/shinsegae>
- Tukatech. (n.d.). Retrieved September 5, 2010, www.tukatech.com/
- U. N. Department of Economic and Social Affairs. Division for Sustainable Development. (2010). *Trends in sustainable development: Towards sustainable consumption and production*. Retrieved from http://www.un.org/esa/dsd/resources/res_pdfs/publications/trends/trends_sustainable_consumption_production/Trends_in_sustainable_consumption_and_production.pdf
- U.S. Environmental Protection Agency. (n.d.). *Textiles*. Retrieved from <http://www.epa.gov/wastes/conserves/materials/textiles.htm>
- Ulrich, P.V., Anderson-Connell, L.J., Wu, W. (2003). Consumer co-design of apparel for mass customization, *Journal of Fashion Marketing and Management*, 7(4), 398-412.
- Verbeek, P. P., & Slob, A. (2006). Analyzing the relations between technologies and user behavior: Towards a conceptual framework. In P. P. Verbeek & A. Slob (Eds.), *User behavior and technology development: Shaping sustainable relations between consumers and technologies* (pp. 385-399). Dordrecht, The Netherlands: Springer.
- Vogel, D. L., Wetser, S. R., Wei, M., & Boysen G. A. (2005). The role of outcome expectations and attitudes on decisions to seek professional help. *Journal of Counseling Psychology*, 52(4), 459-470.
- Wang, J., Lu, G., Chen, L., Geng, Y., & Deng, W. (2011). Customer participating 3D garment design for mass personalization. *Textile Research Journal*, 81(2), 187-204.

- Weidenboerner, K. (2008). Correlation of affect, verbal commitment, knowledge, locus of control and attitude to environmentally responsible behavior in designers of the built environment: Is knowledge enough?. *Forum on Public Policy*. Retrieved from <http://forumonpublicpolicy.com/summer08papers/archivesummer08/Weidenboerner.pdf>
- World Commission on Environment and Development. (1987). *Our common future*. Oxford; New York: Oxford University Press.
- World Health Organization. (2010). *Climate change and health* (Fact sheet No. 266). Retrieved from <http://www.who.int/mediacentre/factsheets/fs266/en/>
- World Wildlife Fund. (2010). *Living planet report 2010*. Retrieved from <http://assets.panda.org/downloads/lpr2010.pdf>
- Zaffalon, V. (2010, July 19). Climate change, carbon mitigation and textiles. *Textile World*. Retrieved from http://www.textileworld.com/Articles/2010/July/July_August_issue/Features/Climate_Change_Carbon_Mitigation_In_Textiles.html

CHAPTER 4
AN INTERVENTION STUDY ON USING VIDEO CLIPS AS PERSUASION
AGENTS FOR SUSTAINABILITY IN APPAREL CONSUMPTION

4.1. Background and Justification

From the purchase to the possession and use of objects, “pleasure in consumption” is the main reason some people shop a lot (Schaefer & Crane, 2005, p.83). In the domain of fashion, the market system aggressively promotes consumption to keep earnings high (Forum for the Future, 2007). This system works by marketing goods via their symbolic functions and encourages consumers to fulfill their social and cultural needs through the consumption of commodities (Schaefer & Crane, 2005).

The shift from four or five season-based fashion cycles to continuously changing styles and the moving of apparel production overseas have resulted in increasingly affordable clothing and constant choices for consumers over the last two decades (Forum for the Future, 2007). Schor (2005) argued that “apparel is priced far too low to reflect its true economic and ecological costs” (p.312). As the unit cost of garments decreases, sales are constantly promoted by retailers striving to keep their market share (Forum for the Future, 2007). The commodities of contemporary fast-fashion culture are short-lived, and much of the clothing purchased ends up in landfills (Forum for the Future, 2007). This shift has thus amplified the impact of the fashion industry on economies, societies, and the environment.

As a recent United Nations report (2010) explained, “three planets would be needed now if every citizen adopted the UK lifestyle, and five planets if they adopted the average North American lifestyle ” (p. 2). However, motivating consumers to practice a sustainable consumption is a challenge (Peattie & Collins, 2009). Morgan

and Birtwistle (2009) found that study participants, young female consumers 17 to 25 years old, said they would consider modifying their clothing consumption and disposal behavior if they were more aware of the social and environmental consequences of these behaviors.

This chapter examines the effect of a short video on increasing knowledge and creating a “sense of crisis” about the environmental impact of short-lived garments. It presents a study investigating whether such media intervention can promote environmental responsibility, raise awareness about apparel purchase and use and influence behavioral intentions to consume sustainably.

4.1.1. Creating Awareness for Sustainable Consumption

Peattie and Collins (2009) stressed that consumption has been generally discussed from the narrow perspective of purchases. From the viewpoint of conventional consumption in marketing, discussions of what happens after purchasing a product are limited to creating customer satisfaction and brand loyalty to increase sales (Peattie & Collins, 2009). In contrast to conventional practice, sustainable consumption is focused on an “understanding of all the social and environmental impacts that occur throughout the entire production and consumption cycle of a product [. . .] This requires an understanding of consumption, not as the activity of purchase, but as a process of decisions and actions that include purchasing, product use and dealing with any remaining tangible product after use” (Peattie & Collins, 2009, p. 170).

Dolan (2002) stressed the role of sustainable consumption for communicating the link between “ecological degradation, modern hyperconsumption and prevailing economic and political institutions” (p. 5). Schaefer and Crane (2005) explained that it

is difficult to separate consumers from the dominant social paradigm⁴ (and its political, economical, and technological elements), according to which consumers' consumption patterns became habitual and chaotic. In addition, Arbuthnott (2009) reported that people are self-centric in terms of satisfying their own needs without thinking of others (or the environment), and they choose to adhere to familiar habits, which take less effort to perform than new behaviors, such as consuming sustainably by minimizing one's purchases. According to Dourish (2010), although adopting a model of ethical shopping sounds reasonable, framing sustainability only in terms of the theme of personal moral choice around the consumption is not enough to bring about significant changes.

Schaefer and Crane (2005) listed several barriers to more sustainable consumption from the consumer's point of view, such as having "insufficient levels of environmental awareness and concern", being "limited in environmental knowledge and cognitive capacity", giving "insufficient salience and importance to environmental criteria over other product performance benefits", being "skeptical toward environmental-marketing claims" and feeling "ineffective, even powerless, in contributing to environmental solutions through any single act of purchase" (p. 82). Moreover, Buenstorf and Cordes (2008) argued that as incomes and new consumption opportunities increase, expectations for voluntary limitation of consumption should be kept to a minimum.

Other scholars discuss the importance of raising awareness of environmental issues and agree that people need some motivation to break away from the habit of consumption and adopt sustainable practices. Learning is imperative to developing

⁴ Milbrath (1984) stated that "every organized society has a dominant social paradigm [DSP] which consists of the values, metaphysical beliefs, institutions, habits, etc., that collectively provide social lenses through which individuals and groups interpret their social world" (p. 7)

such determination and to the diffusion of sustainable consumption behaviors (Allen, Kilvingston, & Horn, 2002; Arbuthnott, 2009; Su, 2006; Buenstorf & Cordes, 2008).

Schaefer and Crane (2005) discussed how academia and the media play powerful roles in terms of creating a “sense of crisis” about environmental problems. Institutions of higher education should direct students toward environmental sustainability by communicating environmental challenges and generating social or individual initiatives through education (Pasricha & Kadolph, 2009; Su, 2006).

To promote sustainable consumption, Kolandai-Matchett (2009) designed an information campaign through the use of five newspaper articles. The author compared the responses of people who read the articles to those of people who did not, and reported that those who read the articles exhibited significantly greater understanding of sustainable consumption.

In their meta-analysis of environmental behavior, Hines, Hungerford, and Tomera (1987) found that to increase environmental concerns and sustainable behaviors, knowledge about environmental problems should be combined with knowledge of action strategies and skills. As pointed out by Arbuthnott (2009), even when people intend to act in a sustainable way, external influences and personal characteristics play an important role on turning intentions into actions.

4.1.2. The Effect of Multimedia on Learning and Behavioral Change

Mayer (2001) defined multimedia as “the presentation of material using both words and pictures” and maintained that instructional messages should be designed in the form of “multimedia instructional messages” if they are to be effective (p. 4). Fueled by sophisticated computer technologies and the development of Web 2.0⁵ technologies, multimedia learning has become widespread (Hartsell & Yuen, 2006;

⁵ Web2.0, a term coined by O’Reilly, refers to a web-based technology that facilitates communication and sharing among users worldwide via the web (Barnatt, 2009).

Barnatt, 2009). According to Mayer (2001), education was long dominated by the verbal mode (lectures and printed text), until the emergence of current technologies. As new technologies have developed, visual modes (illustrations, simulations, photos, and dynamic graphics such as video) of presentation have been incorporated into previous methods.

Allen and Seaman (2008) stated that online education is a relatively new phenomenon and that because of current economic circumstances; people have become more inclined to take online courses. According to the authors, this trend is likely to increase in the coming years, because it provides flexibility to students who either have time constraints or are at diverse locations. E-learning is the Internet-based technology most widely used to deliver educational material quickly and effectively and offers possible online collaboration and discussion options (Beldarrain, 2006; Zhang, Zhou, Briggs, & Nunamaker, 2006). Zhang et al. (2006) stated that e-learning is “one of the fastest-moving trends” and that it is becoming an alternative to traditional classroom learning practices.

Allen et al. (2002) stated that the cognitive-constructivistic perspective is especially useful to help people change their behaviour towards the environment. Indeed, the cognitive, and constructivist learning theories are widely accepted by researchers engaged in multimedia learning research (Siemens, 2004; Cook, 2010).

Constructivist learning theory postulates that individuals construct their own meaning depending on their interpretations of their personal experiences and what is happening in their social environment (Snelson & Elison-Bowers, 2007; Zhang et al., 2006; Neo & Neo, 2009; Allen et al., 2002). Zhang et al. (2006) reported that “richer learning environments” such as video can convey information in an intriguing way that allows users to engage with the instructional material.

Cognitive learning theory, which stems from the constructivist model, assumes that the “learner’s attention is limited and therefore selective” (Zhang et al., 2006, p.17). This theory is based on “dual coding theory,” according to which visual information and verbal information are processed in two separate and limited channels and then integrated with previously stored memory (Mayer, 2001; Snelson & Elison-Bowers, 2009; Snelson & Elison-Bowers, 2007; Zhang et al., 2006).

Video is a powerful medium that “stimulates, engages and entertains people, triggering them to think, feel and do things differently” (Addison, 2009, p. 21). Choi and Johnson (2005) compared the effects of video-based instruction with those of text-based instruction. Their study participants reported that video-based instruction was more memorable, which implies that the use of “context-based” videos in online courses can improve the ability to memorize content and increase motivation to learn.

According to Addison (2009), the storytelling nature of video makes the process of conveying messages easier while bringing learners together via the same “common frame of reference”. Video-sharing services became especially popular after the foundation of YouTube™ in 2005 (Burke, Synyder, & Rager, 2009; Heldman, 2007). The younger population, known as Generation Y or the Net Generation, has been particularly active in adopting and using online technologies such as video sharing (Nielsen, 2010; Heldman, 2007). These mediums as methods of communication for the younger generation are increasing in approaches and importance.

Snelson and Elison-Bowers (2009) explained that video-sharing services (video 2.0, as coined by the authors) comprise a subset of Web 2.0 tools (i.e., blogs, wikis, and social networking websites). The expansion of video-sharing sites such as YouTube, or the more academically oriented TeacherTube or YouTube Edu shows

that streaming online video can be a useful tool for educational purposes (Snelson & Elison-Bowers, 2009; Hartsell & Yuen, 2006)

Video-based intervention studies used for training and educational research in various areas have demonstrated the effectiveness of video as a learning tool (Choi & Johnson, 2005; Collins, Higbee, & Salzber, 2009; Nikopoulou-Smyrni & Nikopoulos, 2010; Snelson & Elison-Bowers, 2009, Zossou, Van Mele, Vodouhe, & Wanvoeke, 2009). For example, Zhang et al. (2006) compared four learning environments in an experiential study of learning effectiveness: three e-learning settings (interactive video, noninteractive video, and no video) and one traditional classroom setting. They measured learning effectiveness via test scores and perceived learner satisfaction using a survey instrument. Overall, both of the video environments yielded higher scores than the traditional classroom.

The report of the Sustainable Development Commission, “I Will If You Will” (2006), stressed that mass communications (advertising, marketing, and the media) powerfully shape a society’s consumption patterns. In an early study, Iozzi (1989a, 1989b) reported that media (such as broadcasting messages and television) are powerful sources for positively affecting environmental attitudes and values. He added that people gain 88 percent of their knowledge through a combination of seeing and hearing.

The knowledge of environmental issues alone does not encourage positive environmental attitudes (Poolay & O’Connor, 2000). To increase positive environmental attitudes, an education process to increase the knowledge should be specifically designed to address certain pro-environmental behaviors if it is to be more effective (Arbuthnott, 2009). Iozzi (1989a, 1989b) stated that an increased environmental knowledge is not the only key factor for developing an environmentally

conscious behavior. Changing emotions (affective domain) along with logical understanding (cognitive domain) can be useful as well.

According to Fogg (2009), to persuade someone one must select a channel that is familiar to the target user. He states that some channels, such as online video and social networks, are effective in the way that they increase motivation to fulfill a target behavior. Scaturro (2008) identified how digital technologies (she emphasized cameras, home computers, and the Internet) could be used as tools for transforming the conventional fashion system. However, the use of video to persuade and educate has not been widely investigated in the area of sustainability in apparel design.

Perhaps one of the most influential online videos about increasing knowledge of environmental issues is the 20-minute video, “The Story of Stuff Project”, created by the environmental activist Annie Leonard. The project was intended to “amplify public discourse on a series of environmental, social and economic concerns and facilitate the growing [. . .] involvement in strategic efforts to build a more sustainable and just world” (The Story of Stuff Project, n.d.).

Fink (1995) explained that knowledge questions can be added to a survey “to determine if people have enough knowledge on a topic to warrant asking their opinions about it, to identify gaps in the knowledge, and to help explain attitudes and behavior” (p. 74). For the current study, the question of how video clips can advance student knowledge and generate environmental consciousness about apparel consumption was investigated by asking students questions designed to measure their knowledge and attitudes. By summarizing the issues above, research hypotheses for evaluating effects of a videotape on sustainability in the apparel industry were established as follows:

H1a: There will be a significant knowledge difference (posttest–pretest) between the control and the intervention groups after the treatment.

H1b: There will be a significant knowledge difference (posttest–pretest) between Low Environmental Concern (LEC) and High Environmental Concern (HEC) groups after the treatment

H2a: There will be a significant change in intention to “be a green consumer” (posttest–pretest) between the control and the intervention groups after the treatment. Students’ perceptions of themselves as environmentally conscious consumers will be altered after seeing the video.

H2b: There will be a significant difference in intention to “be a green consumer” (posttest–pretest) between the LEC and HEC groups after the treatment.

4.2. Sample Selection

This study was aimed at understanding the use of enabling technologies in an environment in which seeing body–garment relationships is important. Considering the use of design terminology as well as the concept of using enabling technologies for garment design and creation, participants with apparel design knowledge were recruited. Furthermore, as these enabling technologies are new, and the study was intended to discuss the findings for technology-savvy populations, recruiting was conducted on a younger population (i.e., undergraduate and graduate students).

Participants for this study were drawn from the pool of the students enrolled in apparel design programs in North America. Apparel design students in particular were selected because of their education and basic apparel knowledge; they would provide more specific answers for the open-ended section. Moreover, at this initial step, design students were deemed the best participants for the study because of their desire to participate in the design and creation process, and because of their greater design and

terminology knowledge, which would shorten the participant response time.

Participants with design background were also thought capable of providing “to the point” answers, compared with general consumers.

In this pretest–posttest experimental study, all participants first completed an 8- to 10-minute pretest survey. In addition to providing demographic information, respondents rated statements about their knowledge of sustainability issues (seven statements, 5-point Likert scale), and their environmental concerns as consumers (seven statements, 7-point Likert scales). After responses were received for the pretest survey, the participants were divided into two groups: intervention and control. Participants were assigned to a group based on their responses to the green consumerism assessment scale (GCA) to ensure that the more sustainability-conscious people were distributed evenly across both groups for the sake of controlling the study. Depending on their average scores from these particular scales, respondents were stratified into two groups: a Low Environmental Concern (LEC) group and a High Environmental Concern (HEC) group. Respondents were identified as showing LEC if the self-reported GCA results were lower than the midpoint (3). If respondents’ scale results fell between 2.5 and 3, and if they indicated having previously taken a class on sustainability, or showed garment-recycling behaviors (by not choosing a “throw away” option), they were considered to be in the HEC group. The similar number of environmentally conscious participants was in each group (Figure 4.1)

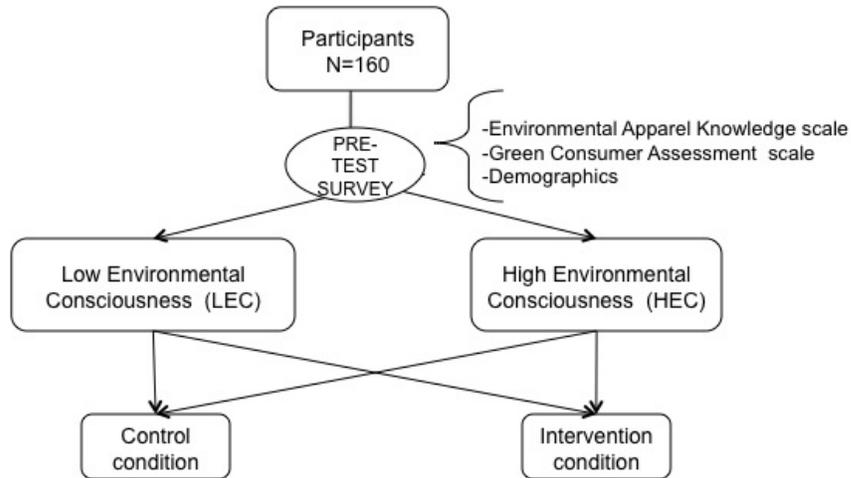


Figure 4.1. Distribution of the Study Participants to Control and Intervention Groups

4.3. Methodology

4.3.1 Instrument Development

Online questionnaires (pre-treatment and post-treatment) were developed using Checkbox 4.6 and used as the research instrument. Checkbox was provided free by Cornell Information Technologies to build online surveys. With this service, it is possible to create invitation-only surveys for increased security. Likert-scale questions were designed that use radio buttons, allowing respondents to choose only one option, and questions requiring users to select one or more options were designed that use checkboxes. For each question line, two different colors were used alternately to discourage respondents from skipping questions. Each page included “Next” and “Previous” tabs at the bottom, allowing respondents to move forward or backward. Questions were placed in the survey so as to minimize scrolling as much as possible. Including the consent form, the pre-treatment survey was eight pages long, and the post-treatment survey was fourteen pages long. Checkbox 4.6 made it easy to export

the results for further analysis to Microsoft Excel, in the .csv format, or to SPSS, in the .sav format, which prevented any errors that might result from manual data entry.

4.3.2. Variables in the Study

Questions were adapted from relevant prior studies, with minor wording changes to tailor the questions to the targeted context. For this study, two Likert-scale measures (Environmental Apparel Knowledge and Green Consumer Assessment Scales) were adapted from previous studies.

The first scale was adapted from Kim and Damhorst’s (1998) 11-item Environmental Apparel Knowledge scale, from which 7 items were used, each of which was measured on a 7-point Likert scale ranging from 1 (*disagree*) to 7 (*agree*) (Table 4.1). To relate this instrument to the video content, minor changes were made to the statements. Two apparel design professors, who were experienced with similar scale measurements, reviewed the items to ensure that their meaning and wording were clear for this application, and further necessary adjustments followed their suggestions. During the pilot testing, no problems related to wording were reported.

Table 4.1. Modified Environmental Apparel Knowledge scale

Statement (code)
1-Chemical pollutants are produced during manufacturing of synthetic or manufactured fibers such as polyester (know1)
2- Chemical pollutants are not produced during processing of natural fibers such as cotton (know2, reverse scored),
3- Pollution occurs during the transportation of textile goods (know3)
4- Dyeing and finishing processes use a lot of water (know4)
5- Whole garments can not be recycled (know5, reverse scored)
6- Fast fashion strategies have substantially contributed to the quantity of textile products discarded in landfills (know6)
7- Phosphate-containing detergents can be a source of water pollution (know7)

As explained by Kim and Damhorst (1998), agreement with 5 items and disagreement with 2 items were taken to indicate that respondents were aware of the environmental facts related to the apparel industry. Posttest data from 160 participants were analyzed using SPSS 19, and yielded a Cronbach’s alpha coefficient of 0.77, which satisfied the requirement for measurement-scale reliability by exceeding the threshold value of 0.70. Therefore, the knowledge scale has reasonably high internal consistency.

According to Schaefer and Crane (2005), “green consumption” focuses on consumers’ environmental concerns and defines consumption patterns and products that are less harmful to the environment. The authors defined green consumers as “motivated by strong environmental values and attitudes” (p. 79). The scale used to measure this factor was adapted from Dombek-Keith’s (2008) Green Consumer Assessment scale (GCA) (Table 4.2).

Table.4.2. Green Consumer Assessment scale (GCA)(Dombek-Keith, 2008)

Statement (code)
1- If I had more money I would definitely buy more and more things (GCA1, reverse scored)
2- I buy fewer things than the average person my age (GCA2)
3- When I go shopping, I usually plan out what I am going to buy beforehand and I usually end up buying what I planned (GCA3)
4- I read and compare labels to look for environmentally safe ingredients/ practices (GCA4)
5- I consider myself as an ‘environmentally conscious’ consumer (GCA5)
6- My local environment would really have to deteriorate before I would consider altering the way I consume (reverse scored) (GCA6)
7- I do not feel I have enough knowledge to make well informed decisions on environmental issues (GCA7, reverse scored)

The seven items for this construct measured participants’ levels of environmental knowledge, behaviors, and attitudes toward excessive and impulsive

consumption intentions using a 5-point Likert-type scale that ranged from 1 (*strongly disagree*) to 5 = (*strongly agree*). For this study, the reliability of the GCA was found to be .73 (Table 4.3). Factor analysis of the GCA revealed that it had two dimensions. However, because they reflect several faces of this particular context, for the purposes of this study the whole scale average was calculated instead of dividing it into two separate components.

Table 4.3. Descriptive Statistics for Main Constructs (N=160)

Construct	#Items	Cronbach's alpha obtained in this study (N=160)	Previously obtained Cronbach's alpha
Environmental Apparel Knowledge Scale	7	.77	.74 (11 item, Kim & Damhorst, 1998)
Green Consumer Assessment Scale	7	.73	.73 (Dombek-Keith, 2008)

In order to assess the effectiveness of the video in participants' own words, and to discover whether any parts of the video were unclear, two open-ended questions were posed:

- 1- How understandable was the video in explaining sustainability issues in the textiles and apparel area?
- 2- Do you think you learned something from it? Can you describe what you learned?

4.3.3. Pretesting and Pilot Testing

First, the questionnaires were pretested among Fiber Science and Apparel Design (N=6) and Design and Environmental Analysis (N=2) graduate students at Cornell University. They were asked to comment on the relevance of the items,

wording, accessibility of the survey, ease of survey use, length of the survey, and time taken to complete it. Based on feedback from this pretest, some questions were modified and some terms were explained in more detail. In addition, some items were dropped, and the design of the survey, typefaces, and colors were improved. The survey was divided into subsections, which allowed the respondents to answer the questions with a minimum of scrolling. Additionally, three professors in the apparel design area reviewed the chosen scale items for wording and redundancy problems and provided their feedback. Changes were made according to their feedback.

As a pilot test to measure the clarity of the modified surveys, they were tested with a group of apparel design students (N=21) who had graduated one semester before this study. Generally, good comments on the items and the duration of the survey were received. However, some items still appeared to be redundant, so they were dropped for the final questionnaire. Cronbach's alpha values were calculated for each scale as a measure of reliability and internal consistency. As a global rule, a Cronbach's alpha value of more than .70 indicates a reliable measure.

The results of the pilot study helped to determine whether the instrument would work well under different operating systems (Microsoft Windows and Mac OS). The pilot-test results also indicated the duration of the pre- and post-treatment survey sections (8–12 minutes and 20–30 minutes, including the treatment, respectively).

4.3.4. Survey Administration

Following the pilot test and necessary corrections, a professor in another university's apparel design department was contacted and asked whether she would distribute the recruitment message to her students. At first, a raffle was given as an incentive, but only one student responded to the message. Therefore, the incentive was

changed to a \$10 online gift card from Amazon.com for every participant. This greatly improved the response rate.

After obtaining an exemption from the Institutional Review Board (IRB) (Appendix A), professors in apparel design programs across North America were contacted to and request help in recruiting their students to this study. The video link was sent to the professors as an e-mail attachment, and their assistance in advertising the study to their students was solicited. Some of the universities required a second IRB application from their own institutions, so before any data collection could occur; separate IRB approvals were acquired from these institutions. Official recruiting started on April 24, 2010, and lasted until September 30, 2010. Each participant received a \$10 online gift card from Amazon.com. Some participants received extra credit for participating in this study, which was given as an option by their professors. The participants generally contacted me directly through e-mail. For some of the smaller participant populations, e-mail addresses were collected from the students' professors.

After the e-mail addresses were acquired, an automated email was sent, including a copy of a consent form with information on the study and a contact number, with the link to the pre-test at the end of the message. As soon as a response was received, scale items were summed and averages were calculated; then the respondents were assigned to one of the posttest survey groups within 24 hours in a stratified manner. This decision was made based on reducing the time frame that participants can be exposed to other external effects which might affect their response.

4.3.5. Survey Structure

The final survey consisted of two parts: pretest and posttest. Data collected during the pretest were used to assign participants to two groups in a homogenous manner based on their environmental knowledge and concern levels (high or low)

In the pretest survey, respondents were required to read a consent form, which briefly described the research and consent to participate in the study, before they began (Appendix C). Then they were asked to provide demographic data. The pretest survey included scales, which measured the environmental orientations of the participants (Green Consumer Assessment Scale), as well as their knowledge of apparel industry–related environmental issues (Environmental Apparel Knowledge Scale).

At the beginning of the posttest, intervention group participants, who would watch the video intervention, were directed to a Web site via an html link where they could watch the short treatment video on sustainability and technology’s possible effect on garment design and consumption. The video was ten minutes long, and was uploaded to a video-sharing website (www.vimeo.com) and protected by a password. The focus of the video was on how technology can engage users of the technology in apparel design and how environmental responsibility can be a part of apparel design. At the end of the posttest the same green-consumerism and environmental-knowledge scales, as those used in the pretest were presented. Responses to these scales were used to determine the effect of treatment video on participants’ environmental knowledge and behavior.

The dependent variable for this study was the effect of the video on participants’ short-term learning and intention to change their consumption behaviors according to the information presented. It was operationalized as the difference in level of knowledge (delta knowledge) and difference in consumption intentions (delta

consumption) based on pre- and posttest results. Participants' self-reported perceptions of the video content were summarized from the two open-ended questions placed at the end of the survey instrument. For the open-ended questions, answers were quantified as positive or negative. Responses to the open-ended responses were mainly collected as feedback for developing a better video and to understand the actual thoughts of the respondents.

In addition to the closed-ended Likert-scale questions, the effectiveness of video was further assessed through two open-ended questions at the end of the posttest survey for both groups.

4.3.6. Treatment (Intervention Video)

The intervention video was prepared in order to create a scenario to establish a sense of urgency on sustainability and convince people that change is necessary and possible. It was intended to tell a story, not to give a lecture. Video was selected as the intervention delivery vehicle for its visual qualities. As Zhang et al. (2006) pointed out, a video clip is an effective way to gain a student's attention when introducing a topic. To convey the instructional messages, on-screen modeling by a character to whom students can relate was also used.

A film student from another college in the same city was hired to create an engaging video integrating the research questions and vision of sustainability into a storyline about the journey of discovery of an apparel student. From conception to postproduction editing, the development of the video took approximately two months. The filmmaker and I collaborated throughout the activity as a team. The filmmaker had an innovative vision and was willing to create a product on a limited budget. To find the actress to portray Maggie Wu, student groups were contacted by email, emphasizing the limited budget, and received one positive response. The student's

incentive was meals, snacks and drinks during the shooting, and the experience of acting in a short video.

Snelson and Elison-Bowers (2009) suggested applying the following steps when designing a “micro-level instructional online video”:

- 1- Shift to a small-scale focus (instructional content should be chunked into small amounts)
- 2- Apply relevant learning theory (the cognitive theory of multimedia learning was recommended as an appropriate theoretical framework)
- 3- Manage the technology (select and apply appropriate technologies)
- 4- Evaluate the product (collect formal and/or informal data to assess effectiveness)

While preparing the video treatment, several of Mayer’s (2001) research-based principles on cognitive theory of multimedia learning in the video-clip design were employed. Verbal information was narrated by “Maggie Wu”, rather than on-screen text; visuals were presented along with the verbal information for coherency; and any extra input was avoided. As recommended by Muller, Lee and Sharma (2008), this short multimedia clip included images, animated flowcharts, excerpts from an interview with a local activist (Wendy Skinner from SewGreen, on reducing excess apparel consumption), demonstration of available technologies as a solution that can lead to change (showing Maggie Wu getting a 3D body scan, and using virtual-try on software as an enabling technology to create well-fitted custom clothing). Following Koumi’s (2006) multimedia design instructions, several tactics were used such as using transitory effects by not staying with a single medium, but switching media from static images to dynamic mediums (interview, demonstrations, animation), in order to

avoid “warm-bath syndrome”, whereby monotony causes loss of attention to the topic (Koumi, 2006, p. 46).

Time constraints led me to select images directly from the Web for the creation of this intervention. The intervention video was delivered via a video-share environment, Vimeo, in a password-protected environment where only invited participants can enter and watch. The video was deleted immediately after the data acquisition was completed. Fair-use guidelines of the images for one-time research purpose were met, as it was not open to the public to view.

4.3.7. Script

Koumi (2006) created a detailed table with a framework to show how to write a pedagogic video script: (make the viewers want to know, tell them what you will do, do it pedagogically (post questions, sensitizing, reinforce by repetition), tell them what you have done by summarizing key features, and connect it [to the setting, instruction etc.]). Overloading was prevented by keeping the script short (Koumi, 2006, p. 161) The script was written based on the literature (Su, 2006; Loker, 2008; Forum for the Future, 2007; Fletcher, 2008) and considering the most prominent areas in which change is needed (such as usage and disposal of textile chemicals, sweatshops, transportation of goods, inhibiting/environmental effect of secondhand garments on the development of local industries) that also addressed the selected measurement items (Table 4.4).

The video begins with the following introductory sentence (after Maggie Wu introduces herself): “What I really didn’t know about until now is the fact that, from new material production to transportation and distribution, our apparel industry is contributing to significant environmental degradation”.

For the storyline the character Maggie Wu, an apparel design undergraduate, was created who underwent a metamorphosis after realizing the environmental effects of excess apparel consumption. The issues surrounding environmental responsibility in the apparel industry, an expert’s views on living in a sustainable community environment, advances in digital apparel design that could lead to change, and suggestions for change were some of the topics introduced within the video clip. Images that created a strong emotional feeling about the concept were selected.

Table 4.4. Excerpts From the Video Related to the Environmental Apparel Knowledge Scale Items

Knowledge Scale item #	Related Script
1-2	“Starting from the earliest production processes we create pollution in our industry: Growing natural materials and the manufacture of dyes and synthetic materials create pollution” (<i>sensitizing images+narration</i>)
3	“(. . .) the system of offshore production introduces some other issues such as unethical working conditions and greater transportation distances and increases carbon emissions to the atmosphere (<i>flowchart and images+narration</i>)
4	“Dyeing and printing consume vast amounts of water and chemicals, and wastewater with high chemical content is often dumped back into clean water sources.” (Sensitizing images of polluted rivers and a flowchart showing the stages where pollution occurs during textile production was animated in addition to the narration)
5	“Recycling is discarding and processing the materials in such a way that they may be incorporated into new products. (<i>Patagonia images+NO narration</i>)
6	“Clothing over the past few decades has gotten cheaper, and along with this trend our waste from clothing has increased more than ever. One of the reasons for the disposal problem is the shift in the seasonal fashion cycle. It used to be based on climatic needs only - but not anymore: A ‘new’ fashion item only lasts for a few weeks, and retail stores are constantly stocking new clothing, instead of just for well defined seasonal changes.” (<i>images of well-known fast fashion companies such as Zara, H&M+ narration</i>)
7	Phosphate-containing detergents can be a source of water pollution (<i>images</i>)

The length of the video was ten minutes, similar to Web 2.0 clips frequently seen on the video-sharing services. The focus of the video was how apparel design technology can engage users and how environmental responsibility can be a part of apparel design. The video was shot with a Panasonic AG-DVC80P and recorded on mini DV tape. Then it was digitized directly in the editing software Apple Final Cut Pro. The file was uploaded to the video-sharing website Vimeo to be used for password-protected video streaming over the Internet.

4.4. Data Analysis

The data were analyzed using SPSS 19.0. In the first step, descriptive statistics (frequency, percentage, mean, standard deviation, visual tests for normality using histograms) were computed to obtain an overall picture of the data. Scales' reliability and validities were calculated by Cronbach's alpha and factor analyses before using variables in further analyses. Then, the data analysis examined the relationships between the independent and dependent variables. General linear model [GLM] univariate analysis was employed for the multiple regression analyses.

Scales contained both negative and positive items to avoid agreement bias. For the evaluation, negative items were reverse-scored. Higher scale means show higher environmental knowledge and a positive attitude toward sustainable actions.

Respondents who had not answered a particular question were excluded from the analyses for that question. For instance, if a respondent did not answer a question regarding demographics, his/her responses were left out of the analysis of demographic data, but his/her responses to scales were used for the analysis.

The GLM was used to compare learners' knowledge levels and apparel-consumption intentions as "green consumers" based on data collected from pre and posttests for the intervention and control subgroups of LEC and HEC groups. Change

(posttest–pretest) within groups for both knowledge and GCA scales was measured. These new variables were named delta knowledge (Δ knowledge) and delta green consumer assessment (Δ gca). For statistical significance, $p < 0.05$ was the criterion for all analyses. The dependent variable was the change (posttest–pretest) and the model was fitted to the data controlling for the two categorical independent variables, Treatment and Environmental Concern (EC), and the continuous independent variable, Pretest. An interaction term, Treatment by EC was also included.

Participant responses to open-ended questions were collected from the questionnaire for every subject in each group. All responses were reviewed for their agreement/disagreement with the video’s contribution to the participants’ knowledge, and the results were quantified by counting the negative and positive comments. Comments such as “not really” were counted as negative, whereas comments such as “I learned a lot” were considered positive. Comments such as “it could have been better” were considered neutral. In addition to quantifying responses, key terms were identified.

4.5. Results and Discussion

A total of 327 invitations were initially sent out to students. One hundred and eighty students responded to the pretest (response rate: 55.05%), and 160 of these respondents completed the second part of the survey. Therefore, the overall completion rate among the participants who were willing to take the survey was 88.9%. A maximum of two reminders were sent in the three weeks after the first invitation e-mail. Reminders resulted in 14 more participants completing the second survey. At the end of the data collection, there were 78 people in the control group and 82 people in the intervention group. Data analyses showed that both of the groups were also nearly identical to each other in terms of the participants’ educational

background, interests, environmental concerns, and garment-purchase and disposal behaviors.

Toward the end of the survey, many of the control-group participants did not complete the Section Five questions. Only 46 (58.9 %) of the control group completed this section while all of the intervention group participants completing the survey.

4.5.1. Demographics

Among the respondents, there were 150 (93.8%) females and 10 (6.2%) males. The participants were sophomore (29.4%), junior (28.7%), and senior (39.4%) apparel design students ranging in age from 18 to 26 with a mean age of 20.81 and a standard deviation of 1.83. Caucasians made up the majority of the study population (74.7%), followed by Asian (15.2%) and African American (5.7%) participants.

Results indicated that 51.2% of the respondents had taken at least one sustainability-related course (53.9% in the control group and 48.8% in the intervention group).

Table 4.5 shows the percentage of participants in the subgroups (LEC and HEC) of control and intervention groups.

Table 4.5. Distribution of the participants

	Environmental Concern (EC)		Total
	Low Environmental Concern (frequency %)	High Environmental Concern (frequency %)	
Control	36 (46.8%)	42 (53.2%)	78 (100%)
Intervention	43 (51.8%)	39 (48.2%)	82 (100%)

Usage of technologies: The majority of the respondents were technologically proficient. All of the participants were Internet users; most used YouTube™ (96.1% in the control group and 95.2% in the intervention group). Over fifty percent of the total

group owned PDAs (50.6%). The majority of students responding to the survey reported that they used gaming systems (e.g., Nintendo's Wii; 77.6% control group, 82.1% intervention group), and all of them were users of social networks (e.g., Facebook).

Shopping Behaviors: Possible responses to the questions about participants' garment purchase frequencies included six choices including several times a week, once a week, two to three times a month, once a month, once every three months, and less than once every three months. When intervention and control groups were analyzed individually, it was apparent that both groups purchased frequently, many purchasing garments two to three times a month (intervention = 42.9%, control = 37.3%). For both of the groups, the next most popular option was "once a month" (intervention = 27.3%, control = 24.1%). The least popular option was "less than once every three months" (intervention = 3.9 %, control = 0%). 66.9% (N=107) of the respondents shopped using the Internet. When both groups were examined regarding the frequency of their Internet purchasing of clothing, the most participants reported that they shop once every three months (intervention = 27.5%, control = 30.7%). This frequency was followed by "once every six months (intervention = 23.3%, control = 17.3%). The frequency of purchasing more than once a month was the lowest option for both groups (intervention = 4.3%, control = 3.5%).

As for shopping preferences, the respondents reported that they mostly shop from specialty stores (82.5%), department stores (74.4%), and the Internet (66.9%). Only 27.5% of the respondents reported using thrift stores for their garment purchases.

Garment Disposal: The majority (78.8%) of the respondents reported that they donate their garments to thrift stores (intervention = 85.7%, control = 72.3%). Passing clothing on to friends and relatives was also a frequent choice, as indicated by the high percentage of 71.9% (intervention = 71.4%, control = 72.3%). Storing the garments in

a closet was the third most frequent behavior at 58.8% (intervention = 63%, control = 54.2%). The percentage of respondents reporting throwing the garments away was lower, 22.5% (intervention = 19.5%, control = 25.3%). Refashioning was not a high concern for either of the groups (intervention = 41.6%, control = 37.3%). Only 20.6% of the participants were interested in selling the garments to a thrift store.

4.5.2. Descriptive Statistics

4.5.2.1. Changes in Knowledge

Aggregated data given in Table 4.6 show that mean values for the HEC groups were slightly higher than those for the LEC group in all conditions. Moreover, all groups' scores were higher than the neutral point (=4) in all conditions. This indicates that all group members had fairly high apparel-related sustainability knowledge before taking the survey. When compared with the control group, intervention group posttest scores were higher than pretest scores, but posttest scores for the HEC control group were also higher than pretest scores. Knowledge change (posttest-pretest) was positive for all groups.

Table 4.6. Descriptive statistics for the pretest and posttest knowledge scale means

Groups		Pretest Knowledge			Posttest Knowledge			Δ knowledge
		N ^a	Mean	SD	N ^a	Mean	SD	
Low Environmental Concern	Control	36	5.64	.73	23	5.62	.89	.02
	Intervention	43	5.20	.82	43	5.86	1.00	.66
High Environmental Concern	Control	42	5.86	.75	23	5.96	.60	.10
	Intervention	39	5.46	.83	39	6.10	.88	.64

Note: Based on 7-point Likert-type scale (1 = *strongly disagree*, 7 = *strongly agree*).

^aN totals vary due to missing cases.

4.5.2.2. *Changes in Assessment of Self as a Green Consumer*

GCA responses to the pre- and posttest questions were examined to see whether the treatment had an effect on participants' attitudes toward consuming less and their opinions about whether they had "enough knowledge to make well informed decisions on environmental issues" (GCA Statement 7) after watching the video. The persuasive effect of the video on the perceptions of being "green consumers" was examined for this section; results are presented in Table 4.7

Table 4.7. Descriptive statistics for the pretest and posttest Green Consumer Assessment scale means

Groups		Pretest GCA			Posttest GCA			Δ GCA
		N ^a	Mean	SD	N ^a	Mean	SD	
Low Environmental Concern	Control	36	2.30	.51	23	2.28	.48	-.02
	Intervention	43	2.29	.46	43	2.79	.65	.50
High Environmental Concern	Control	42	3.15	.75	23	3.16	.60	.01
	Intervention	39	3.08	.53	39	3.47	.61	.39

Note: Based on 5-point Likert-type scale (1 = *strongly disagree*, 5 = *strongly agree*).

^aN totals vary due to missing cases.

The mean values for the whole GCA scale are given in Table 4.7. Overall, mean values for the HEC group were higher than those for the LEC group, which were below the neutral point (=3). The intervention group scores were higher for the posttest than for the pretest, but the HEC control group also scored higher on the posttest than the pretest.

As a general trend, even though the differences between posttest and pretest means for the knowledge and green consumer statements were greater for the intervention group, control group members in HEC group also scored higher for some statements as well, an indication that the mean differences may not be statistically significant. To understand the real nature of the data, the data were further analyzed with the univariate GLM procedure in SPSS.

4.5.3. The General Linear Univariate Model (GLM)

4.5.3.1. Preliminary Data Analysis for Multiple Regression

Data were checked for multicollinearity by running linear regression analyses and concluded that there was no multicollinearity within the data.

Linearity between dependent and independent variables was evaluated by looking at the scatter plots and it was found that entire variables met the assumption of linearity. Normality was checked in the same manner (visual inspection), and plots of standardized and studentized residuals were examined for their deviations from normal.

4.5.3.2. Environmental Apparel Knowledge

To investigate the presence of significant knowledge differences between the LEC and HEC groups in the control and intervention groups, a new variable, delta knowledge, was created to represent the differences between the pre- and posttest responses for each statement. The results were compared for both control and intervention groups to see the effects of treatment, environmental concern (EC), pretest interactions (Treatment \times EC and Treatment \times Pretest) on the dependent variable (delta knowledge; Table 4.8). All these variables were entered into the multiple regression, then, nonsignificant terms were removed, hierarchically, starting with the highest nonsignificant term. Table 4.8 presents aggregated scale variables' significance effect on total delta knowledge.

Table 4.8. General linear model result of between-subjects effects for aggregated knowledge-scale items

Source	EM Means	Ad. R ²	R ²	df	B	SE _B	F
Intercept					1.98	.42	
Treatment (ref. group = control)	.34	.20	.22	1	.53	.13	15.88**
EC (ref. group = LEC)					.05	.12	.16
Preknow				1	-.26	.08	10.72**

Note: Dependent variable is delta knowledge calculated as mean.

EC = Environmental concern; LEC = Low environmental concern; Preknow = Pretest effect; calculated as mean.

* Results are significant at the .05 level ($p < .05$).

** Results are significant at the .001 level ($p < .001$).

Hypothesis 1a: There will be a significant knowledge difference (posttest–pretest) between the control and the intervention groups after the treatment.

GLM analysis yielded a significant main effect for the pretest. Pretest had a significant indirect effect on the dependent variable, $F(1, 128) = 10.72, p < .001, B = -.26$. This shows that taking the same test twice within a short period of time resulted in pretest sensitization, as described by Kim and Wilson (2010).

However, as a group, the treatment was effective on total knowledge increase. GLM analysis for the aggregated knowledge scale yielded significant main effects for the treatment, $F(1, 128) = 15.88, p < .001, B = .53$. Treatment’s effect on the dependent variable was significantly positive. This shows that for both levels of EC, respondents’ agreements with the knowledge statements increased after watching the video. The responses of the LEC group increased from $M=5.20$ ($SD=.82$) to $M=5.86$ ($SD=1.00$), and the HEC group’s results increased from $M=5.46$ ($SD=.83$) to $M=6.10$ ($SD=.88$). Therefore, Hypothesis 1a is supported. A relatively small portion (20%) of the variance in the dependent variable was explained by two variables, treatment and pretest, in the model. There was no interaction effect of variables on the dependent variable.

Hypothesis 1b: There will be a significant knowledge difference (posttest–pretest) between Low Environmental Concern (LEC) and High Environmental Concern (HEC) groups after the treatment.

GLM analyses revealed that, EC did not affect total knowledge increase. EC had no significant effect on knowledge increase after the video intervention, $F(1, 128) = .16, p > .05, B = .05$. Therefore, Hypothesis 1b is rejected.

4.5.3.3. Green Consumer Assessment (GCA)

As a means to analyze the presence of an increase in GCA statements between the control and intervention group, a new variable called delta green consumerism (posttest–pretest) was created for each GCA question. Results for both control and intervention groups were compared to see the effects of treatment, environmental concern, Treatment \times EC and Treatment \times Pretest GCA interactions, and pretest (covariate) on the (posttest–pretest) difference (Table 4.9). All these variables were entered into the multiple regressions, then, nonsignificant terms were removed hierarchically, starting from the highest nonsignificant term. Table 4.9 presents aggregated scale variables’ significance effect on total delta green consumerism.

Table 4.9. General linear model result of between-subjects effects for aggregated Green Customer Assessment scale items

Source	EM Means	Ad. R ²	R ²	df	B	SE _B	F
Intercept					1.12	.20	
Treatment (ref. group = control)	.24	.21	.23	1	.41	.08	23.65**
EC (ref. group = LEC)					.19	.10	3.33
Pregca				1	-.29	.08	12.16**

Note: Dependent variable is delta GCA calculated as mean. EC = Environmental concern; Pregca = Pretest effect, calculated as mean.

* Results are significant at the .05 level ($p < .05$).

** Results are significant at the .001 level ($p < .001$).

Hypothesis 2a: There will be a significant change in intention to “being a green consumer” (posttest–pretest) between the control and the intervention groups after the treatment. That is, participants’ perceptions of themselves as environmentally conscious consumers will be altered after seeing the video.

GLM analysis for the aggregated green consumerism scale yielded significant main effects for the treatment, $F(1, 128) = 23.65, p < .001, B = .41$. The treatment’s effect on the dependent variable was positive. This shows that for both levels of EC, respondents in the intervention group scored the GCA statements higher after watching the video. The LEC group’s responses increased from $M=2.29$ ($SD=.46$) to $M=2.79$ ($SD=.65$), but results were still below the neutral point ($=3$). The HEC group’s results increased from $M=3.08$ ($SD=.53$) to $M=3.47$ ($SD=.61$), and showed increased concern about the environmental effects of overconsumption and above the neutral point ($=3$). Therefore, Hypothesis 2a is supported. Pretest had a significant indirect effect on the dependent variable as well, $F(1, 128) = 12.16, p < .001, B = -.29$. A relatively small portion (21%) of the variance in the dependent variable was explained by two variables, treatment and pretest, in the model. There was no interaction effect of variables on the dependent variable.

This result showed that the participants were affected by the narration and images used in the video about the importance to the environment of reducing excessive garment purchases.

Hypothesis 2b: There will be a significant difference in intention to “be a green consumer” (posttest–pretest) between the Low Environmental Concern and High Environmental Concern groups after the treatment.

EC had no significant effect on knowledge increase after the video intervention, $F(1, 128) = 3.33, p > .05, B = .19$. Therefore, Hypothesis 2a is rejected.

4.5.4. Open-Ended Questions

The responses of the LEC and HEC intervention groups to open-ended questions were quite similar. In general, for Question 1, “How understandable was the video in explaining sustainability issues in the textiles and apparel area?” the video received many positive comments from the participants who viewed it (76 out of 81, or 93%).

Very understandable! I enjoyed the visual pictures in the background while listening to the video narration. (Participant E33)

It made a lot of sense and explained sustainability in a way that was easy to understand. (Participant E20)

The video was very clear in explaining sustainability issues. The flow charts were simple and easy to read and the images showed realistic examples. (Participant E2)

Comments (5 out of 81, 6.2%) showed that for some participants, the content was limited and needed to be developed. As one participant responded,

I thought it approached the problem from an understandable, but slightly limited, point of view. (Participant E10)

. . . the charts were confusing. (Participant E75)

These responses will be helpful for the future development of the video. As Kolandai-Matchett (2009) suggested, some amount of quantitative information would increase the persuasive effect of the message by providing convincing support. As Participant E4 suggested,

The video went over key concepts, but did not provide examples (legal cases?), numbers (statistics?) or enough evidence (proof) to convey its message with a strength that could turn a non-believer into a believer. (Participant E4)

For Question 2, “Do you think you learned something from it? Can you describe what you learned?” Of the respondents, 71 out of 80 (89%) reported that they did. Responses to this video indicated that, although the respondents already knew some of the presented information, the video was still effectual. This demonstrated the power of images and of conveying information via an effective channel.

[...] not necessarily new information but many issues were brought to my attention. (Participant E60)

I do! It really made me think about the ways I currently consume clothing. (Participant E23)

I would definitely say it helped me think more about sustainability and showed me ways to actually provide future generations with a sustainable future. It’s quite a motivating video. (Participant E49)

The video was capable of creating a sense of urgency, as stated by the following participants:

. . . I was very touched by the video and I would definitely start changing the way how I purchase my clothes. (Participant E7)

I did learn, and the next time I go shopping, I’ll probably have this thought reoccur in my head. (Participant E83)

I would definitely say it helped me think more about sustainability and showed me ways to actually provide future generations with a sustainable future. It’s quite a motivating video. (Participant E5)

Moreover, the video intervention was seen as a reinforcer, and a refresher of the issues covered in classes:

I have taken a class on sustainability issues in the textiles and apparel area, so the video was more like a refresher of the knowledge that I gained from the class. (Participant E49)

These findings supported Hartsell and Yuen's (2006) arguments that using well-synchronized visual and auditory messages can help students to process the instructional information quickly.

The potential effect of new fashion technologies on sustainable consumption was also mentioned in the video. Some respondents stated that they found these technologies interesting and the idea challenged them to think about technology-sustainability relationship:

Most of these things I knew from class experience, however I did learn of new opportunities in sustainable fashion that I was unaware of and will now investigate. (Participant E80)

yes—there is a whole different side to the custom clothing industry that is even good for the environment and consumer habits. (Participant E81)

I had never heard of the technology until now and I think that it is amazing. When it becomes more readily available I think designers all over the world will use it. (Participant E7)

Other comments (9 out of 80, 11%) indicated that participants already knew the topics covered in the video from their classes, or get similar messages from the media on a regular basis. However, as one respondent stated, the media was appealing to our target population.

I don't think I learned anything that has not been discussed in recent media accounts, but it brought the point home very well, and in a format that is tangible for many people. (Participant E82)

There was also one negative comment about the concept itself; it was also helpful to see that depending on participants' educational background or beliefs, the

intervention video was not quite persuasive for all participants. As reported by Rickinson and Lundholm (2008), it should not assume that students would share educators' beliefs about the sustainability-related issues presented in this particular educational tool.

I don't think I learned anything that I didn't already know except that some people have very unrealistic expectations of what people are going to be willing to do for sustainability. (Participant E145)

Criticisms of the video helped us to detect some of the limitations of the video and where people needed to see more information.

As users of Web 2.0, respondents also indicated that they wanted to share the video with their friends:

Fantastic, really informative, but also really great fashion images that connect seemingly disparate issues of production and ethics. I was really impressed and would want to share this video with my friends. (Participant E56)

It was great. I want to share it with friends. (Participant E19)

4.6. Conclusions and Future Work

There is an increasing demand for a fashion education and institutions, which teach fashion, are currently very popular. As stated by Welters (2004), fashion "is not going away anytime soon" (p.27). One way to change the wasteful fashion system is to educate future's fashion designers about sustainability. In this study the effect of short video clips on knowledge of and development of awareness about environmental sustainability was explored by providing information in a story-like context rather than a more instructional one.

The story telling and the narrative nature of the video intervention for persuasion were successful in finding evidence to motivate people to rethink their

apparel purchase/ disposal behaviors. The video also affected its viewers in a way that they would seek more information about the garments they buy as a result of their increased awareness. Following the suggestions of Hartsell and Yuen (2006), it was important to keep the participants' engagement with the instructional content high through 10 minutes. Responses to the open-ended questions demonstrated that keeping the video treatment short, and presenting it from a student's point of view, rather than that of a lecturer, helped maintain participants' interest.

GLM analysis results showed that, the video treatment led to a significant increase in knowledge on apparel industry's environmental impact. The video treatment also led to a significant increase in respondents' perceptions of themselves as environmentally conscious consumers. Furthermore, being subjected to a pretest 24 hours before taking the posttest had a significant effect on knowledge for all of the statements. As pretest effects increase, the difference between pretest and posttest scores decreases. These were reflected by the negative association between pretest and delta knowledge.

This study's findings support those of an earlier study by Kozar and Hiller-Connell (2010), which showed that students today are more knowledgeable than Kim and Damhort's participants in 1998. Kozar and Hiller-Connell (2010) emphasized that possessing knowledge about sustainability-related issues in the apparel industry does not automatically change habitual behaviors, such as purchasing practices and decisions. In this present study, the video treatment's effect on increasing environmental concern was successful and promising. Participants' perceptions of themselves as environmentally conscious consumers were significantly altered after seeing the video treatment. As Fien, Neil and Bentley (2008) stated, the high literacy of young people in new media may "offset the influence of their immersion in consumer culture" (p. 58). This present study demonstrated that a short-term

persuasion on sustainable consumption is possible, as long as the format and content are chosen to convey the messages successfully to the target population. For future studies, a follow-up study should be conducted to measure the long-term effects of the video treatment. Participants can be contacted to answer the same questions after a certain time period, or participants' actual consumption behaviors can be observed as an in-depth qualitative study following the intervention study.

Open-ended responses reflected participants' perceptions of the intervention video. The video stimulated thinking about the relationship between sustainability and apparel consumption, as one of the participants' response demonstrates:

Definitely. I never really thought about a lot of what she was saying.
(Participant 50)

The video intervention was especially effective in increasing awareness of excessive apparel consumption, providing some evidence that a sustainable behavior intention can be influenced by awareness of environmental sustainability when information is presented from an emotional perspective. In this short video intervention, besides 'influencing hearts and minds' (Arbutnott, 2009) by explaining current environmental problems through images that add an emotional dimension to the knowledge, participants were presented several different points of view regarding sustainable consumption of garments. Recalling Participant 50's quote ("I have never really thought about a lot of what she was saying"), such a strategy could be a beneficial supplement to current sustainability education.

The results also provided further support for Pooley and O'Connor's (2000) findings on the importance of both cognition and affect as sources of information. As the authors suggested, in educating people about environmental sustainability, it is important to target both emotions and beliefs. Responses to the open-ended questions supported Van Birgelen, Semeijn, & Keicher's (2009) arguments on the importance of

reaching consumers' minds through affective use of instructional tools. Choosing a media format that would appeal to our target group was also useful in terms of generating a thought-provoking process.

A skeptical comment made by Participant 145 illustrates the point made by Schaefer and Crane (2005), that efforts made to reduce material consumption for sustainability purposes can be perceived as unfavorable by some individuals, because consumption has deep sociocultural roots. Although Schaefer and Crane (2005) do not foresee a majority of consumers adopting less wasteful forms of consumption anytime soon, our results suggest that effective information campaigns may reduce the frequency of impulse shopping.

In general, intervention group participants showed more interest in explaining their thoughts while answering open-ended questions than the control group participants. This may be a sign of the video's stimulating effect, since this group's answers varied from environmentalism to refashioning to excitement about new technology to participants' insights and inputs about technology's possible problems and how to use it. It can be inferred that the video created a discussion environment, and therefore, served as a discussion starter. Such short videos can be used as a part of an online class or in traditional class settings to open up a discussion.

The results of this study can provide a basis for prescribing educational tools and techniques for teaching sustainability in other programs. Buenstorf and Cordes (2008) found that consumer learning does not lock-in consumer behavior. When people start adopting more sustainable patterns of consumption, they do not necessarily continue on this track without a continued exposure to supportive messages. For this reason, it would be important to develop a series of media interventions, such as video messages. Such work should be done in collaboration with organizations (such as UN, WWF, WHO), research institutes, and non-

governmental organizations. The impact of such media interventions should be consistently checked for feedback through qualitative and survey studies. Educational institutions can be a starting point to employ such interventions.

It is possible that cross-media comparisons would shed more light on the effectiveness of these media. A study in which short videos are compared with other multimedia learning tools, such as Power Point presentation files, would be a better measure of its effectiveness. However, it should be kept in mind that comparing the effectiveness of persuasive media types (such as print versus video) is limited in terms of generalizing conclusions (Fogg, Lee, & Marshall, 2002).

Kim and Willson (2010) urged researchers to consider the potential effects of pretest–posttest design. They recommended a Solomon four-group design (treated groups with and without pretest versus untreated groups with and without pretest) as a better approach to deal with such effects. Hence, for future studies that include an intervention for persuasion, an experimental design should be used other than just pretest-posttest. The Solomon four-group design would be a good approach to deal with pretest sensitization effects of a pretest-posttest experimental design.

The questions in this study focused on the video rather than learning and behavioral change, so as a further study, the content should be developed and diversified in a way that it can deliver various aspects of sustainability to inform its viewers more effectively than it did for this study. Improving the video so that it better addresses the sustainability-related context may also require more up-to-date knowledge measurement scales than the one used in this present study. Existing scales can be revised so that they can address new concepts in sustainability, such as design or usage aspect of the garments. Moreover, conducting a study over a period of time can be helpful to measure behaviors using a scale developed for this purpose.

Behavior can be also measured through a detailed qualitative study, which employs observation and interview.

4.7. Limitations

A few limitations of this study should be mentioned. The first limitation is that our sample was composed of primarily female participants and university students, which means that the findings should be generalized carefully. Furthermore, response rates changed from one college to the next because incentives varied for some students. For example, students at several colleges received gift cards and extra class credit from their professors, whereas the rest of the population received online gift cards only.

Second, because of the nature of the online surveys and how questions were posed, participants gave short answers to the open-ended questions. In future studies, such video interventions, which can be designed to increase environmental knowledge, concern and behaviors, should be evaluated more comprehensively with a more detailed qualitative study.

Two participants indicated that they could not view the video because of some technical problems. One of them was in the control group (and therefore was not able to take advantage of the opportunity given to control group participants to view the video at the end of the study). The other participant was in the intervention group. As a result, her data were analyzed with control group participants. Also, because of the study setting, it is possible that students might have been faced with some factors while taking the online survey. Such problems might have included watching the video with a friend, multi-tasking while listening to the video, and so forth. Moreover, it was not possible to control participants' exposure to other media content during the experimental treatment. Third, results of the Green Consumer Assessment scale only

explained self-reports, i.e. consumers' perceptions of their apparel-consumption behavior. Findings did not address participants' actual behaviors. For this reason, it is important to conduct a follow-up study for the actual behavior assessment. A long-term approach into exploring the effects of sustainability education would provide valuable insights to create effective education strategies. For this initial study, existing scales were employed, but developing the video based on the feedback would require revising these existing measurements scales.

REFERENCES

- Addison, M. (2009, August). Enlivening learning with digital video. *Training Journal*. Retrieved from <http://www.trainingjournal.com/feature/2009-08-01-enlivening-learning-with-digital-video/>
- Allen, I., & Seaman, J. (2008). *Staying the course: Online education in the United States*. Needham, MA: The Sloan Consortium.
- Allen, W., Kilvingston, M., Horn, C. (2002, May). Using participatory and learning-based approaches for environmental management to help achieve constructive behavior change. Retrieved from http://www.landcareresearch.co.nz/research/sustainablesoc/social/par_rep.asp
- Arbuthnott, K. D. (2009). Education for sustainable development beyond attitude change. *International Journal of Sustainability in Higher Education*, 10(2), 152-163.
- Barnatt, C. (2009). Higher Education 2.0. *International Journal of Management Education*, 7(3), 47-56.
- Beldarrain, Y. (2006). Distance education trends: Integrating new technologies to foster student interaction and collaboration. *Distance Education*, 27(2), 139-153.
- Buenstorf, G., & Cordes, C. (2008). Can sustainable consumption be learned? A model of cultural evolution. *Ecological Economics*, 67(4), 646-657.
- Burke, S., Synyder, S., & Rager, R. C. (2009). An assessment of faculty usage of YouTube as a teaching resource. *The Internet Journal of Allied Health Sciences and Practice*, 7(1), 1-8.
- Choi, H.J., & Johnson, S. D. (2005). The effect of context-based video instruction on learning and motivation in online courses. *The American Journal of Distance Education*, 19(4), 215-227.
- Collins, S., Higbee, T. S., & Salzber, C. L. (2009). Implementation of a problem-solving intervention with adults with developmental disabilities. *Journal of Applied Behavior Analysis*, 42(4), 849-854.
- Cook, D. (2010). Views of learning, assessment and the potential place of information technology. In A. McDougall, J. Murnane, A. Jones & N. Reynolds (Eds.), *Researching IT in education: Theory, practice and future direction* (pp. 39-45). New York, NY: Routledge.

- Dolan, P. (January 01, 2002). The sustainability of sustainable consumption. *Journal of Macromarketing*, 22, 2, 170-181.
- Dombek-Keith, K. M. (2008). *Re-Fashioning the Future: Eco-Friendly Apparel Design*. (Unpublished master thesis). Cornell University, Ithaca, NY.
- Dourish, P. (2010). HCI and environmental sustainability: The politics of design and the design of politics. *Proceedings of the DIS 2010 8th ACM Conference on Designing Interactive Systems* (pp. 1-10). New York, NY: Association for Computing Machinery.
- Forum for the Future. (2007, March). Fashioning sustainability: A review of the sustainable impacts of the clothing industry. Retrieved from <http://www.forumforthefuture.org/files/Fashionsustain.pdf>
- Fien, J., Neil, C., & Bentley, M. (2008). Youth can lead the way to sustainable consumption. *Journal of Education for Sustainable Development*, 2(1), 51-60.
- Fink, A. (1995). *The survey kit, Volume 2: How to ask survey questions*. Thousand Oaks, CA: Sage Publications.
- Fletcher, K. (2008). *Sustainable fashion and textiles: Design journeys*. London; Sterling, VA: Earthscan.
- Fogg, B. J. (2009). Creating persuasive technologies: An eight-step design process. *Proceedings of the Persuasive '09: 4th International Conference on Persuasive Technology*. New York, NY: Association for Computing Machinery.
- Fogg, B. J., Lee, E., & Marshall, J. (2002). Interactive technology and persuasion. In J. P. Dillard & M. Pfau (Eds.), *The persuasion handbook: Developments in theory and practice* (pp. 765-788). Thousand Oaks, CA: Sage Publications.
- Hartsell, T., & Yuen, S. (2006). Video streaming in online learning. *AACE Journal*, 14(1), 31-43.
- Heldman, C. (2007, January), YouTube nation. Retrieved from <http://www.apsanet.org/~lss/Newsletter/jan07/Heldman.pdf>
- Hines, J. M., Hungerford, H. R., & Tomera, A. N. (1987). Analysis and synthesis of research on responsible environmental behavior: A meta-analysis. *Journal of Environmental Education*, 18(2), 1-18.
- Iozzi, L. A. (1989a). What research says to the educator. Part one: Environmental education and the affective domain. *Journal of Environmental Education*, 20(3), 3-9.

- Iozzi, L. A. (1989b). What research says to the educator. Part two: Environmental education and the affective domain. *Journal of Environmental Education*, 20(4), 6-13.
- Kim, E. S., & Willson, V. L. (2010). Evaluating pretest effects in pre-post studies. *Educational and Psychological Measurement*, 70(5), 744-759.
- Kim, H., & Damhorst, M. L. (1998). Environmental concern and apparel consumption. *Clothing and Textiles Research Journal*, 16(3), 126-133.
- Kolandai-Matchett, K. (March 01, 2009). Mediated communication of 'sustainable consumption' in the alternative media: a case study exploring a message framing strategy. *International Journal of Consumer Studies*, 33, 2, 113-125.
- Kozar, J. M., & Hiller Connell, K. Y. (2010). Socially responsible knowledge and behaviors: Comparing upper- vs. lower-classmen. *College Student Journal*, 44(2), 279-293.
- Koumi, J. (2006). *Designing video and multimedia for open and flexible learning*. London: Routledge.
- Loker, S. (2008). A technology-enabled sustainable fashion system: Fashion's future. In C. Ulasewicz & J. Hethorn (Eds.), *Sustainability fashion, why now?* (pp. 95-126). New York, NY: Fairchild Books.
- Mayer, R. E. (2001). *Multimedia learning*. New York, NY: Cambridge University Press.
- Milbrath, L. (1984). *Environmentalists: Vanguard for a new society*. Albany: State University of New York Press.
- Morgan, L. R., & Birtwistle, G. (March 01, 2009). An investigation of young fashion consumers' disposal habits. *International Journal of Consumer Studies*, 33, 2, 190-198.
- Muller, D. A., Lee, K. J., & Sharma, M. D. (2008). Coherence or interest: Which is most important in online multimedia learning?. *Australasian Journal of Educational Technology*, 24(2), 211-221.
- Neo, M., & Neo, T. K. (2009). Engaging students in multimedia-mediated constructivist learning - students' perceptions. *Educational Technology & Society*, 12(2), 254-266.
- Nielsen. (2010, August). How people watch: A global Nielsen consumer report. Retrieved from <http://www.nielsen.com/content/dam/corporate/us/en/reports-downloads/Global%20Video%20Report%20How%20People%20Watch.pdf>

- Nikopoulou-Smyrni, P., & Nikopoulos, C. (2010). Evaluating the impact of video-based versus traditional lectures on student learning. *Educational Research, 1*(8), 304-311.
- Pasricha, A., & Kadolph, S. J. (2009). Ecological literacy level and meaning of sustainability among college students. In A. Klein & V. W. Thoresen (Eds.), *Proceedings of the Sixth International Conference of The Consumer Citizenship Network* (pp. 154-163). Berlin, Germany. Retrieved from http://fulltekst.bibsys.no/hihm/oppdragsrapport/2009/02/oppdrapp02_2009.pdf
- Peattie, K., & Collins, A. (2009). Guest editorial: Perspectives on sustainable consumption. *International Journal of Consumer Studies, 33*(2), 107-112.
- Pooley, J. A., & O'Connor, M. (2000). Environmental education and attitudes: Emotions and beliefs are what is needed. *Environment and Behavior, 32*(5), 711-723.
- Rickinson, M., & Lundholm, C. (2008). Exploring students' learning challenges in environmental education. *Cambridge Journal of Education, 38*(3), 341-353.
- Schaefer, A., & Crane, A. (2005). Addressing sustainability and consumption. *Journal of Macromarketing, 25*(1), 76-92.
- Schor, J. B. (2005). Prices and quantities: Unsustainable consumption and the global economy. *Ecological Economics, 55*(3), 309-320.
- Siemens, G. (2004, December 12). Connectivism: A learning theory for the digital age. Retrieved from <http://www.elearnspace.org/Articles/connectivism.htm>
- Snelson, C., & Elison-Bowers, P. (2007). Micro level design for multimedia enhanced online courses. *Journal of Online Learning and Teaching, 3*(4). Retrieved from <http://jolt.merlot.org/documents/snelson.pdf>
- Snelson, C., & Elison-Bowers, P. (2009). Using YouTube videos to engage the affective domain in e-learning. In A. Mendez-Vilas, A. S. Martin, J. A. Mesa Gonzalez & J. Mesa Gonzalez (Eds.), *Research, reflections and innovations in integrating ICT in education* (Vol. 3, pp. 1481-1485). Badajoz, Spain: Formatex. Retrieved from <http://www.formatex.org/micte2009/book/1481-1485.pdf>
- Su, J. (2006). Integrating sustainability in apparel and textiles higher education. *Environmental Informatics Archives, 4*, 453-458.
- Sustainable Development Commission. (2006, May). *I will if you will - Towards sustainable consumption*. Retrieved from http://www.sd-commission.org.uk/data/files/publications/I_Will_If_You_Will.pdf

- The Story of Stuff Project. (n.d.). *About the project*. Retrieved from <http://www.storyofstuff.com/about.php>
- TeacherTube. (n.d.). Retrieved October 9, 2010, from www.teachertube.com
- U. N. Department of Economic and Social Affairs. Division for Sustainable Development. (2010). *Trends in sustainable development: Towards sustainable consumption and production*. Retrieved from http://www.un.org/esa/dsd/resources/res_pdfs/publications/trends/trends_sustainable_consumption_production/Trends_in_sustainable_consumption_and_production.pdf
- Van Birgelen, M., Semeijn, J., & Keicher, M. (2009). Packaging and proenvironmental consumption behavior: Investigating purchase and disposal decisions for beverages. *Environment and Behavior*, *41*(1), 125-146.
- YouTube. (n.d.). Retrieved October 9, 2010, from www.youtube.com/.
- YouTube Edu. (n.d.). Retrieved October 9, 2010, from www.youtube.com/edu
- Zhang, D., Zhou, L., Briggs, R. O., & Nunamaker, J. F. (2006). Instructional video in e-learning: Assessing the impact of interactive video on learning effectiveness. *Information & Management*, *43*(1), 15-27.
- Zossou, E., Van Mele, P., Vodouhe, S. D., & Wanvoeke, J. (2009). The power of video to trigger innovation: Rice processing in central Benin. *International Journal of Agricultural Sustainability*, *7*(2), 119-129

CHAPTER 5

A 3D “PAPER DOLL” OF *YOU*: AN EXPLORATORY STUDY OF 3D AVATARS FROM BODY SCANS AS MEDIATORS OF SELF-DESIGNED DIGITAL APPAREL AND SUSTAINABLE CONSUMPTION

5.1. Background and Justification

The radical philosopher Ivan Illich (1973) argued that when people become dependent on the expert knowledge of professionals, they lose faith in their own capacity to act. According to Illich, with the help of “convivial” tools, people will spend less time as consumers and more as producers of their own welfare. In their philosophically grounded book *Understanding Computers and Cognition* (1986), Terry Winograd and Fernando Flores noted that “in creating tools, we are designing new conversations and connections” (p. 169).

Indeed, increased accessibility to technology first changes our tools, then our behaviors. With the development of Web 2.0, people have increased their online interactions and formed new social networks. Web 2.0 is defined by Wilson (2008) as “a second-generation method of using Web technology to create communities, or social networks, where instead of passively viewing content, each user can dynamically create and modify and share Web content” (p. 1). This new way of using technology allows users to increase their peer relationships and to take control of the flow of information they receive. Such online interactivity and technology can integrate consumers into the production process and allow them to become producers of their own products. Increased online interactivity and ways of using technological tools have also led to the emergence of the mass customization [MC] and made-to-measure [MTM] segments in the apparel industry within the last decade (Magnanat-Thalman, 2010). In this digitally networked age, in which computer technologies and

virtual data are changing the way people interact and exchange information, the use of a virtual try-on paradigm can provide access to personalization through online collaboration platforms.

Virtual try-on can be defined as a software tool for 3D visualization of garments that uses two-dimensional patterns (digitized or created in a CAD system) and virtually stitches them together to simulate the garment on a 3D body. It allows consumers to choose garments, apply fabric properties, and try the garments on their avatars.⁶ These avatars may be either artistically created parametrics, for which the overall appearance and body measurements can be adjusted by the user (Istook, 2008; Loker, Ashdown, & Carnrite, 2008; Calhoun, Ashdown, & Lyman-Clarke, 2009), or the user's own exact digital body, acquired using a 3D body scanner. The avatar then can be imported into the virtual-try-on environment. Once the garment has been visualized in three dimensions, users can zoom in and out, and rotate their 3D models to get a better idea of the clothing fit.

Three-dimensional body scanners are used to create a “virtual clone” of the original model through non-contact capture of the body-surface data with the help of laser-based or white light-based scanning technologies (Ashdown, Loker, Schoenfelder, & Lyman-Clarke, 2004; Magnenat-Thalmann, 2010) and show great potential to be instrumental in virtual-fit applications (Calhoun et al., 2009). Ashdown et al. (2004) stated that users are willing to use body scanning to obtain better-fitting garments. An early study, conducted by Calhoun et al. (2009), compared college students' reactions to parametric-avatar and 3D body-scan data, and showed that most participants preferred a “more realistic avatar,” acquired from the 3D body scanner. It is possible that 3D virtual images can replace many standard fitting-room practices for

⁶ Messinger et al. (2009) stated that the word avatar, which means “incarnation” in Sanskrit, was popularized by Neal Stephenson in his novel, *Snow Crash*. Chung (2005) indicates that avatars, representations of the “self” in telepresence, are increasingly evolving, enabling individuals to “step into the internet”.

trying on garments. Magnenat-Thalmann (2010) envisions that although currently this technology targets clothing designers, pattern makers, and technical designers, a wider range of users will eventually benefit from it. The literature that tackles this issue argues that virtual try-on can deliver exact product information and has the potential to revolutionize online apparel shopping. In addition, the use of avatars may increase online sales (Ashdown & Loker, 2010; Fiore, 2008; Kim & Forsythe, 2007; Wood, 2002; Taylor & Varley, 2008).

Virtual try-on is expected to be the most influential technology in terms of empowering individuals to purchase more clothing on the Internet (Loker et al., 2004). According to Apeagyei and Otieno (2006), the inability to fully evaluate garments before purchase and to decide whether they would fit correctly has been the biggest obstacle to online purchase of clothing. Advances in 3D technologies will help implement the increased availability of mass customization and mass personalization (Apeagyei & Otieno, 2006).

5.2. Commercial Applications of Virtual Try-On

Key vendors of the CAD technologies driving virtual fit include the Israel-based companies Browzwear and OptiTex; Lectra, of France; and Gerber, Tukatech and [TC]² of the United States. Each of these companies has developed 3D visualization and/or design tools for the apparel industry. V-Stitcher (developed by Browzwear and sold by Gerber Technologies as the Accumark V-Stitcher), 3D Runway Suite (OptiTex), e-fit Simulator (Tukatech), Modaris 3D Fit (Lectra), Vidya (Assyst/Bullmer, recently acquired by Human Solutions) and VDresser by [TC]² are the current leading virtual try-on software systems in this arena.

In addition to their continuous software development, some companies offer interactive communication services to online fashion communities. For example,

Browzwear created an interactive online fashion community, StyleZone. The company defined this service as follows: “users can design their own clothes and share their creations with other users [. . .] After the completion of one design, each user gets his/her own StyleZone homepage where their creations are exposed to the rest of the community. Users can rate each other’s designs, try on each other’s designs, chat with other fashion addicts, and write personal blogs. (StyleZone, n.d.)

My Virtual Model⁷ [MVM] (n.d.) originally offered virtual try-on tools to online retailers, such as Land’s End. MVM led avatar-technology development for the apparel industry (Loker et al., 2008). With MVM, it was possible to create a personal avatar by entering body measurements to change the body shape, selecting appropriate ethnic features, and even adding a picture of one’s face to make the model look more like the user (Calhoun et al., 2009; Loker et al., 2008; Fiore, 2008). Citing Nantel’s 2004 survey, Fiore (2008) reported that online consumers who used MVM were “26% more likely to purchase and spend 13% more than those who did not use this feature on a site” (p. 185). Although this company declared bankruptcy on November 12, 2009, (PriceWaterhouseCoopers Canada, 2010), a virtual site (MVM Community) where users can share their creations on an MVM avatar is still available at <http://www.mvm.com/cs/>.

5.3. Interactive and Collective Usage of Virtual Try-On on the Internet

Interactive digital data and Internet technology are changing our engagement with our dress (Loker et al., 2008). As indicated by Ashdown and Loker (2010), Internet tools can be used to augment communications around apparel and fit as recommendation devices or conversation initiators in a social networking domain.

⁷ Although the company declared bankruptcy, its online community relaunched on June 1, 2010, to allow users to continue sharing their digital collages and virtual models and to obtain feedback about how they look in virtually tried-on garments from fellow MVM community members. (<http://www.mvm.com/cs/>).

Fashion-conscious individuals have been increasingly using new digital fashion design platforms (that offer other features besides online shopping and virtual try-on) such as Polyvore,⁸ and other similar online services, to satisfy their appetites for creating collages from existing fashion pieces, to mix and match garments and accessories, and to share their taste with other members and obtain feedback on their choices from their online peers. Fast-fashion retailer Target recently launched a new style application, Merona My Look Maker, which is quite similar to what Polyvore is offering, via Facebook in June 2010. This application allows its potential customers to mix and match the pieces in its own Merona brand and share their looks with Facebook friends Elliott (2010). Recently *The New Yorker* published an article, “Fashion Democracy”, on this current trend, specifically “Polyvore addiction.” Its writer, Alexandria Jacobs, describes this new wave as “a lot like playing paper dolls with pictures of real clothes” (Jacobs, 2010, p. 52). People use this website to make online collages of mood boards of fashion outfits. Over six million people visit the Polyvore website in a month and spend an average of nine minutes on the site; daily 400,000 people are adding it to their favorite lists from all over the world (55% of users are from the United States; 45% are from other countries), and its users create a new set every three seconds (or 30,000 sets daily) (Polyvore, n.d.).

OptiTex partnered with the Swiss-based sewing machine company Bernina to create MyLabel, a virtual-fit software product for home sewers that automatically modifies patterns for custom fit. Bernina of America launched this software in 2007. The software has a function to allow individuals to create their 3D avatars by changing the measurements of the provided parametric model. Garment patterns, surface designs, and embroidery can be chosen from the existing style library to visualize garments, and/or downloaded from MyLabel’s website for free (Bernina, 2010), On

⁸ Founded in 2007, Polyvore provides its users with a virtual styling tool that allows them to create unique digital collages of clothing, accessories, and lifestyle products.

this website, consumers can also share their garment images with each other. The company also provides online web seminars (webinars) for its users. Users have formed online forum groups elsewhere as well (BerninaMyLabel Yahoo Group, 2010).

OptiTex is marketing a slightly different model—Apassion, an online store marketed to retailers and manufacturers where their customers and potential customers could create their own personal 3D avatars for virtual shopping and get assistance from a virtual “stylist” sitting outside of the “dressing room”. In this model users would interact with an expert instead of one another in assessing different virtual styles and ensembles.

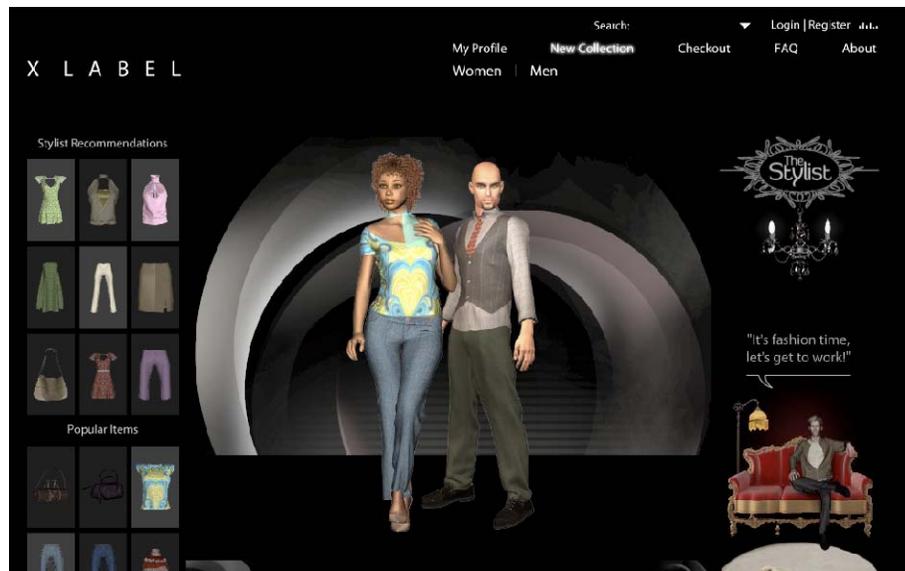


Figure 5.1. Avatar examples at Appassion.com with different ethnicities and gender. Expert recommender can be seen at the lower right corner of the screen (www.apassion.com).

From the retail point of view, Ashdown and Loker (2010) stated that the availability of virtual try-on using 3D-scan avatar technology on the Internet will increase interactions between the customer and the retail company, and that it will

communicate the fit and preferred size of garments effectively. Loker et al. (2008) predict that in the future “design options will multiply as technology connects the design, pattern making, cutting, and virtual try-on and fit steps in the process” (p. 173). Such an environment could empower individuals or communities by improving their skills to make better decisions for themselves (Allen, Kilvingston, & Horn, 2002; Mugge, Schifferstein, & Schoormans, 2009).

Pentina, Prybutok, and Zhang (2008) investigated the social influence on individual shopping preferences in the context of virtual communities. The authors defined virtual communities as “self-selecting groups of individuals engaged in sustained computer-mediated interactions around common interests or goals, governed by shared norms and values” (p. 114) and found that social relationships in virtual communities would influence a member’s shopping decisions in either a positive or a negative way. As demonstrated above by the MVM, Polyvore, and Target’s Merona My Look Maker examples, virtual try-on technologies have started to give rise to their own communities, whose members enjoy creating looks, sharing their thoughts, and deciding what to buy/wear around them. Existing literature and current trends indicate that customers could be more involved in apparel design in the future through the use of technological tools, in the domain of virtual try-on and online communities.

5.4. Emerging Digital Apparel Technologies and Sustainability

Illich’s (1973) statement made forty years ago, that “Almost everyone in rich societies is a destructive consumer”, still applies to our contemporary culture. Schaefer and Crane (2005) call our present-day consumption patterns habitual and chaotic. The shift from four or five season-based fashion cycles to continuously changing styles and the moving of apparel production overseas have resulted in increasingly affordable clothing and constant choices for consumers over the last two decades

(Forum for the Future, 2007). The commodities of contemporary fast-fashion culture are short-lived, and much of the clothing purchased ends up in landfills (Forum for the Future, 2007). Driven by the demands of the population to acquire more and cheaper garments, the textiles and apparel industry increasingly contributes to climate change through energy use and waste generation during manufacture, transportation, and consumption of the goods by producing high CO₂ emissions.

Fletcher and Tham (2003) suggest that, it is impossible to ignore fashion's presence, but a healthier and less destructive way should be found to engage with it. Sustainable consumption is focused on an "understanding of all the social and environmental impacts that occur throughout the entire production and consumption cycle of a product [. . .] This requires an understanding of consumption, not as the activity of purchase, but as a process of decisions and actions that include purchasing, product use and dealing with any remaining tangible product after use" (Peattie & Collins, 2009, p. 170). Developing a long-lasting relationship with a fashion item through increasing a garment's emotional value by user engagement into the creation of the garment is one of the methods for defining a new way of promoting sustainability in fashion.

Technology and sustainable consumption are related to each other. Scaturro (2008) argues that between manufacture and post consumption; there is a synergy between technology, sustainability, and fashion. She divides the mediating effect of technology on sustainability in fashion into a material level and a digital level. On the material level, technology can be related to developing sustainable textile materials and to recycling. On the digital level, which is also connected to the creation of fashion, digital technologies can promote sustainable consumption by facilitating consumer involvement through powerful communication tools and accurate product

information. Current technologies such as product configurators⁹ and body scanning for made-to-order or mass customization production systems are two examples of enabling apparel design and virtual try-on technologies (Loker, 2008). Such systems can indirectly affect the consumer use stage by extending the lifespan of products, and/or by adding meaning to garments through increasing consumer involvement. As Loker indicates, they can “balance production and consumption through increased durability, expansion of functional and emotional value” (Loker, 2008, p.100).

What would happen if digitally networked people were introduced to actual design tools for apparel? (i.e., their own virtual bodies as avatars and a try-on software application with tools that make it possible to actually design or modify garments). How would such tools affect people’s interaction with their commodities? Would such digitally mediated environments encourage them to consume more, or would they turn them into more selective consumers?

5.5. Objectives

The purposes of this study were:

To investigate the interaction patterns, and how people may react to similar—and more simplified—software in the future online shopping environment.

To examine how and why people (for this study, design students with background, interest, and talent regarding apparel design) would want to use a 3D software package to design.

⁹ Product configurators are interactive computer software allowing consumers to customize their own fashion items by selecting color, style, fabric or size options (Loker, 2008)

To explore the possible effects of using virtual try-on software and 3D body-scan avatars on people's intentions to use garments created and designed online.

The reflections of a group of apparel design students after engaging with two digital technologies (3D body scanning and 3D virtual fit, which enabled them to create 3D mono-color virtual avatars and to create and drape digital garment on their virtual selves) are analyzed and discussed in the following sections.

5.6. Methodology

5.6.1. Participants

Study participants consisted of Cornell University's Fiber Science & Apparel Design [FSAD] department's apparel design undergraduate students. Participants were recruited through flyers inviting them to enroll in a one-credit independent study class and based on their willingness to participate in a multi-week experience using 3D body scanning and 3D virtual fit technologies. Apparel design students were appropriate for this study because the virtual fit software used was specifically written for the apparel industry. Participants had patternmaking experience and knowledge of apparel design terminology that made this industry software accessible to them. Also, as it is mandatory for all FSAD students to take at least one class on either ethics or sustainability, at least half of the potential participants were expected to have some level of sustainability knowledge. Since the plan was to examine characteristics of a

particular subgroup of interest, purposeful sampling¹⁰ was used to recruit apparel design students as study participants. Eight students were recruited as participants. As Patton (2002) explains, there are no rules for sample size in a qualitative study, and even a group with as few as five participants might provide insights.

5.6.2. *Instrument*

For this exploratory case study, OptiTex 11 PDS 2D/3D was chosen as a basic software application. The Israel-based company OptiTex Inc. specializes in the development of innovative 2D/3D CAD and computer-aided manufacturing [CAM] solutions. The company introduced software that simulates 2D patterns onto a 3D avatar and successfully communicates with pattern design software [PDS] systems and 3D body-scan systems. OptiTex also creates digital parametric avatars, to be used along with the software. One can change multiple measurements and postures of these avatars. The company is still developing and updating its parametric avatar portfolio. In addition to the parametric models, one can also upload 3D body-scan data from Human Solutions and [TC]² 3D body scanners into this software (OptiTex, 2010). At this stage of the software's development a parametric model has been animated to create a virtual catwalk turn, but the 3D avatar created from a body scan has not been animated by any software provider at this time.

OptiTex is very accessible 3D virtual-fit software for use in an undergraduate college environment, the OptiTex software is compatible with the use of the VITUS XXL Human Solutions body scanner to import the 3D body-scan models, and the company provides strong customer service. Although currently this software is used

¹⁰ Patton (2002) states that the power of purposeful sampling is that what would be considered "bias" in statistical sampling (and therefore a weakness) becomes the intended focus in qualitative sampling (and therefore a strength). Information-rich cases can help in developing an understanding of the "central importance" of the inquiry. Lofland, Snow, Anderson, & Lofland (2006) said that purposeful sampling is "appropriate [. . .] when you want to learn about select cases" (p. 91).

primarily in professional settings for the apparel-patternmaking domain, the potential of developing this software for more public use is compelling. The population that has embraced MVM, Bernina's My Label, and Polyvore seemingly has a high potential to experiment with this technology if it can be developed as a more broadly commercially available product.

5.6.3. Data Collection

The research design included the following methods: use of online questionnaires to obtain demographic and behavioral data, participant observation, analysis of image journaling and documentation, and semistructured in-depth interviews.

Miles and Huberman (1994, p. 10) describe qualitative data as being “not so much about behavior, but about actions”. They contend that qualitative data provide “*thick descriptions* that are vivid, nested in a real context” (p. 10). A post-positivistic¹¹ approach was used and advice from Lincoln and Guba (1985) and Miles and Huberman (1994) applied on capturing the “naturalistic research” by

organizing a “prolonged” contact with the “field” I was engaged with: that is, observation of the group of design students who were working with the design software, and designing for themselves on their own 3D body models

developing a "holistic" (i.e., systemic, integrated) overview of the context under study: the explicit and implicit rules for “designing for oneself”, and seeing oneself on the screen.

¹¹ As cited in Denzin and Lincoln (2000), Guba defined postpositivism as the notion that “reality can never be fully apprehended, only approximated” (p. 9) and note that to capture reality as much as possible, multiple methods are used in a postpositivistic approach.

capturing data that described the perceptions of the group of people being studied.

After obtaining the IRB approval (Appendix B), a group of eight participants used OptiTex 2D/3D intensively in an independent study class throughout the Spring 2010 semester. The class began in January and ended in May 2010. At our first meeting, participants filled out informed consent forms.

A hands-on workshop on OptiTex was conducted for four weeks with a group of eight participants. A new version of OptiTex 2D/3D PDS 11 was purchased for six workstations for this initial study. After the introductory session, participants were divided into two groups meeting at different times of the week, because of the limited number of software keys.

Observation took place for one month, once a week for each group, for 45 minutes to 1 hour each session, as suggested by Patton (2002) (long-term, multiple observations). Audio recordings were made of all verbal interactions during these sessions. They were asked to design two to three garments for themselves to be worn for a semi-special event. Each participant was scanned with the Human Solutions 3D body scanner to create his or her virtual avatar. These virtual avatars were processed using ScanWorx Software by Human Solutions, Geomagic v. 9.0, and Polyworks v. 10.1 software by Innovmetric (patching under the arms and other visible holes on the body), and then imported into the OptiTex system as (.obj) files so that participants can design and drape their digital garments on their digital bodies. Participants were asked to create screen shots and documentation of their design achievements, problems, and problem solving for each step when they were working outside of class hours.

In the second week of the study, participants took the first half of an online survey used to obtain demographic information about the study group. This short section of the online survey was designed to determine the technological background and understanding the level of environmental concern of the participants as well as their garment-purchase and discard behaviors, purchasing frequency, Internet purchase, and, because they would be working on custom-designing their digital garments, included measures of their perceptions of unique objects in general. After taking this survey, participants watched the intervention video on sustainability (described in Chapter 4 in more detail, pp.145-147). The intervention video was prepared in order to create a scenario to establish a sense of urgency on sustainability and convince people that change is necessary and possible. It was intended to tell a story, not to give a lecture. Video was selected as the intervention delivery vehicle for its visual qualities. As Zhang et al. (2006) pointed out, a video clip is an effective way to gain a student's attention when introducing a topic. To convey the instructional messages, on-screen modeling by a character to whom participants could relate was also used.

Interviews were conducted two weeks after the four-week observation period, from mid-May to the end of May, 2010. The average interview took 45 minutes plus or minus 15 minutes. Interviews were recorded with voice recorders and transcribed verbatim by the researcher for analysis. During participant observations and semistructured interviews, questions were asked about participants' software use, their responses to viewing their virtual models, and their expectations for sustainable use of garments if made using a similar design process. Interview questions were not necessarily asked in the written order, but all questions were asked of each participant. During the interview, some of the participants' responses were further probed for more detailed answers. In addition to responding to questions about these issues,

participants answered questions about their attitudes toward using these garments in the second section of the online survey, which included open-ended questions.

5.6.4. Online Questionnaire

The first section of the online questionnaire was designed to collect participants' demographic information (such as age, gender), their garment-purchase and disposal behaviors, and their perceptions of the product attributes (uniqueness, custom-made features) and themselves (green consumerism, fashion forwardness). All measures used a 5-point Likert scale with responses ranging from 1 (*strongly disagree*) to 5 (*strongly agree*).

Three items from Lynn and Harris (1997) uniqueness scale ($\alpha=.78$) were adapted to examine participants' opinions on fashion-forwardness, unique items, and custom-made products: 1, "I rarely pass up the opportunity to order custom features on the products I buy"; 2, "I tend to be a fashion leader rather than a fashion follower"; and 3, "I am attracted to unique objects". These items were reported individually for each participant.

Participants' environmental orientations related to minimizing their purchases were measured by adapting the Green Consumer Assessment Scale (GCA) by Dombek-Keith (2008), ($\alpha=.68$), adapting the following three items: 1, "If I had more money, I would definitely buy more and more things" (GCA1, reverse scored); 2, "I buy fewer things than the average person my age" (GCA2); and 3, "When I go shopping, I usually plan out what I am going to buy beforehand and I usually end up buying only what I planned" (GCA3). To report results, the scale mean was calculated as well as item means.

Participants were asked to take the second part of the online survey after the interview stage was completed. This second section introduced them to a hypothetical

“integrated system”, integration of the 3D body scanner, patternmaking, and virtual try-on software tools, a more sophisticated version of what they had experienced for several weeks. It contained four open-ended questions asking respondents about their thoughts on such a system and garments designed using this system. Questions asked were as follows: 1, “Would you be willing to wear “these customized garments” compared to the way you wear other garments that you purchase?”; 2, “How do you think that these “Integrated Technologies” would affect your choices about the number of the garments you buy and the way you consume them?”; 3, “How would using these “Integrated Technologies” change the meaning that your clothing has for you?”; 4, “How would using these “Integrated Technologies” help you to design clothing more easily and successfully for yourself?”

5.6.5. Data Analysis

In addition to interviews, explained above, the evolution of design ideas and design changes were analyzed using the screen shots the participants took and the journals they kept throughout the study period. Field notes from participant observation were also analyzed. I actively worked to help the participants with their software-related questions at the same time in order to “combine observing and informal interviewing” (Patton, 2002, p. 287). Field notes recorded my personal impressions and feelings as well (Wolfinger, 2002).

For data analysis, an a posteriori, exploratory thematic analysis method (according to which categories are created after all data have been collected) as suggested by Miles and Huberman (1994) was used. Content analysis was conducted to discover themes and recognize existing patterns. Interview transcripts, design logs, participants’ answers to the open-ended survey questions and observation notes were read through many times to obtain familiarity with the data and to identify emerging

themes. Then, all collected data were re-read with the emergent themes developed in the first stage in mind. All responses were sorted under the emergent-themes headings. Theme labels and definitions were not only given by myself but also adapted from the participants' comments, or existing theories from the literature (Onwuegbuize & Teddlie, 2003; Lincoln & Guba, 1985). This step was repeated a final time to refine and give the themes their final form. During application of the method, previous knowledge, expectations, and prejudices were put aside to let the themes emerge from the data (Glaser & Strauss, 1967).

5.6.6. Trustworthiness

Triangulation was used as a validity check. Several methods for data collection were applied rather than relying on just one method, in order to check the consistency of findings generated by several data-collection methods and to avoid errors linked to the use of any one particular method (Maxwell, 1996; Patton, 2002; Lincoln & Guba, 1985). This also helped to gather "rich data" around the subject matter. The methods (key informant interviews, participant observation, open-ended survey answers as additional self-reports) used together added some rigor (Adler & Adler, 1994) to the study. In addition to triangulation, negative cases (Maxwell, 1996; Lincoln & Guba, 1985; Adler & Adler, 1994) were analyzed as a validity check. Negative cases, which describe interactions that never happened, or "the absence of occurrence" as defined by Patton, were also recorded whenever they were noticed during the observation (Patton, 2002; Wolfinger, 2002).

To address validity in the descriptions of observations and interviews, both class sessions and interviews were audio-recorded, and then verbatim transcriptions were created from the audiotapes as suggested by Maxwell (1996). To address validity of interpretation of my notes and transcripts, such as whether leading questions were

posed, a member-check was conducted as suggested by Maxwell (1996) and Lincoln and Guba (1985), by sending the results and my discussion of the results to the participants, asking them for their responses. All participants approved the report and did not suggest any changes to it.

5.7. Results and Discussion

Demographic information, and its relation to emergent themes and summaries related to the interview questions, observational remarks, and responses to open-ended questions are presented and analyzed. The major purpose of this analysis was to organize the responses so that patterns would emerge. This information provided a basic understanding of the participants. Results are tabulated in Table 5.1.

The demographics of the participants varied in several characteristics. The study sample included five females and three males, and the ethnicity distribution was four Asian American and four Caucasian. The group consisted of two seniors, two juniors, and four sophomores. All of the participants were familiar with digital patternmaking programs. Pseudonyms are used instead of participants' real names to ensure anonymity of the participants.

One of the participants (Eric) had used the 3D features of OptiTex previously, and he helped the others when they encountered problems with the software. Participants had fair to good knowledge of patternmaking and draping. Interviews revealed that all of the participants had taken one or more classes on sustainability in general or on sustainability related to the apparel industry.

Table 5.1. Characteristics of the Participants, from the first part of the online survey

	G ^a	Ethnicity	Buying less if they had more money (GCA1 ^b)	Buying few compared with their peers (GCA2 ^b)	Planning out what to buy beforehand (GCA3 ^b)	GCA ^c	Unique objects ^b	Custom features ^b	Fashion Forwardness ^b	Favorite items and number of years worn
Bill	M	Asian	1	2	3	2.00	4	4	4	Skinny jeans (4 yrs), Cardigan (5 yrs), T-shirt (6 yrs)
Jen	F	Caucasian	2	2	2	2.00	5	4	4	Winter coats (3 yrs and up, vintage pieces (forever)
Chris	M	Caucasian	5	4	4	4.33	4	4	1	Winter boots, coat (2 yrs), down coat (6 yrs), cargo pants (2 yrs)
Gena	F	Caucasian	2	5	2	3.00	5	4	5	Black turtleneck (6 yrs), brown jersey dress (5 yrs), grey trousers (4 yrs), shirt dress (4 yrs), H&M shirt (1 yr)
Eric	M	Caucasian	1	4	3	2.67	5	3	4	Lucky Brand Jeans (1 yr), Gap jeans (2 yrs), Aeropostale Waffle Shirt (2 yrs), Target coat (3 yrs), H&M shirt (1 yr)
Anna	F	Asian	1	3	2	2.00	5	3	5	Jeans from Urban Outfitters (4 yrs), fall coat from Benetton (4 yrs), V-neck cotton/cashmere blend sweater from Gap (4 yrs), hooded Cornell sweatshirt (4 yrs), thin cardigan from Banana Republic (4 yrs)
Beth	F	Asian	2	2	3	2.33	4	3	4	Basic long sleeve t-shirts (5 yrs), bras (3 yrs), down jacket (5 yrs)
Julie	F	Asian	1	1	1	2.33	5	3	4	N/A

^a G: Gender. F = Female; M = Male

^b Scale item score,

^c Green Consumer Assessment Scale (GCAS) Mean (1 (*strongly disagree*) to 5 (*strongly agree*))

When participant's self-reports from the first section of the online questionnaire were examined, it became apparent that five out of eight participants defined themselves as being fashion-forward (Item Mean score = 3.88, Range = 4, SD = 1.25). All of the participants remarked that they are attracted to unique objects (Item Mean score = 4.63, Range = 1, SD = .52), but that they were neutral on having a custom-made product (Item Mean score = 3.5, Range = 1, SD = .53).

Three out of eight participants purchased garments on the Internet once a month, and two made online purchases more than once a month. Half of the participants purchased garments two to three times a month. They generally purchased more from department stores, specialty stores (e.g., The Gap) and the Internet (seven out of eight), followed by vintage shops (six out of eight) and boutiques (five out of eight). Thrift-store and off-price retailing options were generally ranked fourth (preferred by three out of eight participants).

When their self-reports on fashion-forwardness were compared with their sustainable garment-usage behaviors (buying more if they had more money, buying few compared with their peers, and planning out what to buy beforehand) it was apparent that the more fashion-conscious participants did not tend to plan out what to buy when they go shopping (four out of eight participants, Item Mean score = 2.5, Range = 3, SD = .93). The participants overall, except one, agreed that when they have money, they buy more and more garments (Item Mean score = 4.13, Range = 4, SD = 1.36). Participants' responses were almost neutral (=3) about buying fewer clothing items than the average person their age (Item Mean score = 2.88, Range = 4, SD = 1.35).

The favorite items, which participants prefer to use for many years, were basic items such as jeans, t-shirts, and coats. One participant, Jen, said that she always has vintage pieces in her wardrobe.

In response to questions regarding garment-disposal behaviors, all participants reported donating their garments to a thrift store, while the second most popular strategy was passing them on to a friend or relative. The remaining three options (refashioning, selling to a vintage store, and storing away in a closet) were reported equally as the third alternative by half the participants.

5.7.1. Self-Reports on Pro-Environmental Behaviors-Environmental Concern Levels of the Study Participants

During the study, a visit for the study participants to SewGreen, a local sustainability organization focusing on clothing was organized for participants when founder, Wendy Skinner, discussed her activities regarding sustainable ways to use fabrics and accessories and her efforts to foster an informed and linked sustainable community. Encouraging the participants to attend this discussion was thought to be a good way for helping the participant to think more about sustainability. However only two out of eight participants attended this visit, most likely due to time pressures.

This was a discouraging experience since it reflected a lack of participant engagement in learning more about their community's apparel-related sustainability practices. Their behavior patterns were consistent with their self-reports on being a "green consumer", where attending participants Chris (GCAS Mean score = 4.33) and Gena (GCAS Mean score = 3.00) showed the highest two environmentally conscious attitudes. During interviews, the participants were asked about their thoughts on their garment purchase and consumption, and willingness to purchase and use fewer garments or customized garments after seeing the intervention video. Except Chris and Gena, they reported that they do not take into consideration "environmental" issues when it comes to shopping more or use of resources. They were aware of the results of their purchase behaviors, but they possessed fewer intentions to change the way they

consume. This finding echoed Ha-Brookshire and Hodges's (2008) findings that in the domain of used-clothing donation, participants were not motivated primarily by the thought of minimizing their consumption. The authors suspected that donation behavior was in fact motivated by the idea of opening up space for even more clothing purchases. Study participants' comments on their willingness to donate their clothing reflect these issues:

I am and I am not an environmental person. I am aware of how wasteful everything is, which is . . . I internally know. But at the same time it's hard to act on these rules. (Beth)

I do not think I am that environmentally conscious, like I am not like super crazy about it. Like grocery shops I get plastic bags. I think I try, I seldom go to Salvation Army, and mostly donate them there. So, I am in the middle. (Bill)

It's definitely in my brain; I know that I am doing some irresponsible things. But no, I am not that environmentally helpful. I know that if you buy more, you're putting more waste on the environment. I definitely refashion my old clothes and give it to other people. (Jen)

Chris had the highest pro-environmental intentions and behaviors:

I do consider myself as an environmentally conscious person and that's one of the reasons I like to have very few garments that I wear a lot and love and wear out. Because the fewer garments we have, fewer resources go into producing that . . . um, and if I have one pair of pants that fit me well, and comfortable and durable, do I really need anything else?? No! So I'd rather prefer having that one pair of pants fit me well, that is durable and comfortable. (Chris)

5.7.2. Class Interaction

When working together in the classroom, I observed that participants were inspired by seeing the results of their peers who had worked with the 3D options of the software early in the process. For example, Beth's initial "drapey" and shiny dress caught the attention of Gena, who was sitting close enough to see her screen. When

Gena saw Beth's initial 3D draping trial she said, "That's neat. Wow! I just wanna do 'drapey' things like that". The study setting was the department's computer room, where the participants interacted with the other participants who were working on computer projects in the room. There was a close association between the sitting arrangements and participants' interactions with one another. Seating affected communication among participants about their designs, and helped to initiate discussion among those who could see each other's computer screens.

5.8. Themes Emerging from Observation and Interview Data

This next section presents themes that emerged from observation and interview data. The findings are divided into eleven themes, which were grouped into two categories: the eight themes in the first section address the first research objective regarding the interaction patterns that emerged during virtual software usage, and the three themes in the second section address the second research objective regarding the designed garments.

5.8.1. Themes Related to Software Usage

5.8.1.1. Initial hesitation to work with a new software package

During the first six weeks, the participants encountered a number of difficulties in using the software that tested their patternmaking knowledge. They worked on digital patternmaking skills to recall the patternmaking CAD functions they had learned in classes a year or two before. However, another possible underlying factor for their difficulties was "escapism", since working on something else (the basic patternmaking skills) would legitimize the fact that they were not working on learning the 3D patternmaking functions that were demonstrated as an initial first step for the project. This came to the surface with four participants (Jen, Chris, Beth, and Gena) as

a result of a member-check conducted during the interview process. Although they had completed their patterns quite early, these participants spent additional time refining the patterns instead of moving immediately to the next step, the 3D visualization.

Yeah, I was definitely hesitating. I was like totally down to the patterning. I am not very confident with computers as I am with doing stuff with hand. Once you learn it, it was not very difficult. (Jen)

Following responses from Chris, Ann and Gena also demonstrated this hesitation:

It was a little daunting to look at, but once you start doing it, it was not as hard as it seems like it might be. (Chris)

3D was a bit scary at the beginning. (Ann)

Once I got past the initial patternmaking stages I thought it was going to be really hard to make 3D thing (pause), it was so easy. You just sew it up and put it on. It was just so easy. I wish I had more time to devote to it in order to play with it more. (Gena)

5.8.1.2. “*Seeing-moving-seeing*”

Donald Schön (1992) postulates that a designer makes design judgments by having a “conversation” with the design medium. After seeing the results of her design decisions, a designer makes judgments and then moves to another level, repeating the process until a satisfactory result is obtained. He calls this interaction “seeing-moving-seeing” (Bennett, 1996). In this case study, as participants saw how their initial/progressing patterns looked on their avatars, they made a series of ongoing changes to their designs. The 3D software extended designers’ abilities to work by “seeing-moving-seeing” as expressed by Schön (Bennett, 1996) as they explored the look of their designs on their digital prototypes.

Examples of “seeing-moving-seeing” include, Jen’s choice to lengthen the hems of her dresses as well as to change the skirt design (Figure 5.2). She had

problems arising from the kimono-sleeve design, which was not draping smoothly over her 3D avatar. Creating an additional cuff pattern solved her problem. Jen chose surface design elements, such as sheers, and solid color fabrics after virtually experimenting with the combination of a pink lace with a solid golden fabric.

[. . .] I tried lace, but that was not the look that I was going for. I took some screenshots (Figure 5.2) of this lace *disaster*. (Jen)

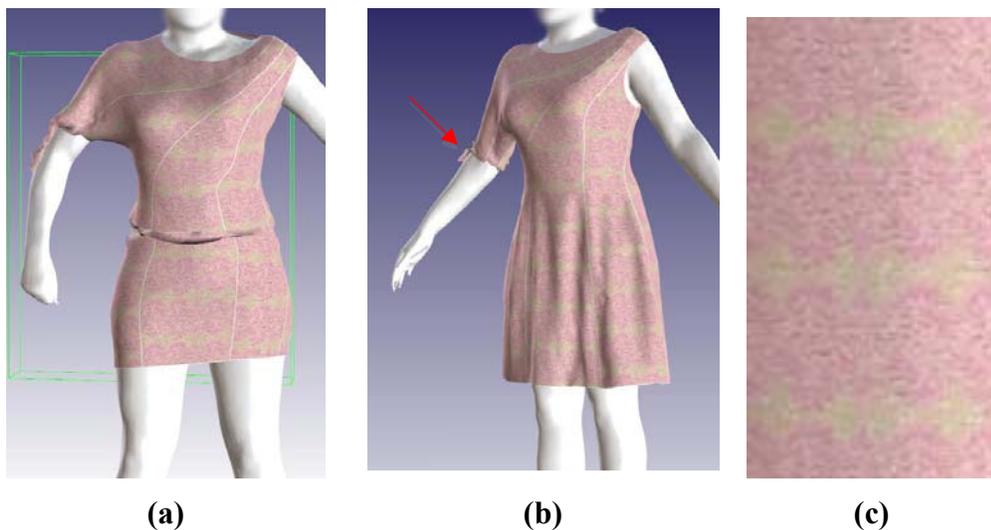


Figure 5.2. Jen’s Initial Designs. (a) First skirt design, showing how it bunches up at the waist. (b) Skirt fits better here, with no bunching up. The sleeve does not drape around the arm correctly. (c) Lace in more detail

5.8.1.3. Time-saver

3D virtual-fit software drastically reduces the time to prepare the patterns and first-fitting muslins. From this perspective, it is quite efficient because it simplifies some initial patternmaking tasks. This particular feature of the software was appreciated by all of the study participants. As Chris stated:

If you are going to do that on paper and actual patterns, it’s going to take you five or six hours to do that. But because of the computer doing a small change, if you have stitches everywhere, it takes you 10 seconds . . . Well, I just try it

and it takes 10 seconds and if I decide it makes it worse, I just do CTRL+Z and it is undone! So that was the most useful thing. You do not spend hours for making the muslin and changing the pattern by hand and then you do not even have the original pattern. (Chris)

Gena, Jen, and Beth were also happy about the fact that this new technology could affect existing practices of apparel design:

I thought it would be awesome to be able to try the clothes on without cutting the fabric, without sewing them, so, like, faster process to get the right pattern. (Gena)

It's just cool how you just go and do the fitting and try-on immediately. I don't need to sew the muslin, which is really nice. (Jen)

It can give you like a start. Then you can make small changes. You can go back and forth [. . .] I like how it shows you—a preliminary run of it. (Beth)

While he shares similar opinions with the other participants on this topic, Bill had higher expectations:

Patternmaking takes longer by paper; it's like annoying draping all over again and making muslins. I thought it was a good system for making slopers and base patterns. The only thing I was little disappointed with was, I wanted to see if it could create highly finished things, like fly guards, plackets and like, integrated all of these like, odd seaming. (Bill)

5.8.1.4. Fun and exciting

During our interview, Jen repeated the term “fun” a lot, indicating that overall she enjoyed the whole process:

I thought it was really fun to actually design an engineered fit on myself. (Jen)

Gena (commenting on her classmates' reactions to 3D drape after they watched her work, and hearing their enthusiasm) said with animation that “it's like watching a

sports game”. Among other things, this comment reflects that designing with 3D technology and watching the progress of draping the garment over your body on your computer screen is exciting.

Once he understood how to use software tools, Chris liked 3D design very much. After practicing pattern placement, he worked on changing fabric color and texture. Once he saw his design in color and liked the fit of the pants on himself, he remarked, “ These pants fits better on me than real life”.

I did like my designs, yeah, it’s fun. It’s more fun designing for yourself, not for a dress form, and you want to spend more time because that’s for yourself.
(Chris)

5.8.1.5. Almost accurate

Participants thought that 3D virtual draping offers almost-accurate representations; however, Eric modified this judgment with the following comment:

Personally, I am too attached to the actual fabric. Like, for the patternmaking, yes I can use it all the time, but 3D, I would not like that very much—because it has not gotten far enough to replace the ... like, I look at this and you can tell the general problems about how it fits but I do not really quite believe it 100%. So I would not trust it completely enough to not do real prototypes. (Eric)

Ann liked playing with the fabric properties and stated that it was the most important feature of the software for her:

I thought like changing the fabrics was very cool. It’s like, not just like muslin, and textures. So that was cool. And like sheerness. All the functions that change fabric, texture or weight or whatever, I thought that was neat and pretty realistic. (Ann)

5.8.1.6. *Limited*

Even though the participants spent a relatively long time with the virtual try-on software, they were still inexperienced in its use and felt limited with the design possibilities it offered.

Jen wanted to create designs with long kimono sleeves. However, because of software limitations this sleeve type was difficult to drape over the arm on her original scan, which was taken of her with her arms down by her sides. As a result, she shortened the sleeves for one of her designs. A second scan, taken with her arms held away from her body, and the addition of a small cuff, solved the problem for another of her designs.

Definitely placing of the arm was an issue for me, but other than that, it was really straightforward. I was actually really impressed . . . So, my sleeves were not normal set-in sleeves. It was interesting to see how strange a design problem can get and be fixed. (Jen)

Here, Jen's comment on fixing a design problem resonates with Schön and Wiggins's (1992) argument of how "seeing-moving-seeing". The unintended consequence of moves allows a designer to bring more components of his/her knowledge to conscious thought and handle a complex ill-defined design problem.

Beth went with easy and "drapey" designs in order to simplify the tasks required for her designs. Participants generally were not confident that the program would manage pleats and gathers.

Just knowing the program could not really recognize certain things like pleats and gathers. I found it very limiting. I did not want to make anything with complex seaming, so, I avoided doing complex seams. I just designed simple pieces, like rectangular shapes. (Beth)

Chris was trying to achieve a real-life look, which he had already experienced with muslin and denim fabrics, by playing with the virtual fabric properties:

I actually have [a] couple of questions about pants and fit. I made a muslin and it fit me very well. And I made it out of denim and I had so many problems. It was looser than the muslin. It was also looser in weird areas. [He is speaking about his actual muslin and denim prototypes.] When I started draping on the computer, I used the very same pattern that I used to make patterns for myself. So when I first put it on the computer, it was like the muslin, it fit me [his virtual model] very well. By tweaking the fabric properties, I was somewhat able to re-create the problems [that he experienced with denim fabric], but not totally. (Chris)

During the design process, Bill wanted tucks, but ended up with darts; Beth's gathers did not lie smoothly; Eric had a problem with layering pockets. He wanted to give the pockets a 3D look by creating a "gap" between the pocket layer and the base pants layer, and he spent a lot of time on this, trying to create this look. But he was dissatisfied with the resulting "flat" look. Gena experienced drape problems on the shoulder seams and side seams. Many of these problems originated in lack of experience with the program. Some have been solved in a new software upgrade that was not available when this study commenced.



Figure 5.3. Bill's Design. Sleeve seam is not stitching correctly and sleeve cap is not draping well.

5.8.1.7. Engaging

Once the participants felt comfortable using the 3D functions, they sat in front of the computer until they achieved a good fit and were satisfied with their designs.

Like the others in the study, Beth was at first very hesitant to use the 3D features of the software. At the very beginning of the semester, she had expressed interest in learning this software, as she knew another student who liked working in 3D. Once Beth started working on draping her asymmetrical dress designs on her 3D image, she ended up spending two hours working with the 3D tools. She selected different fabric colors, and experimented with the shine, transparency, and gloss features. As soon as she understood the software features and felt comfortable with them, she became very engaged with the process.

Chris expressed his general feeling about the accessibility of the program:

It was easy to get a hold on the 3D. If you get a basic understanding that you could actually use it functionally, then it was not hard. (Chris)

Bill did not participate in the study for credit, but he showed a deep interest in this topic from the start. He started using the 3D function earlier than the rest of the participants; he also started playing with the fabric properties and color early in the process. Bill would open the 3D window and load his scan as soon as he turned on the computer. He was one of the participants who was already very skilled at using the OptiTex patternmaking features. He regularly checked his patterns by trying them on his avatar and making design changes. He decided to work on pants since he likes designing pants for himself. He spent a lot of time fitting and modifying his patterns on his avatar, as they were somewhat unconventional pattern shapes.

Although all participants agreed that they wanted to learn the software and found it exciting, six of the eight participants (Bill, Chris, Gena, Beth, Jen and Eric) were more embedded than the rest in the process. Even though they showed an initial hesitation at the very beginning of the study, the participants were engaged with the 3D features almost from the beginning to the end of the project, and continued to feel

excited about what they were doing/seeing. When informally asked what makes him come to every meeting of the study participants and work on his patterns so regularly, Bill explained his high motivation, which resonates with the responses of the other participants (Chris, Beth, Jen, Gena, and Eric): he wanted to make something for himself. He had previously designed pants patterns for the student fashion show, and he really liked what he had designed. He wanted to alter his patterns to his own size and to see the “finished” result digitally before he actually cut the fabric.

5.8.1.8. Body scans are more realistic than computer-generated models, but elicit some discomfort

Contrary to expectations that more realistic images would make virtual try-on more captivating for users, all participants, except Ann, agreed that mono-color (a very pale grey) 3D avatars are acceptable as they are: they resemble the dress forms they use for their classes, and that color of body models are less distracting for them. Ann said that flesh tones instead of plaster/statue-like color would make her model more realistic, lifelike.

When asked to compare body scans with the provided parametric model (named Eva by OptiTex), Jen replied as follows:

I think seeing them (her designs) on my body scan was less creepy than seeing them on “Walking Eva” [the animated parametric catwalk model] because she’s like [giving her voice a mechanical/robotic-like pitch] “evil-machine woman” . . . it is weird to see yourself in this creepy white avatar. You look like one of those statues, kind of. Although I think it might be less distractive. I think for the purpose of this, I think it’s really helpful to have just one white shape that you are trying to fit onto.

In response to the question about the avatars, Gena tried to explain why she felt uneasy looking at her 3D body model. She kept repeating the sentence “it’s weird, right?” as if looking for approval/agreement.

Gena: I guess it made it more real to look at [an]other body versus look at the parametric body. But I think some people might be uncomfortable looking at their body. But I think they can get over with it, right? Like, it's really weird to see yourself, but . . . it's fine. It's good that it's grey. If I cannot see my face, that's good. Cause then it will be really strange to look at my face. Like in detail—for me—cause [the] first time I saw myself I was like “OH NO!”

Question: Do you think that it's different than looking at yourself in a mirror?

Gena: It's like [the] 3D thing, zoom in zoom out, I think I have problems with that. But, it's just like people have to get over with it. It's like you do not imagine yourself turning around on the screen. So it's weird, right?

A reaction from a student who was not part of the study reveals one participant's discomfort with her avatar. During our session, the non-participating student (I will call her Linda) saw her friend Ann and sat by her side to see what she was working on. As soon as she looked at the virtual-fit screen, she was astonished—it was the first time she had seen a 3D avatar. She did not believe that it was her friend Ann's avatar: “Oh my God! Is it you??? That's so funny!” (Linda). As a result, Ann appeared to become irritated and turned off the 3D screen and stopped working in Linda's presence. Ann recalled this incident during the interview by laughing at it and said that Linda was really “weirded out” by the avatar. Ann further described her feelings: “It's kind of about just seeing your own body, you know, on this screen and you're like ‘Whoa!’ I need to lose some weight!”

Unlike the female participants, male participants reported that they felt confident looking at their 3D images on the screen. In general, it can be speculated that this behavior could be related to how they feel about their bodies in real life.

I thought it was partly nice just to see myself, like, how I think the other people probably see me [. . .] I really liked looking at myself but depends on the person I suppose. And how happy you are with the way you look. (Chris)

Chris was also the only participant who called his avatar “Me” during the interview:

So when I first put it on the computer, it was like the muslin. It fit me very well. (Chris)

5.8.2. Themes Related to the Designed Object

5.8.2.1. Simpler designs are preferred

Participants generally started out with fairly complex designs and then simplified their designs over time. Beth indicated that she deliberately kept her designs to simple rectangular forms. Jen originally planned to make a coat, but later focused on designing and patterning dresses.

5.8.2.2. Designed object is tempting to obtain

Six out of eight participants (Chris, Beth, Jen, Gena, Bill, and Eric) were highly motivated to design well-fitted, unique, comfortable garments that they could be proud of, and that would be appreciated by others. Participants in this study rated themselves quite high in terms of their fashion-forwardness and their interest in unique objects. The following comments support these results:

I really like them [the pants he designed]; if I knew they would fit me well I would definitely sew them and wear them. They would be really cool and unique. I mean, nobody else in the world would have those jeans. And everyone would notice them, you know? (Chris)

The ability to see three-dimensional images on the screen encouraged some of the participants to construct their garment designs. Two of the participants (Bill and Beth) wore their designs for the annual end-of-semester student fashion show (Figures 5.4 and 5.5)

I am gonna make it. I wanna make it for work 'cause I like pants. Because it's better and cheaper if I make it myself. (Bill) (Figure 5.4)

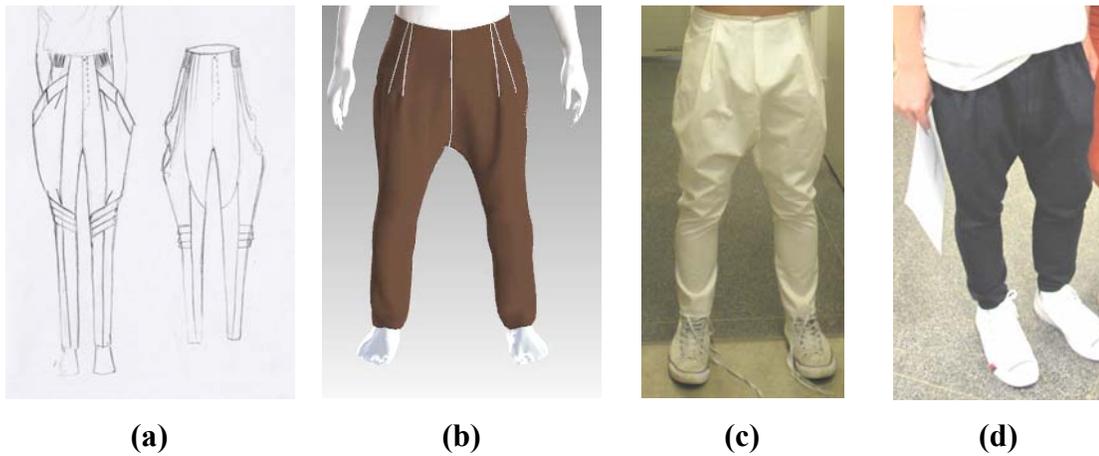


Figure 5.4. (a) Initial sketch. (b) Virtual design. (c) Muslin prototype. (d) Actual pants designed by Bill.

Both participants also planned to wear their garments during their summer internships. Their statements reflected their desires to show their creativity and talent to other people in the same industry. Bill reports this feeling as follows:

[. . .] I am planning to wear them this summer, for my internship, and I am hoping that some of the designers would say “oh I really like your pants!” and I would say like “Oh thanks, I made them.”

During the interview, although Beth explained that she prefers buying inexpensive but “nicely fitting things,” from fast-fashion companies such as Forever 21 and H&M, she actually enjoyed what she designed with this software (Figure 5.5). She also set her picture as a profile picture for her Facebook page to share with her friends. Although the dress was of a simple shape, she complemented it with stylish and elegant accessories that emphasize its graceful design.

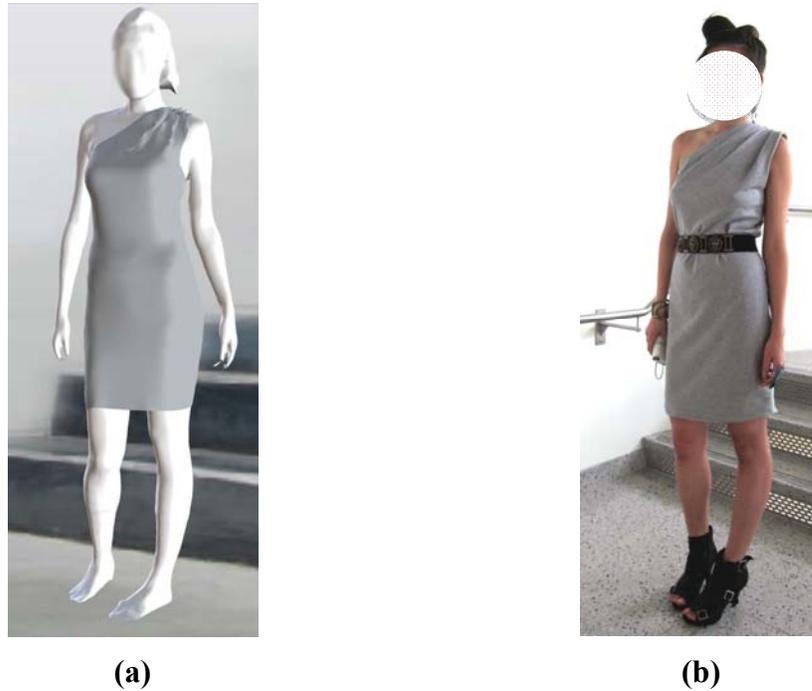


Figure 5.5. (a) Virtual dress. (b) Actual dress designed by Beth.

Beth: It's sometimes a lot cheaper to buy clothes for yourself [. . .] So I usually do not make clothes. But I do like the dress I made it for myself.

Question: Do you plan to wear it?

Beth: I do plan to wear it over my summer internship.

5.8.2.3. Satisfying the appetite for shopping

One comment made by Chris resembled a comment made by a Polyvore user, described in a *New York Times* article (Jacobs, 2010). As one of Jacobs's (2010) interviewees stated, making fashion sets “would feed that shopping urge [in me], without having to go and spend all that money” (p. 52). The more a person works on creating outfits or outfit combinations, the likelier he or she is to feel satisfied. As Chris mentioned:

Maybe I can try the shirt virtually because I do not need to buy it. I do not need to put it on . . . I just click the button and there it is. (Chris)

5.8.3. *Other Thoughts on Actual Usage*

When participants were asked to share their thoughts on their potential use of garments created using a similar process, but one that was fully operational with integrated virtual try-on technologies and the capability to have designs produced to their specifications, the answers varied in terms of their breadth. Gena had some concerns about the quality of garments designed by customers who were not designers, while commenting on the fact that no matter what, this experience would make people think more critically about clothes offered to them by retailers:

If people design what they want, then ideally they would want to wear that more. But it really depends on how well they are designing things. Cause I do not know if the average person has the knowledge or fashion [. . .] if people take their own hands to design the clothes, they would probably be more critical [of] the things that they find in the stores. Most people I would think just go to the store and think “Oh this is what I should be wearing”. (Gena)

Ann and Bill share similar ideas with Gena. Ann foresees that this fully operationalized technology would result in people having a more personalized wardrobe since they would put their own design creativity into making these garments. As Bill suggests:

I think everyone has in mind what they want to look like in their clothes and what kind of clothes they want. Everyone is different and everyone has a style no matter what. So I think with this technology it allows people maybe to explore a lot of things like “Oh, I do not really wear wide crop tops, maybe I can see how it looks like on me,” things like that. So I think people would be more conscious on what kind of designs are available to them and maybe even, like, actually make them too. (Bill)

Among other comments on the garments, some participants were more interested in reflecting on the effects of a virtual try-on tool on garment purchase. According to Beth, under such circumstances online shoppers would end up purchasing better-fitting garments. Therefore, Beth believes, it is likely that after

purchasing a garment via a virtual try-on tool, people would be more satisfied and would not leave it in the closet. On this point, Ann and Bill also agree with her. Bill mentioned that such technology would stimulate customers to buy more online without worrying about fit problems. For Ann, consumers would be smarter about their purchases. These well-fitted customized garments would likely to be used more frequently as opposed to the products of fast fashion.

In terms of what people's relationships with such garments would be, the participants' opinions were polarized. On the one hand, participants thought that these smart purchases would diminish the number of impulse purchases. Chris thinks that this practice could make other people buy less:

I think this is part of the reason that people buy so much clothing they do not really need and have so many pairs of pants when you really need only one or two. If your pants do not fit you well, you are gonna want to have more variety. If you get things just right, then more people would be satisfied with less clothing. (Chris)

Only six out of seven interviewees completed the final survey with open-ended questions. Four out of six believed that utilization of the integrated technologies, including virtual fit to design garments, would not affect their overall clothing-purchase habits too much, and that they would purchase the same number of items. But they emphasized that they would be more critical about the chosen garments and would use the technologies to create unique and well-fitting outfits.

Open-ended answers to the survey revealed that in general, participants were willing to wear these garments—as long as they are aesthetically pleasing. Five out of six participants were willing to use these garments until they wore out. Three out of eight participants reported that they would be willing only to make minor changes, such as hemming their clothes, to extend their lives. When a person attempts to prolong the life of a product and does not dispose it after a short period of usage, it is a

sign of his or her degree of attachment to it, according to Schifferstein and Zwartkruis-Pelgrim (2008). In this present study, although the participants reported that they would be interested in using unique garments and that the whole process of garment creation is fun, they did not show evidence of strong attachment to their creations. This could be because they plan on being designers and design for other people every day.

Because of their design background, the participants were also very aware of potential construction quality issues and the fit of the virtually designed custom garments. In addition, four out of seven participants claimed that, even though during the interview they expressed high pro-environmental attitudes, they would still purchase cheaper, fast-fashion items. Wagner (2003) categorizes this type of cognitive thinking as ignorance or as “not knowing and not wanting to know/do”.

Participants’ reflections on the designed garments differed. Their answers suggested that they believed that garments they designed would be more meaningful and more personal, and that they would suit their personalities and aesthetic well. They would care more for these garments, use them for a longer time, and wear them with pride. On the other hand, however, participants would miss the excitement of surprises encountered during shopping practice as it is conducted in stores:

Clothing would equal expression in a much deeper way. However, the act of shopping and thus finding something you knew you wanted would be hard to replace. (Beth)

This answer closely resembles what Eric reported during the interview: “I feel like most people do not have the idea of what they want, so it’s much more [about] discovering something that you never knew you wanted than having [an] idea of exactly what to want and not being able to find it”.

Although I did a purposeful sampling, and this group had a chance to experience the technology hands-on, it was surprising to see that the answers of this group were similar to responses from a parallel questionnaire study of apparel design students who were shown the technology but did not experience it (see Chapter 3). This small case-study group was different only in that it focused on more technical and design details.

5.9. Conclusion and Future Work

The objectives of this study were to define some key points with regard to garment-sustainability and consumer-behavior research in the domain of apparel virtual try-on and product personalization. Interaction patterns were investigated to understand how and why people would want to use 3D virtual try-on software to design and purchase garments. The qualitative nature of the study enabled an in-depth analysis of potential consumers' perceptions of the digitally created garments and provided rich data around their personal interaction with this particular technology. Examination of the study data revealed eleven themes in the two categories of software usage and garment purchase and usage.

The themes related to the technology and to viewing virtual 3D objects emphasized initial hesitation to work with a new and relatively complex design software and lack of engagement with technology in facilitating design conversations. Initial hesitation to use a new and relatively complex software application was an expected result. As updated and simplified versions of the application are made available, the ease of use and understanding the value of technology could increase.

Although it occurred in an offline setting, the effect of the class's seating arrangement facilitated real time sharing designs with others to get some feedback and to exchange design ideas. Since the participants were able to see each other's

computer screens, they experimented with design ideas similar to those generated by their peers, especially when they saw a compelling idea. A future qualitative study on creating a similar environment in an online setting which enables the exploration of interactions among the users around such design conversations might be useful to determine which functions should be developed to make this system more user-friendly for design communication.

Participants stated that technology can decrease the time to design/choose garments by giving instant results, and it is fun, exciting, and engaging. Because virtual try-on technology is still new, its capacity was viewed as limited. The 3D visualizations were identified as somewhat accurate. People enabled by such technology could base their clothing purchase decisions on the types of garments that look good on them, and could therefore make smart purchases that they keep for a longer time. Virtual try-on technology with a product configurator could also potentially change the pace of shopping. Because the software can be perceived as fun, exciting, and engaging to use, it could lead users to sit in front of a computer for a long time, such as the behavior of Polyvore users. This might lead users to think more about the styles and incubate possible choices before they make their decisions, reducing impulse purchases that are then not valued or kept in their wardrobe.

Most of the participants in this study preferred the mono-color of their avatars; mono-color distanced them from the image, allowing them to treat it as a dress form and to feel less distracted by the personal nature of the form. This tendency also showed that checking for accurate fit was more important for the participants than the image quality of the avatars, emphasizing their utilitarian impact.

The findings also revealed that although actual 3D avatars provide accurate data in terms of fit, the female participants in particular exhibited some discomfort with the body scans. The issue of how individuals' think of their bodies, or see their

virtual bodies on the screen will influence the usage of 3D body-scan avatars in the virtual try-on environment. As long as users feel comfortable with their bodies, or have people looking at their bodies, they would share their images with their friends and ask for their opinions on the fit/look of a garment. Otherwise, they might tend to keep their images to themselves—thus limiting the normative input. From this point of view, a more simplified commercial application of similar software might be designed in a way that it can slightly modify body scan of the users in a way that provides a more attractive visualization of the scan. The visualization should not compromise the validity of the scan during the virtual try-on process so that it can be ensured that the system can still provide useful information on garment fit to its users.

The overall themes related to garment purchase and usage were distinguished as follows. Simpler designs were preferred. Designed garments were revealed to be tempting to obtain. Using this technology, people can review many options in a short time. The respondents described two contradictory expectations as outcomes of the widespread usage of such a system: it could be used either to fulfill its users' desires to shop and provide them with better-fitting and better-styled garments, thus reducing their need to buy more; or used to promote the consumption of more items by enabling its users to make appropriate decisions about what to buy without going to a mall and trying them on.

Future studies should examine this issue in more detail. For examining the first expectation, Polyvore users can be interviewed. To explore the second expectation, it would be beneficial to study how people would react to purchasing garments when they can virtually create and try on many garments. This study can use Kamali and Loker's (2002) study as a model where the authors compared a limited customization (50 possible design combinations) and advanced customization (37,500 possible combinations). The first step for conducting a similar study can be comparing OptiTex

2/3D software with a very comprehensive design library to MyLabel, a similar, but limited technology developed in a partnership between Bernina and OptiTex for home sewers. Such study can also examine satisfaction with design involvement in a 3D digital environment, and the impact of design involvement level on behavioral intentions to purchase the designed garment.

Employing interview, observation, and questionnaire methods together yielded data that suggested some hedonistic and utilitarian motives for participants to use the garments they design. Expectation of approval from their peers for their creative talents, a feeling of pride in their creative design capabilities and taste, and the unique characteristics and good fit of the customized garments would play the most important roles in a virtually mediated apparel-retail environment. Such an environment can emphasize these issues as the garments created through a similar system would be more meaningful and useful to obtain and use compared to ready-to-wear garments. As stated by one of the participants, Gena, being a part of designing a garment can change people by making them more knowledgeable about the garments and take control of what they really want to purchase. The garments acquired through this system would possess the latent values of being perceived as unique and meaningful, and as reflections of their creators' selves. These values are reported among the promising factors for the sustainable consumption of goods (Mugge et al., 2009; O'Cass, 2004; Loker, 2008).

Virtual try-on environment could be used as a powerful marketing tool for environmental consumption if optimized into a working system. Such system would also give people more ideas about what to wear according to their body types. The interactions between the users and the virtual-design and try-on technology suggested that designed garments could be better cared for, for a longer time, and worn with pride. Six out of seven participants in this study were very willing to see their own

digital design on themselves. This qualitative phase was helpful to observe some of the actual behaviors, for example two participants created their garments and wore them. However, periodic follow-ups of these participants regarding how they use these garments can provide more insight into understanding the effect of enabling technologies on sustainable consumption.

Although the participants were reasonably well-educated about the environmental problems related to apparel production and consumption, only two reported that their sustainability thinking entered into the garment-purchase and usage stages (i.e., using a garment for a longer period of time). The other participants knew their responsibilities, but were not very keen to change their current behaviors of purchasing as they appreciate the cheap and fashionable fast fashion garments on the market. For future research the emphasis should be put on educating consumers on purchase of more valued versus consuming low quality, frequently disposed garments.

Because participants in this study were fashion design students, they had more training in fashion design and higher expectations for the use of design technologies than people outside of the apparel design business. Using design students as participants limits the generalization of the results to the population as a whole. The study of user groups other than design students, different age groups, different locations, and cross-cultural level studies could solve the generalization limitation. . Further directions for research could be concentrated on diversifying the population to seek answers to the following questions: How would other designers (for example, architects or product designers) and non-design groups react to such technology? Non-design groups of the same age and technological knowledge might react to the idea totally different than this study's participants who chose fashion design as a career. For the non-design group, simple style choices can be provided and perhaps a complicated patternmaking (product design) process could be hidden behind a user

friendly process. Also, this group can be provided with a broader range of surface and fabric choices which they can modify easily.

How would different age groups react to this technology? MyLabel users tend to be women from 30 to 60 years of age (Fiore, 2008), the same target market as Target's recently launched Merona My Look Maker (35 and older). Development of software that provides the general consumer tools with which they can design custom clothing, using avatars for testing fit and suitability, would be appealing to older or younger consumers depending on how this software was designed. Studies of consumer behaviors around these questions would benefit the apparel and associated industries.

Fashion-conscious individuals have been increasingly using new digital fashion design platforms (Polyvore, Merona My Look Maker), that offer features for creating collages from existing fashion pieces, to mix and match garments and accessories, and to share their taste with other members and obtain feedback on their choices from their online peers. Literature showed that retailers are interested in offering this virtual try-on option around virtual communities; this is why they have been offering like/unlike options and collage sharing (Pentina et al., 2008). How would creating online communities around these technologies change the dynamics of consumption? A future experimental study should include an online mock-up shopping environment, with a virtual try-on function, as well as a virtual community around it to examine design and decision-making processes. Researchers should collaborate with business to identify new applications within a context of sustainability. Businesses should also play a role in advertising sustainable consumption as initiatives. Studying existing online communities, such as Polyvore, or MVM- and perhaps interviewing them might reveal how these groups think about consumption of customized garments. An in-depth study of these communities might

give additional insights into the question of sustainable consumption of customized garments.

5.10. Limitations

There were several limitations to this study. First of all, data for this study were collected before and after the annual end-of-semester student fashion show that all participants were showing one or more designs. This put a lot of pressure on each participant for much of the study period. Participants became less overwhelmed during the last three to four weeks of the semester. This was the period in which the participants used the software most intensively; therefore, most of the useful data were taken during this period. Also, during the period in which these independent study meetings were held, participants had many conflicting demands and were not fully capable of dedicating themselves to the process.

I really did like having the opportunity to like—work on clothes for myself. Except that I did not realize like my semester load is always so heavy. But I made time for it. (Beth)

In addition to that, because of the nature of the “independent study” format, this study was designed to give the participants some freedom. But this “unstructured” format did not work well in competition with the participants’ more structured deadlines. Concentrated activity occurred only when a final assignment due date was given to the participants. All of them, except the student who was not participating in the study for credit, were unable to complete the full range of tasks expected for the project, which was to complete three outfits. Participants reported that the reason for this was that the class was unstructured:

It could be more structured I guess—I prefer deadlines. (Eric)

It was very open-ended. If there were more deadlines . . . that would be better. And if you make things mandatory, that'll be a lot better. (Gena)

It should be kept in mind that since the participation number was low, this study was not set out to reveal generalizable findings.

The need to divide the study group into two sections because of the limited number of software keys may have had an effect on participant interaction. There were also difficulties in getting participants to talk about and reflect on the virtual garments they designed, mostly because they rushed to complete them, thus working on details or problems that occurred at the last minute—which might have led them to feel some frustration—as a result, they may have had difficulty recalling their experiences later.

As Humphreys (2007, p. 42) emphasized, in the context of mobile communication, if two people are in the same environment and are close, they will be likely to talk to each other in person rather than communicate through devices. The participants in this study worked together, in a co-located manner, in the computer lab. They were all friends with one another. Therefore, the use of social networks was not an option for this study.

Also, during the “class time” I was not properly observing as a researcher since I had to interact in a teacher/student relationship in addition to being a participant observer. Furthermore, although I was audio-recording my own interaction with participants, my role as technical troubleshooter caused me to miss some of the possible interactions of other participants while fixing a problem at one computer station. At the same time, however, I was fortunate to have Eric, who had used the same software before, as a participant, because he was able to interact as a teacher at times, enabling me to continue my observations.

I also anticipate that “what an informant says is always a function of the interviewer and the interview situation,” as explained by Maxwell (1996, p. 91). The

validity of inferences that I extracted from the interviews may have been affected by this fact. The participants knew my research background and interests, so it is highly possible that that knowledge influenced them to give the answers that they believed I wanted to hear.

REFERENCES

- Adler, P. A., & Adler, P. (1994). Observational techniques. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (pp. 377-391). Thousand Oaks, CA: Sage Publications.
- Allen, W., Kilvingston, M., Horn, C. (2002, May). Using participatory and learning-based approaches for environmental management to help achieve constructive behavior change. Retrieved from http://www.landcareresearch.co.nz/research/sustainablesoc/social/par_rep.asp
- Apassion (n.d.). Retrieved September 5, 2010, from www.apassion.com
- Apeageyi, P. R., & Otieno, R. (2007). Usability of pattern customising technology in the achievement and testing of fit for mass customization. *Journal of Fashion Marketing and Management*, 11(3), 349-365.
- Ashdown, S., & Loker, S. (2010). Mass-customized target market sizing: extending the sizing paradigm for improved apparel fit. *Fashion Practice The Journal of Design, Creative Process & the Fashion Industry*, 2(2), 147-174.
- Ashdown, S., Loker, S., Schoenfelder, K. A., & Lyman-Clarke, L. (2004). Using 3D scans for fit analysis. *Journal of Textiles and Apparel, Management and Technology*, 4(1). Retrieved from <http://www.tx.ncsu.edu/jtاتم/>
- Bennett, J. (1996). Reflective conversation with materials: An interview with Donald Schön. In T. Winograd (Ed.), *Bringing design to software*. Retrieved from <http://hci.stanford.edu/publications/bds/9-schon.html>
- Bernina (2010, September 4). *My label free collections*. Retrieved from <http://www.berninamylabel.com/content-n81-sE.html>
- BerninaMyLabel Yahoo Group (2010, September 3). Retrieved from <http://groups.yahoo.com/group/BerninaMyLabel/>
- Browzwear. (n.d.). Retrieved September 5, 2010, from www.browzwear.com/
- Chung, D. (2005). Something for nothing: Understanding purchasing behaviors in social virtual environments. *Cyberpsychology and Behavior*, 8(6), 538-554.
- Calhoun, E., Ashdown, S. P., & Lyman-Clarke, L. (2009). Virtual fit of apparel on the internet: Current technology and future needs. In F. T. Piller & M. M. Tseng (Eds.), *Handbook of research in mass customization and personalization Volume 2: Applications and cases* (pp. 731-748). Hackensack, NJ, London and Singapore: World Scientific Press.

- Coyne, R., Park, H., & Wiszniewski, D. (2002). Design devices: Digital drawing and the pursuit of difference. *Design Studies*, 23(3), 263-286.
- Denzin, N. K., & Lincoln, Y. S. (2000). *Handbook of qualitative research*. Thousand Oaks, CA: Sage Publications.
- Dombek-Keith, K. (2008). Re-fashioning the future: Eco-friendly apparel design. (Unpublished master thesis). Cornell University, Ithaca, NY.
- Elliott, S. (2010, June 25). Target wants you to friend their sweaters [Web log comment]. Retrieved from <http://mediadecoder.blogs.nytimes.com/2010/06/25/target-wants-you-to-friend-their-sweaters/>
- Fiore, A. M. (2008). The digital consumer: Valuable partner for product development and production. *Clothing and Textiles Research Journal*, 26(2), 177-190.
- Fletcher, K., & Tham, M. (2003). Clothing lives!. In Tim Cooper (Ed.), *Proceedings from an Academic Workshop of Product Life and the Throwaway Society* (pp. 49-56). Sheffield Hallam University, England. Retrieved from www.ntu.ac.uk/research/document_uploads/108814.pdf
- Forum for the Future. (2007, March). Fashioning sustainability: A review of the sustainable impacts of the clothing industry. Retrieved from <http://www.forumforthefuture.org/files/Fashionsustain.pdf>
- Gerber Technology. (n.d.). Retrieved September 5, 2010, from www.gerbertechnology.com/
- Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Chicago, IL: Aldine Publishing Company.
- Ha-Brookshire, J. E., & Hodges, N. N. (2009). Socially responsible consumer behavior? Exploring used clothing donation behavior. *Clothing and Textiles Research Journal*, 27(3), 179-196.
- Human Solutions. (n.d.). Retrieved September 5, 2010, from http://www.human-solutions.com/apparel/technology_scanning_en.php
- Humphreys, L. (2007). Mobile sociality and spatial practice: A qualitative field study of new social networking technologies. (Unpublished doctoral dissertation). University of Pennsylvania, Philadelphia, PA.
- Illich, I. (1973). *Tools for conviviality*. New York, NY: Harper & Row Publishers.

- Istook, C. L. (2008). Three-dimensional body scanning to improve fit. In C. Fairhurst (Ed.), *Advances in apparel production* (pp. 94-116). Cambridge, England: Woodhead Publishing.
- Jacobs, A. (2010, March 29). Fashion democracy. *The New Yorker*, 52-53.
- Kim, J., & Forsythe, S. (2007). Hedonic usage of product virtualization technologies in online apparel shopping. *International Journal of Retail & Distribution Management*, 35(6), 502-514.
- Lectra. (n.d.). Retrieved September 5, 2010, from www.lectra.com/
- Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Beverly Hills, CA: Sage Publications.
- Lofland, J., Snow, D., Anderson, L., & Lofland, L. H. (2006). *Analyzing social settings: A guide to qualitative observation and analysis* (4th ed.). Belmont, CA: Wadsworth Publishing.
- Loker, S. (2008). A technology-enabled sustainable fashion system: Fashion's future. In C. Ulasewicz & J. Hethorn (Eds.), *Sustainability fashion, why now?* (pp. 95-126). New York, NY: Fairchild Books.
- Loker, S., Ashdown, S. P., Cowie, L., & Schoenfelder, K. A. (2004). Consumer interest in commercial applications of body scan data. *Journal of Textile and Apparel Technology and Management*, 4(1), 1-13.
- Loker, S., Ashdown, S., & Carnrite, E. (2008). Dress in the third dimension: Online interactivity and its new horizons. *Clothing and Textiles Research Journal*, 26(2), 164-176.
- Lynn, M., & Harris, J. (1997). The desire for unique consumer products: A new individual differences scale. *Psychology & Marketing*, 14(6), 601-616.
- Magenat-Thalmann, N. (Ed.). (2010). *Modeling and simulating bodies and garments*. London, England: Springer-Verlag London Limited.
- Maxwell, J. A. (1996). *Qualitative research design: Interactive approach*. Thousand Oaks, CA: Sage Publications.
- Messinger, P. R., Bone, M., Smirnov, K., Stroulia, E., Lyons, K., Niu, R. H., & Perelgut, S. (June 01, 2009). Virtual worlds - past, present, and future: New directions in social computing. *Decision Support Systems*, 47, 3, 204-228.
- Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook* (2nd ed.). Thousand Oaks, CA: Sage Publications.

- Mugge, R., Schoormans, J. P. L., & Schifferstein, H. N. J. (2009). Incorporating consumers in the design of their own products. The dimensions of product personalization. *Codesign*, 5(2), 79-97.
- My Virtual Model. (n.d.). Retrieved September 4, 2010, from <http://www.myvirtualmodel.com>
- O’Cass, A. (2004). Fashion clothing consumption: Antecedents and consequences of fashion clothing involvement. *European Journal of Marketing*, 38(7), 869-882.
- Onwuegbuzie, A. J., & Teddlie, C. (2003). A framework for analyzing data in mixed methods research. In A. Tashakkori & C. Teddlie (Eds.), *Handbook of mixed methods in social and behavioral research* (pp. 351–383). Thousand Oaks, CA: Sage.
- OptiTex. (n.d.). Retrieved September 5, 2010, from <http://www.optitex.com/>
- OptiTex. (2010). 11 questions to Julia Shaw, National Support Manager for OptiTex USA. Retrieved September 3, 2010, from <http://www.optitex.com/fr/articles/11questionsToJuliaShaw>
- Patton, M. Q. (2002). *Qualitative research and evaluation methods*. Thousand Oaks, CA: Sage Publications.
- Peattie, K., & Collins, A. (2009). Guest editorial: Perspectives on sustainable consumption. *International Journal of Consumer Studies*, 33(2), 107-112.
- Pentina, I., Prybutok, V. R., & Zhang, X. (2008). The Role of virtual communities as shopping reference groups. *Journal of Electronic Commerce Research*, 9(2), 114-136. Retrieved from <http://www.csulb.edu/journals/jecr/issues/20082/paper3.pdf>
- Polyvore. (n.d.). Retrieved September 2, 2010, from <http://www.polyvore.com/cgi/about>
- PriceWaterhouseCoopers Canada (2010). Retrieved September 4, 2010, from <http://www.pwc.com/ca/en/car/mon-mannequin-virtuel/index.jhtml>
- Scaturro, S. (2008). Eco-tech fashion: Rationalizing technology in sustainable fashion. *Fashion Theory: The Journal of Dress, Body & Culture*, 12(4), 469-488.
- Schaefer, A., & Crane, A. (2005). Addressing sustainability and consumption. *Journal of Macromarketing*, 25(1), 76-92.
- Schifferstein, H. N. J., & Zwartkruis-Pelgrim, E. P. H. (2008). Consumer-product attachment: Measurement and design implications. *International Journal of Design*, 2(3), 1-13.

- Schön, D. A. (1992). Designing as reflective conversation with the materials of a design situation. *Knowledge-Based Systems*, 5(1), 3-14.
- Schön, D. A., & Wiggins, G. (1992). Kinds of seeing and their function in designing. *Design Studies*, 13(2), 135-156.
- StyleZone. (n.d.). Retrieved September 5, 2010, from <http://www.stylezone.com/>
- [TC]². (n.d.). Retrieved September 5, 2010, from , <http://www.tc2.com/>
- Taylor, A., & Varley, R. (2008). Embodiment in 3D virtual retail environments: Evolving the perceptions of collaborative art and design research as avatars. *e-Proceedings of ReLIVE08: Researching Learning in Virtual Environments Conference* (pp. 310-323). Milton Keynes, UK: The Open University. Retrieved from <http://www.open.ac.uk/relive08/catch-up.shtml>
- Tukatech. (n.d.). Retrieved September 5, 2010, www.tukatech.com/
- Wagner, S. A. (2003). Understanding green consumer behaviour: A qualitative cognitive approach. New York, NY: Routledge.
- Wilson, C. (2008, April 9). Avatars, virtual reality technology and the U.S. military: Emerging policy issues. Retrieved from <http://www.fas.org/sgp/crs/natsec/RS22857.pdf>
- Winograd, T., & Flores, F. (1986). *Understanding computers and cognition a new foundation for design*. Norwood, NJ: Ablex Publishing Corporation.
- Wolfinger, N. H. (2002). On writing fieldnotes: Collection strategies and background expectations. *Qualitative Research*, 2(1), 85-95.
- Wood, N. T. (2002). Personalization of the web interface: Avatars as vehicles for visual persuasion in the online decision making process. (Unpublished doctoral dissertation). Auburn University, Auburn, AL.

CHAPTER 6

SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1. Summary and Conclusion

The Industrial Revolution and related changes in economic, technological, and cultural systems has fundamentally altered the way people live, interact with the objects they use, and affect natural systems. Humanity's ecological impact to ecosystem has been especially increasing with the increase in overconsumption of resources since 1980s (United Nations [UN], 2010). As a blanket term, the notion of sustainability covers everything related to reducing negative social and environmental impacts of contemporary life. Sustainability is a growing issue for developed countries since their effect on world's resources is greater than any other countries (World Wildlife Fun [WWF], 2010). For the apparel industry, the shift from four or five season-based fashion cycles to continuously changing styles and the effect of moving apparel production overseas has amplified its impact on economies, societies and the environment over the last two decades. Our current apparel consumption patterns are wasteful.

Technological advancements in virtual imaging and apparel try-on technologies bear some potential for contributions toward development of more sustainable consumption model for apparel. The introduction of integrated enabling technologies has a potential to challenge current production and consumption models. In a technology-enabled sustainable fashion system, Loker (2008) included current technologies such as product configurators, and body scanning as enablers of made-to-order or mass customization production systems. She argued that such systems could indirectly affect the consumer use stage, extending the life span of products by

balancing production and consumption, increasing their durability as well as contributing to increased functional and emotional values of the garments.

Current technological developments indicate that 3D scan, ‘scan at home’ initiatives to create 3D images from photographs, and virtual applications could be wide-spread in the near future. [TC]² has currently reported that they developed a new scanning system by using a new device, Kinect, which was developed for the Microsoft Xbox 360 and has a capacity to scan 3D objects. Kinect is a portable, relatively low-cost device that is already in 10 million homes as a part of a game console. Implementing it for getting 3D full body scans at homes and making the output usable for web-enabled smart phone applications is one of the plans being developed by [TC]². The company also aims to combine this technology with their virtual try-on software, Vdresser and launch this integrated technologies in Autumn 2011 (Bruner, 2011). The company currently does not offer a product configurator in addition to these technologies.

If one presumes a situation in people would be fully technologically enabled to be involved with the creation of their garments, several questions come to mind. What would happen if digitally networked people were introduced to design tools that make it possible to participate in the design process of garments, view them on their own realistic virtual fit model images, and share such images and discuss them with their peers? How would such tools affect people’s interaction with their garments? Would such digitally mediated environments encourage people to consume more, or turn them into more selective consumers? Would it be possible to change the current destructive effects of our clothing consumption behaviors on the environment with the help of such technologies?

For this study, 3D body scanning, virtual try-on and online social networking to share information and feedback were identified as enabling technologies for mass

customization in the apparel industry. It should be emphasized that the customized garments made using these technologies would be different from general custom made garments, as there would be more than one enabling technology working altogether to involve users with the product design and making a purchase decision. Moreover, consumers would be able to virtually try on the garments they design on their own individual avatars thereby getting useful information on how the garment will interact with their body and allowing the consumer to make informed decisions as part of the design process, as well as to obtain feedback from friends or from a trusted fashion advisor. These differences in involvement and communication would contribute to a different relationship between the customized garments and the consumers.

This study was designed to examine people's intentions to sustainably consume customized garments acquired through enabling technologies for the fashion industry. Dolan (2002) says that it is difficult to operationalize the concept of sustainability. As explained in The Sustainable Consumption Roundtable report, "I Will if You Will", (2006), currently there are two directions for sustainable consumption: consuming less and consuming differently. While consuming less advocates that "we would actually be happier and enjoy a better quality of life by consuming less," the second group suggests that "consuming less would restrict choice and reduce the quality of people's lives," so people should be consuming efficiently instead (p.55). This present study aimed to operationalize the term, sustainable consumption, as "keeping and using customized garments for many seasons", thus covering both sides of the current debate.

Motivating consumption strategies for sustainability that can be embraced by consumers at large is one of the most challenging issues for sustainable consumption (Peattie & Collins, 2009). Schor (2005) argued that purely technological solutions to solve environmental problems would fail for their apolitical approach, as "the

incentives to increase the scale of consumption are too powerful”. For this reason, an intervention was designed to further investigate the impact of strong political media messages on sustainability and the related potential uses of these enabling technologies. In a ten minute video intervention on technological and sustainability issues in the apparel industry, both content for ‘influencing hearts and minds’ (Arbuthnott, 2009) (explaining current environmental problems through images which give an emotional dimension to the knowledge), and a technology-based change plan for minimizing the consumption were presented.

To evaluate selected systems’ potential impact on sustainable consumption, via examining the impact of intentions to participate in specific consumption behaviors around the products created using these technologies, Icek Ajzen’s (1991) Theory of Planned Behavior provided the theoretical framework for the first part of the study (Chapter 3). The purpose of the study was to investigate if such media intervention can influence behavioral intentions to consume sustainably.

Considering the terminology, current level of the technology interface, and the concept of using enabling technologies for the garment design process, it was decided to recruit participants with apparel design knowledge for this initial study. Furthermore, as these enabling technologies are new and not used equally by all ages, it was decided to recruit younger population (i.e., undergraduate and graduate students). Participants were divided into two groups, in a stratified manner, to explore the impact of social messages containing both information on sustainability and on possible uses of the technologies on their planned behaviors toward sustainable consumption. These results were explained in Chapter 3 (changes in behavioral intentions) and Chapter 4 (effectiveness of the intervention) respectively.

Since these technologies are still at the developmental stages, and it is currently not possible to test actual behaviors, a qualitative study was conducted to

explore behavioral intentions of potential users and to make inferences. This study was designed to capture a glimpse of actual behaviors in a possible setting and to get a deeper understanding for an emerging area. Qualitative study results from the experimental test of the technologies are presented in Chapter 5 in detail. The constant comparative method (Lincoln & Guba, 1985), which is rooted in Grounded Theory, provided the theoretical framework of the qualitative part of the study.

The questionnaire for the quantitative study was developed with a scenario explaining the enabling technologies (virtual try-on technology, 3D body scanning and an online social networking platform). Intervention and control groups received the same information regarding these technologies. The questionnaire contained questions based on the core variables of theory of planned behaviors as well as questions regarding other variables derived from the literature. The responses were evaluated on a five or seven –point Likert scales, smaller values being most negative, three (or four) being neutral, and higher numbers being most positive. The resulting questionnaire was provided by Checkbox, a secure online survey research tool provided by Cornell University until 2011. The online survey’s link was sent to fashion design students. The survey consisted of two parts: pre-treatment and post-treatment. The hypotheses took their roots from the existing literature and applied these concepts into this new domain to see their validity and affect in the area of possible sustainable consumption behaviors when developing and purchasing customized garments. 160 of the respondents completed both parts of the survey.

This dissertation is the first study investigating sustainable consumption within an environment that postulates individual 3D Body Scan avatars for virtual try-on and social networking. Overall, the results of this research provided theoretical support for the predictors of the life span of customized garments obtained through enabling technologies and the intervention. The study supported the usefulness of enabling

technologies for sustainability by providing significant results and proposing several factors to focus on, as summarized in the following sections.

6.1.1. Analysis of the Framework Designed by Employing the Theory of Planned Behavior

As the basis for this research, Ajzen's (1991) Theory of Planned Behavior was developed into an extended model where determinant factors for the usage of customized garments could be investigated. In addition to the theory's core factors (attitude, subjective norm and perceived behavioral control), external factors (uniqueness, behaviors towards green consumerism) influenced intentions to keep customized garments in use for many seasons.

Attitude was found to be one of the influential predictors of intention to keep and wear customized garments. This finding is consistent with other intention based model research (Eagly & Chaiken, 1993). If attitudes can be affected in a positive way, it will be possible to change the behavioral intentions in a positive way.

Uniqueness of the customized garment was found to be as another effective factor on behavioral intention to use it for many seasons. This was an important finding as it drew attention to the perception of customized garments. As Belk stated (1998) consumers satisfy their need for uniqueness by purchasing unique consumer products. Enabling technologies have potential to fulfill the users' needs by giving the opportunity to acquire unique garments. In this vein, customized products can satisfy the need for personal self-uniqueness and dissimilarity from others. Results of this research revealed that the unique properties of the garments would be playing a major role in terms of keeping them for a long time. The emergence of uniqueness as a significant variable is an indicator that customized product qualities would be imperative for determining the life of the garments and people's approaches to their

goods. A production system, which values and emphasize this variable with the help of customization and virtual fit, could be a solution for a sustainable consumption.

Moreover, motivating interventions played a moderating role to affect one of the core determinants, perceived behavioral control. Another significant effect on the behavioral intention for consuming customized garments sustainably was the interaction term of treatment and perceived behavioral control. Availability of options to extend the life of the garment, as explained in the video, and the perceived importance of not discarding excess garments for the sake of environment might have affected this finding. This factor can be also associated with the participants' perceived abilities to be content with fewer apparel items that are worn over many years, and their belief that their actions in designing and wearing clothing can make a difference in using resources more sustainably. Design examples, information on sustainability, and explanations of technologies shown in the video might have had an effect on the respondents' perceptions that, with the given information, they could control the amount of garments they keep and use.

Subjective norms also exhibited a strong, direct effect on intention. Participants indicated that they would be affected by their peers' /family members' behaviors. Their subjective norms also affected the behavioral intentions positively. Any kind of online recommendation systems/ social networking can provide such interface.

Another influential variable predicting intention was perceived behavioral control. This finding also confirms Ajzen's (1991) finding that perceived lack of difficulty in performing a behavior determines whether the behavior will be carried out.

Behaviors toward green consumerism were also showed some significant influence on predicting behavioral intentions toward consuming less clothing.

Results of this study also confirmed the complicated structure of the models. In the context of using customized garments for a longer period of time, attitudes not only had a direct effect on behavioral intentions, but also mediated the effect of the beliefs towards these garments' unique character, thus increasing the intention to use them longer time.

Overall, core model variables were found to be significantly associated with intention to keep and wear customized garments for many seasons. The final model revealed that there were five significant predictors for main effects and one significant predictor for moderating effect of the treatment. All of the latent variables positively affected the behavioral intention. Hale, Householder, and Greene's (2002) meta analyses on combined effects of three predictors (attitude, subjective norm, and perceived behavioral control) of behavioral intentions in the TPB model showed that these constructs accounted for 40-50% of the variance in behavioral intentions. In this present study, inclusion of external variables increased the predictive power of the model. The final model explained 73 % of the between subjects variance.

This result shows that as attitude, subjective norms, personal behavioral control, beliefs toward uniqueness of the product, and green consumerism behaviors increase, behavioral intention to keep and use garments for many seasons increases. Results also revealed that, if there is a stimuli consisted of various messages regarding the target behavior (for our study images and demonstrations showing the connections between sustainability and enabling technologies) such messages affect perceived behavioral control, that is, the behavioral intention toward keeping and using the customized products for many seasons increases in turn.

Theoretically, scholarly work on the Theory of Planned Behavior suggests that intentions are critical factors leading to actual behaviors. In this context, findings can suggest that for the users of the integrated enabling technologies (3D Body scan based

avatars+ virtual try on+ online social networking platform), keeping and wearing customized garments will be affected by these parameters. In addition exposure to motivating messages can tend to influence users to choose the acquisition and wearing of the customized garments for a longer time versus the use of fast-fashion products.

Open-ended results also provided deeper dimensions. In addition to the variables suggested by the literature regarding a long-term association with goods and personal beliefs, open-ended themes manifested other key issues to be investigated for future studies. It was found that fit, quality, and price of the customized garments should be investigated further as additional external factors to the current model. As Bye and McKinney (2007) suggested, as consumers have better knowledge on proper fit, they can make better purchase, consumption, and disposal decisions in the future. In this sense, using virtual fit during garment acquisition might be helpful for developing both a more functional and meaningful (i.e. more fulfilling) wardrobe. Although the respondents to the open-ended questions believed that such integrated systems of technology could increase consumption, most of them agreed that the technology has the potential to minimize purchase of badly fitting garments, to increase knowledge and awareness prior to purchase of the garments, and to generate more appreciation for the products and thus cause better care to be taken of them. They mentioned that fewer but better-fitting garments would cause greater satisfaction with their purchases and cut down their needs to look for more garments.

Examination of the open-ended results showed that intervention had effects at several points. Respondents from the intervention group frequently mentioned that they would plan to use the customized garments frequently as well as for a longer time. Also, the intervention group participants perceived these integrated technologies as enablers (increasing knowledge and awareness on the products, strengthening design skills etc.) as well as inspiration sources (from social network/ sharing designs/

getting feedback from others). They would feel proud of themselves and their accomplishments and feel more connected to the products they create. In addition to these findings, intervention group participants also raised questions on environmental impact of the integrated technologies and developed various ideas on how to address environmental issues. It was apparent from their answers that the intervention made them aware of the problems of excess consumption of clothing, showing that such stimuli could be used for promoting sustainable consumption.

In general, participants from both groups responded that they would use the technologies to design staple garments, garments for special occasions, and more form-fitting garments such as blazers and coats. The way that participants treat customized garments would differ from their treatment of ready-to-wear [RTW] garments, because they expected the custom-made garments to be more expensive than RTW products. Also, intervention group participants perceived garments to have higher quality, and said they would feel more sentimental and attached to the customized garments, as well as they would be using them frequently and for a longer time. Echoing one of the participant's words, "...[I] would work even harder to make them last longer because I would have been personally involved in the creation of the garment for every step of the process" (Participant E44), it can be expected that customized garments would be perceived as valuable in many ways and this will make consumers to want to use them more for a longer time.

6.1.2. Further Analysis of the Intervention

In Chapter 4, the effect of selected media, a short video, on increasing the knowledge and creating a "sense of crisis" about the environmental impact of multiple discarded garments was examined. In this pretest–posttest experimental study, all participants first completed an 8- to 10-minute pretest survey. In addition to providing

demographic information, respondents rated statements about their knowledge of sustainability issues and their environmental concerns as consumers. Based on their knowledge and environmental concern levels, respondents were stratified into two groups: an Low Environmental Concern (LEC) and an High Environmental Concern (HEC). Next, participants belonging to these groups were randomly assigned to either the control group or an intervention group. Intervention-group members viewed the ten-minute video, which was uploaded to a video-sharing website (www.vimeo.com) and protected by a password. Then, participants completed a 10- to 15-minute posttest survey, which contained the same measurements scales of knowledge and consumption that were used in the pretest.

Results showed that, respondents overall exhibited a good level of general environmental knowledge about the apparel industry and clothing consumption problems. However, although they were aware the impact of their consumption patterns on the environment, they exhibited a low degree of intention to change. The same result was found for the intensions of participants of the qualitative study presented in Chapter 5. The intervention video was useful for some participants, as it stimulated and challenged their thinking towards sustainability. Overall, the video received positive responses, as well as some useful suggestions for further development. For instance, some amount of quantitative information would increase the persuasive effect of the message by providing convincing support, or topics different than the ones taught in the classes could be covered.

Broadly, participants mentioned several key factors about the video, such as how it alerted them, reinforced, and refreshed the issues covered in their classes. The intervention also challenged the intervention group participants to think about futuristic possibilities regarding the impact of technological solutions on sustainability. Some participants agreed with the general content presented in the

video about how minimizing garment consumption would diminish our impact on climate change, whereas some did not.

The video intervention was especially effective for increasing awareness toward excessive apparel consumption, proving some evidence to that a sustainable behavior intention can be influenced by awareness about environmental sustainability when presented from an emotional perspective. Although Schaefer and Crane (2005) do not foresee that the majority of consumers will adopt ‘less wasteful forms of consumption’ anytime soon, the results were promising that an effective ‘propaganda’ might reduce the frequency of impulse shopping.

6.1.3. Qualitative Study for Investigating Actual Behaviors

Qualitative phase of this study investigated the interaction patterns, and how people may react to similar software in the future online shopping environment. It examined why people would want to use a 3D software package to design and how using virtual try-on software and 3D body-scan avatars can affect the relationship between customers and customized garments. The objectives of this portion of the study were to define some key points with regard to garment sustainability and consumer-behavior research in the domain of apparel virtual try-on and product personalization. The qualitative nature of this portion of the study enabled an in-depth analysis of potential consumers’ perceptions of digitally created garments and provided rich data around the actual interactions of participants with this particular technology.

The study sample included eight participants. All of the participants were familiar with OptiTex digital patternmaking program, which has a virtual try-on capability. Participants were asked to design two to three garments for themselves to be worn for a semi-special event. Each participant was scanned with the Human

Solutions 3D body scanner to create his or her virtual avatar. These virtual avatars were imported into the OptiTex system. During the study, participants also watched the treatment video, which was provided to the quantitative study participants, in the expectation of interesting them in concepts of sustainability. As methodology, online questionnaires, participant observation, analysis of image journaling and documentation, and semi-structured in-depth interviews were employed to collect rich data about participants' interactions with the technology. Observation notes and transcribed recordings (the design logs, field notes, the interview transcripts, and the written answers to the open-ended survey questions) were used to identify themes.

The themes related to the technology and to viewing virtual 3D objects revolved around initial hesitation to work with a new and relatively complex design software, technology's importance as a medium to facilitate design conversations, technology's effects on decreasing the time to design/choose garments by giving instant results, and the technology's hedonistic qualities (fun, exciting, and engaging). The 3D visualizations were identified as fairly accurate. Fit avatars made from body scans were perceived as more realistic than computer-generated models, but female participants in particular exhibited some discomfort with their body scans. Because virtual try-on technology is still new and not fully developed, its capacity was viewed as limited.

For the style of the garments developed with the technology, simpler designs were preferred. Designed garments were reported to be perceived as successful designs that participants would want to have in their wardrobe. Two participants actually produced the garments they designed by using the virtual try-on system. Their garments fit them well, and the participants stated that they would be wearing them to show their talents to their peers.

Employing interview, observation, and questionnaire methods together yielded data on some hedonistic and utilitarian clues that would motivate participants to use the garments they design. Expectation of approval from their peers for their creative talents, a feeling of pride in their creative design capabilities and taste, and the unique characteristics and good fit of the garments would play the most important roles in a virtually mediated apparel retail environment.

Mugge, Schoormans, & Schifferstein (2005) stated that, energy invested in customizing a product would lead to creating a product which can fulfill the need for the consumer's self-expression. As a result of the satisfaction of self-expression, consumers use the product to "show the world who they are". The results of this present study showed that, the garments created using the proposed system would have greater personal meaning as well, and the technology was perceived as a good tool to help give people some ideas about what to have in their wardrobe. Six out of seven participants in this study would want to purchase and use the clothing as designed.

The group that participated in the qualitative part of the study had a chance to experience the technology hands-on, but even with this much more involved experience, the responses of this group were quite similar to responses from the questionnaire study participants who were shown the technology but did not experience it. In general, results verified the findings in Chapter 3 where uniqueness, fit, and meaningfulness were the major factors, which might play an important role on consumption patterns of the garments created using these technologies. In addition to these findings, the qualitative study participants raised some issues on sharing their 3D body scan images with others in a virtual environment.

This small case-study group was different from the participants in the questionnaire study in terms of their exposure to more technical details of the

technology. As they experienced either minor or major drawbacks of the existing software, they responded somewhat hesitantly to the possibility of effective usage of a similar technology. They could have been biased by technical or software interface difficulties (that could be solved in a more mature technology), affecting their overall responses to the potential use of the technology.

The interactions between the users and the virtual-design and try-on technology suggest that designed garments could be better cared for, used for a longer time, and worn with pride. In this way, this tool would likely serve an oxymoronic function: it could be used either to fulfill its users' need for well designed clothing and provide them with better-fitting and better-styled garments, thus reducing their need to buy more in a search for appropriate items for their wardrobe, or could be used to experiment with exciting new ways to acquire clothing and to buy without the time consuming process of going to a mall and trying clothing thus enabling and promoting the consumption of more items.

6.1.4. Final Model

The model presented in Figure 6.1 summarizes overall findings of from the qualitative study and the theoretical model of extended TPB. Qualitative results were helpful in drawing more detailed conclusions regarding the outcome of the theoretical model, and in detecting new variables that need to be investigated in a model for future studies. In addition to the direct significant effect of attitudes, subjective norms, perceived behavioral control, perception of uniqueness of the garments and the effect of environmental concerns possessed by the user of such integrated technology on sustainable consumption behavior intentions, the treatment (indicated with a green arrow) was found to be effective for promoting the enabling features of integrated technologies and underlining the unique properties of the customized garments

encouraging frequent use and use for a longer time before discarding. Three categories emerged from the open-ended section of the survey relating to behavioral intentions to keep and use customized garments for many seasons: Technology, Garment Characteristics, and Garment Design and Use. These categories were also found to primarily cover the themes that emerged during the analysis of the in-depth qualitative study where a small group of participants actually used the system, which was described to the 160 participants in the quantitative study. The interactions between the users and the virtual-design and try-on technology suggested that designed garments could be better cared for, for a longer time, and worn with pride. Six out of seven participants in the in-depth qualitative study were very willing to see their own digital design on themselves. Figure 6.1 indicates that there would likely be a complicated relationship between technology, garment design and perceptions of garment characteristics, and this relationship would be another major factor affecting the intensity of user-garment relationships in the long run. Dotted lines were used to indicate which domains are important for sustainable consumption of customized garments, and they point out the areas where a further study is needed.

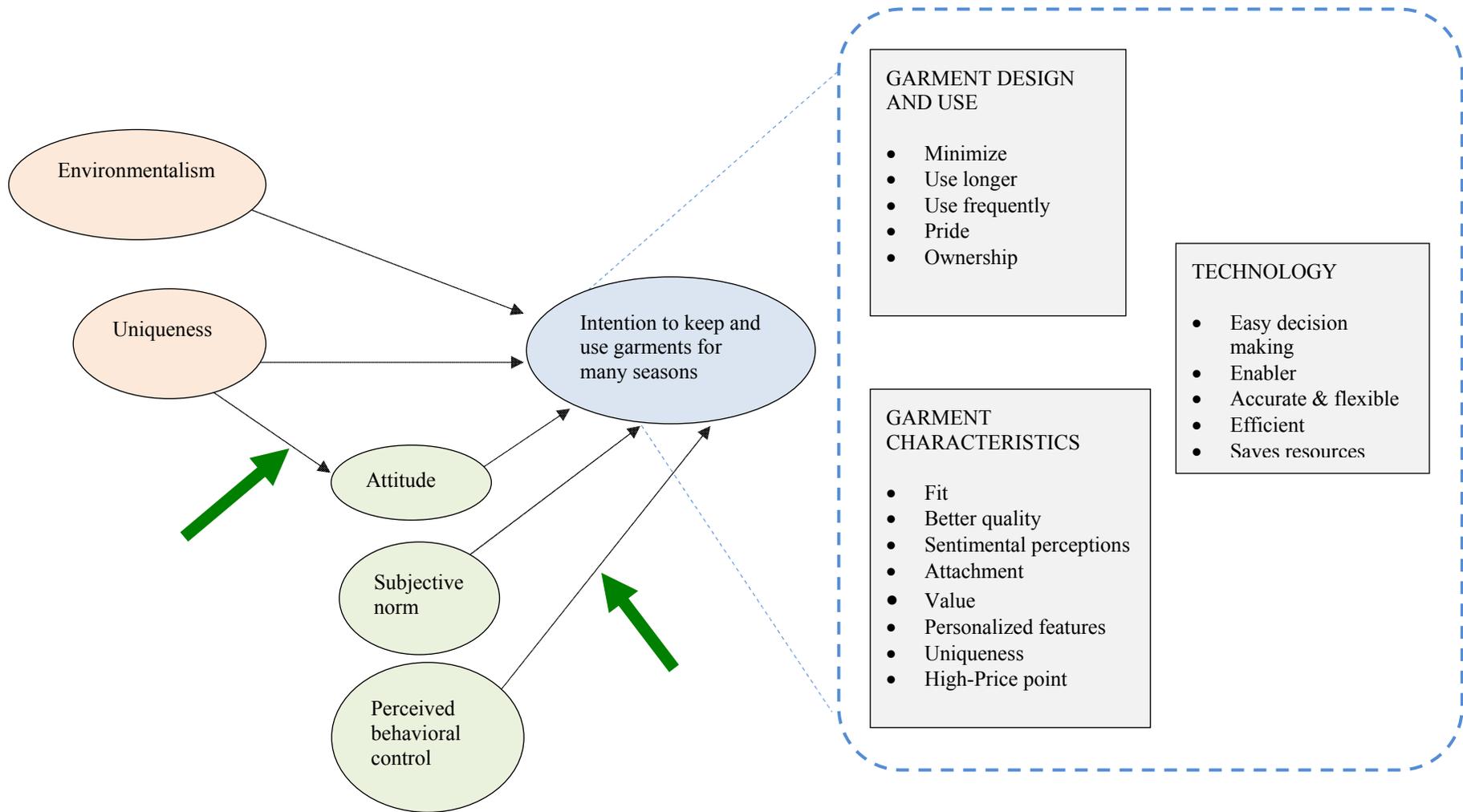


Figure. 6.1. Extended Final Model with implications from the open ended and quantitative study's results. Green arrows represent significant treatment effects.

Virtual try-on environment could be used as a powerful marketing tool for environmental consumption if optimized into a working system. Such system could also give people more confidence in knowing what to wear according to their body types. Much is currently being done to explore people's willingness to use virtual try-on of clothing and combinations of other new technologies in our field. It is still unclear how people's consumption will be affected by such systems. This study targeted these issues. There have been no prior studies conducted on the forecasting of potential users' relationships with the products of these technologies and whether this relationship would be sustainable or not. This dissertation shed some light on the possible forces at play in such technologically enabled environment for a sustainable consumption, and also found some more questions to ask in further studies.

Many studies of apparel use are be focused on ways to induce the consumer to consume more, as this is the economic model that is considered the only way for a manufacturer in our industry to survive. It is important to understand how such a system explored in this study be economically successful for our industry overall. Researchers should collaborate with business to identify new applications within a context of sustainability. Businesses should also play a role in advertising sustainable consumption as initiatives.

The Sustainable Consumption Roundtable report (2006) proposes that economic consumption should be dissociated from material consumption. As Niinimäki and Hassi (2011) indicated, it is the short-life span of textiles and clothing, which makes the apparel industry wasteful, thus a new kind of value creation should be considered when developing a more sustainable business model. New business models, concentrating on service economy, which puts the consumer satisfaction in the center, can be one way to do this. Implementation of emerging digital apparel technologies can help businesses in the fashion industry to distinguish themselves and

thus increase their profit. If people purchase high-value services (for example one high value service that could be offered could be style consulting by experts, in addition to implementing peer interaction), instead of purchasing only products, then lessening their overall material consumption need not affect the apparel industry negatively. The present study's results would imply that online retailers who are committed to sustainability can attract customers by offering unique garments and making their customer feel good about their purchases. Moreover, in such an online environment, consumers' behavioral intentions can be steered toward sustainable consumption (purchasing fewer but higher quality garments). In this case, the uniqueness of the products and the effect of using high quality suitable garments longer instead of replacing them frequently can be highlighted. Also, the customers can be given further ideas about how to lengthen the usage life of the garment with the help of tutorials.

Because the video intervention moderated the effect of perceived behavioral control on sustainable consumption, and as well as the effect of perception of uniqueness on attitudes, short-but-stimulating videos about the impact of the apparel industry and our consumption habits on climate change can be used to inform costumers. Moreover, as people are affected by what other people are thinking when they perform a behavior, an online social network can be created for the customers and their peers where they can share their designs, get feedback, talk about how/when they wear/use the customized garments, and perhaps share garments with each other for special occasions.

Another strategy can be implementing a system where companies not only mediate interaction among their clients, but also provide a "personal style advisor" where customers can get style advice by sharing their virtual avatars dressed with various garments. If people can be educated to purchase similar high-value services, a decrease in product consumption will not affect the apparel industry negatively.

Inspiring people on environmental sustainability issues, and advertising the quality and value of their products can help businesses to increase their competitive advantage and brand image.

Respondents felt that the price of these garments would be high. Many of them thought that since customized garments will be costly, it would not be possible to purchase too many customized garments. They stated that they would mix ready-to-wear and customized garments. Respondents assumed that the garments would be more expensive, so this is why they would design garments that they could keep for a longer time. Future studies should be constructed to explore ways to communicate to consumers the concept that they would not be purchasing an 'expensive' product, but a product valued at its true worth which will be valued and treasured more.

6.2. Limitations and Further Study

As is true with any study, this study had limitations. The results of this study indicated the need for further research in several areas. The nature of the sample, data collection procedures, instrument, methodology, study setting and characteristics of the technology used in this study should be considered when reading the study's results.

6.2.1. Population

The sample was drawn from apparel design students at Northern American universities. Because participants in this study were apparel design students, they had more training in apparel design and higher expectations for the use of design technologies than people outside of the apparel design business may have. Using design students as participants limits the generalization of the results to the population as a whole. Further directions for research could be concentrated on diversifying the

population. The study of user groups other than design students, different age groups, different locations, and cross-cultural studies could solve the generalization limitation.

Other designers (for example, industrial designers) and non-design groups should be examined. A group of people who are interested in do-it-yourself design practices but are not necessarily technologically-savvy or a group of people who are technologically savvy but have a little or no design background can give various different ideas on how to design a more general software and how a technologically enabled sustainable fashion system can be implemented for the general public. It can be expected that non-design groups might react to the idea of using integrated technologies for designing the garments, virtually trying them on and get feedback from others before they decide to purchase these customized garments totally different than this study's participants who chose fashion design as a career and who used to work with body forms.

Studying different age groups, such as a group of technologically-savvy home sewers of 30-60 years old who use Bernina's MyLabel for virtual try-on might give a deeper understanding of ways to develop a software for the general public to design custom clothing and use avatars for testing fit and suitability. This system would be appealing to older or younger consumers depending on how this software was designed and marketed. Studies of consumer behaviors around these questions would benefit the apparel and associated industries.

6.2.2. Instrument and Study Design

Using both the core and external constructs together can be helpful for researchers, marketers, and activists in the sustainability field to gain insights about predicting future behaviors related to integrated technologies and their by-products (customized garments). For future study, sustainable consumption can be

operationalized differently, such as care of the customized garments, intention to refashion them. The same variables used in this study can be used to examine whether different relationships might emerge in different contexts.

For this initial study, existing scales were employed. Further studies should explore other variables, which emerged during the qualitative phase of the study, such as the effect of fit. These new variables can be also tested by using TPB, or other analysis methods, such as by using Structural Equation Modelling [SEM] for both confirmatory and exploratory modeling.

Further exploration of different aspects of the study, such as developing the video further, based on the feedback from this initial version, is necessary. The questions in this study focused on the video rather than learning and behavioral change, so as a further study, the content should be developed and diversified in a way that it can deliver various aspects of sustainability to inform its viewers more effectively. Improving the video so that it better addresses the sustainability-related context may also require more up-to-date knowledge measurement scales than the one used in this present study. The intervention study results indicated that all group members already had fairly high knowledge regarding sustainability in apparel industry as presented in the scale statements before taking the survey. Existing scales can be revised so that they can address new concepts in sustainability, such as design or usage aspect of the garments. Or perhaps new ones should be developed and their validities should be tested. Moreover, conducting a study over a period of time can be helpful to measure behaviors using a scale developed for this purpose. Behavior can be also measured through a detailed qualitative study, which employs observation and interviews. Buenstorf and Cordes (2008) found that consumer learning does not lock-in consumer behavior. When people start adopting more sustainable patterns of consumption, they do not necessarily continue on this track without a continued

exposure to supportive messages. For this reason, it would be important to develop a series of media interventions, such as video messages. As stated by Welters (2004), fashion “is not going away anytime soon” (p.27). This study aimed to address the fact that one way to change the wasteful fashion system is to educate future’s fashion designers about sustainability, therefore it was specific. However, the results regarding what worked and what did not about the video intervention in this study can provide a basis for prescribing educational tools and techniques for teaching sustainability in other programs. Such work should be done in collaboration with organizations (such as UN, WWF, WHO), research institutes, and non-governmental organizations. The impact of such media interventions should be consistently checked for feedback through qualitative and survey studies. Educational institutions can be a starting point to employ such interventions.

In this dissertation, 3D body scanning technology together with virtual try on software were studied as enabling technologies to enhance customer involvement with their garments in the context of online purchasing. Such involvement’s effect on consumption intentions was studied as a parameter of sustainability. Further research should investigate other technologies, such as magic mirrors or online social networking through blogging, in more detail.

As the participants were not in a controlled environment, the self-completed survey can be seen as another limitation. This may raise questions towards external validity. Thus, interpretation of the results should be done carefully. Future studies should be designed in a way that intervention can be given in a more controlled environment, such as in a classroom, to minimize this threat to external validity.

As a methodology issue, the tests of the Ajzen’s TPB model rely on self-reports and actual behaviors are rarely investigated. Future studies should focus on the predictive power of intentions on actual behavior by observing user-garment

relationships within this context. There is much potential to improve the theoretical model presented in this study by addressing this issue in depth. The qualitative phase of this study was helpful to observe some of the actual behaviors, for example two participants created their garments and wore them. However, periodic follow-ups of these participants regarding how they use these garments can provide more insight into understanding the effect of enabling technologies on sustainable consumption.

The relationships among technology, garment design and perceptions of garment characteristics, which were revealed in the analysis of the open-ended questions section of the survey should be examined in a more detailed study. Each of the themes under these domains can be isolated and studied in separate studies in relation to the others. These studies can be designed in a way to get quantitative data, qualitative data, or both as a mixed method study.

In the study, which examined the effect of the intervention, results showed that having been subjected to the pretest 24 hours before taking the posttest had a significant effect on all of the statements, which assessed environmental knowledge and respondents' perceptions of themselves as environmentally conscious consumers. The difference between pretest and posttest scores was indirectly affected by the presence of pretest. Kim and Willson (2010) explain this as pretest sensitization effect and urge researchers to consider the potential effects of pretest-posttest design. They recommend that implementing Solomon four-group design (treated groups with and without pretest versus untreated groups with and without pretest) is a good approach to deal with such effects. Hence, for future studies, a Solomon four-group design can be used to see the effects of such treatment better.

6.2.3 Projections for Future Study Settings

Fashion-conscious individuals have been increasingly using new digital fashion design platforms (Polyvore, Merona My Look Maker), that offer features for creating collages from existing fashion pieces, to mix and match garments and accessories, and to share their taste with other members and obtain feedback on their choices from their online peers. Literature shows that retailers are interested in offering this virtual try-on option around virtual communities; this is why they have been offering like/unlike options and collage sharing (Pentina, Prybutok, & Zhang, 2008). How would creating online communities around these technologies change the dynamics of consumption? A future experimental study should include an online mock-up shopping environment, with a virtual try-on function, as well as a virtual community around it to examine design and decision-making processes. The study of existing online communities, such as Polyvore, or MVM- and perhaps interviewing users of these systems might reveal how these groups think about consumption of customized garments. An in-depth study of these communities might give additional insights into the question of sustainable consumption of customized garments.

One external variable, *Attachment*, did not show any effect on target behavioral intention. This was not surprising, because this technology is not commercially available, and the users didn't have the sense of its full potential. Only 16.9% of the participants reported that had seen/used a 3D body scanner in a class whereas only 21.3% of the participants used actual virtual fit software. In a future study, to be able to observe attachment to customized garments, it would be better to concentrate on investigating the actual garment- user/creator relationship. A system which might produce actual garments for the study participants, or tutorials which help participants to construct their own garments- if they are really interested in choosing this second option, could be considered for the design of such study setting.

Virtual try-on technology with a product configurator could potentially change the pace of shopping. The possibilities will be endless. Because the software can be perceived as fun, exciting, and engaging to use, as it was, for the in-depth qualitative study participants, it would lead users to engage with virtual try-on for a longer time- a similar the behavior reported by the Polyvore users (Jacobs, 2010). This might lead users to think more about the styles and their suitability, and incubate about the possibilities before they make their decisions. Future study should explore the relation between the time actually spent with such technology and the purchase decisions made around the created styles.

The findings also revealed that although actual 3D avatars provide accurate data in terms of fit, the female participants in particular exhibited some discomfort with the body scans. The issue of how individuals' think of their bodies, or see their virtual bodies on the screen will influence the usage of 3D body-scan avatars in the virtual try-on environment. As long as users feel comfortable with their bodies, or having other people looking at their bodies, they would share their images with their friends and ask for their opinions on the fit/look of a garment. Otherwise, they might tend to keep their images to themselves—thus limiting the normative input. From this point of view, a more simplified commercial application of similar software might be designed in a way that it can modify the visualization of the body scan of the users in a way that, they can look more attractive. The amount of modification should be automatically applied to the garments during the virtual try-on process so that it can be ensured that the system can still provide useful information on garment fit to its users.

The respondents described two contradictory expectations as outcomes of the widespread usage of such a system: it could be used either to fulfill its users' desires to shop and provide them with better-fitting and better-styled garments, thus reducing their need to buy more; or used to promote the consumption of more items by enabling

its users to make appropriate decisions about what to buy without going to a mall and trying them on. Future studies should examine this issue in more detail. For examining the first expectation, Polyvore users can be interviewed. To explore the second expectation, it would be beneficial to study how people would react to purchasing garments when they can virtually create and try on many garments. This study can use Kamali and Loker's (2002) study as a model where the authors compared a limited customization (50 possible design combinations) and advanced customization (37,500 possible combinations). The first step for conducting such a study can be comparing OptiTex 23/3D software with a very comprehensive design library to MyLabel, a similar, but limited technology developed in a partnership between Bernina and OptiTex for home sewers. Such study can also examine satisfaction with design involvement in a 3D digital environment, and the impact of design involvement level on behavioral intentions to purchase the designed garment.

Although these limitations are a factor, this study was an initial exploration of the possible factors on the consumption of customized garments in a futuristic scenario and conceptualization of the dynamics of such a system. In addition to utilizing a broadly accepted theory and expanding it within the context of this study, the qualitative experimental portion of this study approach to the same issue provided a deeper understanding of how users of such technologies would approach their customized garments. This study presents an important initial attempt to conceptualize possible changes in consumption patterns through the use of technologically enabled fashion systems. It appears that unique properties of the customized garments will be an important factor in keeping and using the garments for a long time in the future. This means that integrated technologies might have the potential to create a sustainable fashion system.

REFERENCES

- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Making Processes*, 50(2), 179-211.
- Arbuthnott, K. D. (2009). Education for sustainable development beyond attitude change. *International Journal of Sustainability in Higher Education*, 10(2), 152-163.
- Belk, R. W. (1988). Possessions and the extended self. *Journal of Consumer Research*, 15(2), 139-168.
- Bruner, D. (2011, May 30). *[TC]²'s revolutionary in-clothes 3D scanning for size selection and virtual fashion at home and at retail*. Retrieved from <http://www.tc2.com/newsletter/2011/033011.html#one>
- Bye, E., & McKinney, E. (2007). Sizing up the wardrobe: Why we keep clothes that do not fit. *Fashion Theory: The Journal of Dress, Body & Culture*, 11(4), 483-498.
- Dolan, P. (January 01, 2002). The sustainability of sustainable consumption. *Journal of Macromarketing*, 22, 2, 170-181.
- Eagly, A. H., & Chaiken, S. (1993). *The Psychology of attitudes*, Fort Worth, TX: Harcourt Brace Jovanovich College Publishers.
- Fiore, A. M. (2008). The digital consumer valuable partner for product development and production. *Clothing and Textiles Research Journal*, 26(2), 177-190.
- Hale, J. L., Householder, B. J., & Greene, K. (2002). The theory of reasoned action. In J. P. Dillard & M. Pfau (Eds.), *The persuasion handbook: Developments in theory and practice* (pp. 259-286). Thousand Oaks, CA: Sage Publications.
- Kim, E. S., & Willson, V. L. (2010). Evaluating pretest effects in pre-post studies. *Educational and Psychological Measurement*, 70(5), 744-759.
- Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Beverly Hills, CA: Sage Publications.
- Loker, S. (2008). A technology-enabled sustainable fashion system: Fashion's future. In C. Ulasewicz & J. Hethorn (Eds.), *Sustainability fashion, why now?* (pp. 95-126). New York, NY: Fairchild Books.
- Mugge, R., Schoormans, J. P. L., & Schifferstein, H. N. J. (2005). Design strategies to postpone consumers' product replacement: The value of a strong person-product relationship. *The Design Journal*, 8(2), 38-48.

- Niinimäki, K. & Hassi, L. (2011). Emerging design strategies in sustainable production and consumption of textiles and clothing. *Journal of Cleaner Production*. doi:10.1016/j.jclepro.2011.04.020.
- Peattie, K., & Collins, A. (2009). Guest editorial: Perspectives on sustainable consumption. *International Journal of Consumer Studies*, 33(2), 107-112.
- Pentina, I., Prybutok, V. R., & Zhang, X. (2008). The Role of virtual communities as shopping reference groups. *Journal of Electronic Commerce Research*, 9(2), 114-136. Retrieved from <http://www.csulb.edu/journals/jecr/issues/20082/paper3.pdf>
- Schaefer, A., & Crane, A. (2005). Addressing sustainability and consumption. *Journal of Macromarketing*, 25(1), 76-92.
- Schor, J. B. (2005). Prices and quantities: Unsustainable consumption and the global economy, *Ecological Economics*, 55(3), 309-320.
- Sustainable Development Commission. (2006, May). *I will if you will- Towards sustainable consumption*. Retrieved from <http://www.sd-commission.org.uk/publications.php?id=367>
- U. N. Department of Economic and Social Affairs. Division for Sustainable Development. (2010). *Trends in sustainable development: Towards sustainable consumption and production*. Retrieved from http://www.un.org/esa/dsd/resources/res_pdfs/publications/trends/trends_sustainable_consumption_production/Trends_in_sustainable_consumption_and_production.pdf
- Welters, L. (2008). The fashion of sustainability. In C. Ulasewicz & J. Hethorn (Eds.), *Sustainability fashion, why now?* (pp. 7-29). New York, NY: Fairchild Books.
- World Wildlife Fund. (2010). *Living planet report 2010*. Retrieved from <http://assets.panda.org/downloads/lpr2010.pdf>

APPENDICES

Copyright 2003-2010 Cornell University

APPENDIX A:

IRB APPROVAL FORM-CONCURRENCE OF EXEMPTION



Cornell University
Office of
Research Integrity and Assurance

East Hill Office Building, Suite 320
395 Pine Tree Road
Ithaca, NY 14850
p. 607-255-5138
f. 607-255-0758
www.irb.cornell.edu

Institutional Review Board for Human Participants

Concurrence of Exemption

To: Fatma Baytar
From: Matthew Aldridge, Senior IRB Administrator
Date: January 18, 2010
RE: Protocol ID#: 1001001118
Project(s): Questionnaire Study of the Effects of Digital Apparel Technologies and Online Collaboration on Environmentally Sustainable Consumption Behaviors.

A member of the Office of Research Integrity and Assurance (ORIA) has reviewed the above-referenced project and found it to qualify for **Exemption from IRB Review** according to paragraph #2 of the Department of Health and Human Services Code of Federal Regulations 45 CFR 46.101(b).

This proposal has not been evaluated for scientific merit, except to weigh the risk to the human participants in relation to the potential benefits.

Please be aware of the following:

- Exemption from IRB review does not absolve the investigator from ensuring that the welfare of the research subjects is protected and that methods used and information provided to gain participant consent are appropriate to the activity. It is your responsibility as a researcher to familiarize yourself with and conduct the research in accordance with the ethical standards of the Belmont Report (<http://ohsr.od.nih.gov/guidelines/belmont.html>).
- You must notify the ORIA office of changes or amendments to the above-referenced protocol **BEFORE** their implementation.
- You are not required to submit progress reports or requests for continuing review/approval to ORIA, unless you modify your study protocol.

c: Susan Ashdown

APPENDIX B:

IRB APPROVAL FORM- NOTICE OF EXPEDITED APPROVAL



Cornell University
Office of
Research Integrity and Assurance

East Hill Office Building, Suite 320
395 Pine Tree Road
Ithaca, NY 14850
p. 607-255-5138
f. 607-255-0758
www.irb.cornell.edu

Institutional Review Board for Human Participants

NOTICE OF EXPEDITED APPROVAL

To: Fatma Baytar
From: Jenny Gerner, IRB Chairperson
Protocol ID#: 1001001134
Project(s): Design Based Study of the Effects of Digital Apparel Technologies and Online Collaboration on Environmentally Sustainable Consumption Behaviors
Date of Approval: February 01, 2010
Expiration Date: January 31, 2011

The above-referenced protocol has been reviewed and given expedited approval by the Institutional Review Board for Human Participants (IRB) for the inclusion of human participants in research. **This approval shall remain in effect until January 31, 2011.**

The terms of Cornell University's Federalwide Assurance (FWA) with the federal government mandate the following important conditions for investigators:

1. All consent forms, records of study participation, and other consent materials **must** be held by the investigator for **five years** after the close of the study.
2. Investigators must submit to the IRB any **proposed amendment** to the study protocol, consent forms, interviews, recruiting strategies, and other materials. Investigators may not use these materials with human participants until the IRB has reviewed them. For information about study amendment procedures and access to the Amendments application form, please refer to the IRB website: <http://www.irb.cornell.edu/forms>.
3. Investigators must promptly report to the IRB any **unexpected events** involving human participants. The definition of prompt reporting depends upon the seriousness of the unexpected event. For guidance on recognizing, defining, and reporting unexpected events to the IRB, please refer to the IRB website: <http://www.irb.cornell.edu/forms>.

If the use of human participants is to continue beyond the assigned approval period, federal requirements mandate that the protocol be re-reviewed and receive an updated approval. **You may not continue to use information collected from human participants beyond the stated approval period without an updated approval.** Please note that the terms of our FWA with the federal government do not allow for an extension of this period without review. Continuing without an updated approval constitutes a violation of University policy and federal regulations. Research funds administered by the Office of Sponsored Programs will not be released to any project that does not have a current IRB approval.

Federal regulations require that all research be reviewed at least annually. As the Principal Investigator it is your responsibility to obtain review and continued approval **before** the expiration date. Applications for renewal of approval must be submitted sufficiently in advance of the expiration date to permit the IRB to

APPENDIX C:
INSTRUMENT- PRETEST

Questionnaire Study of Digital Apparel Technologies and Online Collaboration

You have been invited to take part in a research study of how digital apparel technologies might influence design behaviors. This is the first of two questionnaires we will ask you to complete. This first questionnaire will take approximately 10 minutes. After you complete the first questionnaire, you will be directed to the second part of this study. Completing the second part will take about 20 to 25 minutes. Your answers will be confidential and will not include any information that will make it possible to identify you.

Taking part in this study is completely VOLUNTARY. You may skip any questions that you do not want to answer.

If you have questions about this project, you are encouraged to contact Fatma Baytar at (607) 229-8178 or fb38@cornell.edu. If you have any questions or concerns regarding your rights as a subject in this study, you may contact the Cornell University Institutional Review Board (IRB) at 607-255-5138 or access their website at <http://www.irb.cornell.edu>

By checking the 'Consent' box, I acknowledge that I understand the above information.

I HAVE READ THE ABOVE INFORMATION. I CONSENT TO TAKE PART IN THIS STUDY

Please answer the following questions about yourself

1-What is your grade level?

Sophomore Junior Senior Masters Student PhD Student Other (Please Specify) _____

2-University: _____

3- What is your age in years?

18 19 20 21 22 23 24 25 and older

4-Gender

Male Female

5 -Which category best describes your ethnic background?

Caucasian African American Asian Native American Hispanic or Latino
 Pacific Islander Other (Please Specify)

6- Please select the topics that you know about from your apparel classes (Please check all that apply)

- Apparel Supply Chain
- Apparel & Textile Quality
- Sustainability in the apparel industry
- Costume History
- Trend and Color Analysis
- Fashion Illustration
- Product Development
- Patternmaking
- CAD
- 3D Body Scanning Technology
- 2D/3D Apparel Patternmaking CAD Technology (OptiTex,Lectra)

7- What types of personal technologies and computer applications have you used? (Please check all that apply)

- Personal computer
- MP3 Player/iPod
- PDA/Blackberry
- Gaming System (Playstation, Wii)
- Social Networks (Facebook, MySpace)
- Virtual worlds (Second Life)
- YouTube

Shopping Behavior

Please answer the following questions about how you prefer to shop

8-How often do you purchase clothing?

- Several times a week
- Once a week
- 2-3 times a month
- Once in every 3 months
- Less than once every 3 months

9-Where do you purchase clothing? (Please check all that apply)

- Department Store
- Specialty Stores (e.g. The Limited, GAP, etc.)
- Off-price retailing (e.g. TJMaxx)
- Mass merchant (e.g. Walmart)
- Outlet centers
- Boutiques
- Internet
- Mail Order
- Vintage shop
- Thrift Store (e.g. Salvation Army)

10-(If you selected 'Internet' option above) How often do you purchase clothing on the Internet?

- More than once a month
- Once a month
- Once in every 3 months
- Once in every 6 months
- Once a year
- Less than once a year
- Never

Please tell us to what extent you agree with the following statements

	Strongly Disagree		Neither Disagree or Agree		Strongly Agree
	1	2	3	4	5
11-If I had more money, I would definitely buy more and more things	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12-I buy fewer things than the average person my age	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13-When I go shopping, I usually plan out what I am going to buy beforehand and I usually end up buying only what I planned	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

14-What do you do with your clothing when you think you will not be wearing it anymore? (Please check all that apply)

- Throw away
- Donate to a thrift store
- Pass on to friends/relatives
- Re-fashion
- Sell to a vintage store
- Store away in a closet
- Other (Please Specify)

Please read the following statements and select one answer that best represents your level of agreement

	Strongly Disagree		Neither Disagree or Agree		Strongly Agree
	1	2	3	4	5
15-I consider myself as an 'environmentally conscious' consumer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16-I read and compare labels to look for environmentally safe ingredients/practices	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Lastly, please tell us to what extent you agree with the following statements.

	Disagree			Neither disagree or agree	Agree		
	1	2	3	4	5	6	7
18-Chemical pollutants are produced during manufacturing of synthetic or manufactured fibers such as polyester	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19-Chemical pollutants are not produced during processing of natural fibers such as cotton	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20-Pollution occurs during the transportation of textiles goods	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
21-Dyeing and finishing processes use a lot of water	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
22-Garments cannot be commercially recycled	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
23-Fast fashion have substantially contributed to the quantity of textile products discarded in landfills	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
24-Phosphate-containing detergents can be a source of water pollution	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
25-The reuse of larger quantities of garments will not significantly decrease energy consumption	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Strongly Disagree		Neither Disagree or Agree		Strongly Agree
	1	2	3	4	5
26-I do not feel I have enough knowledge to make well-informed decisions on environmental issues	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
27-My local environment would really have to deteriorate before I would consider altering the way I consume	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

FINISH

THANK YOU FOR COMPLETING THE PRE-TEST.

You will receive the link to the second questionnaire within 24 hours.

**APPENDIX D:
INSTRUMENT- POSTTEST**

WELCOME BACK!

(For the Intervention Group): Before starting to answer the questions, we would like to ask you to watch a short video by clicking on the following the link.

Please note that the video will be opened in New Window. Your password is: **video1**

After watching the video, you can continue to the survey by clicking on the 'Next' below.

<http://vimeo.com/11049048>

Apparel Technologies

3D Body Scanner

The body scanner operates by having a customer enter a booth where laser light is used to capture the shape of the body by taking over 300,000 points. Software designed for use with the scanner turns the points into the realistic 3D virtual avatar representing the 3D image of the scanned person, which can be used to virtually try on clothing. While the images below only show single color virtual avatars, with the help of the additional cameras, it is currently possible to obtain virtual avatars with real color.



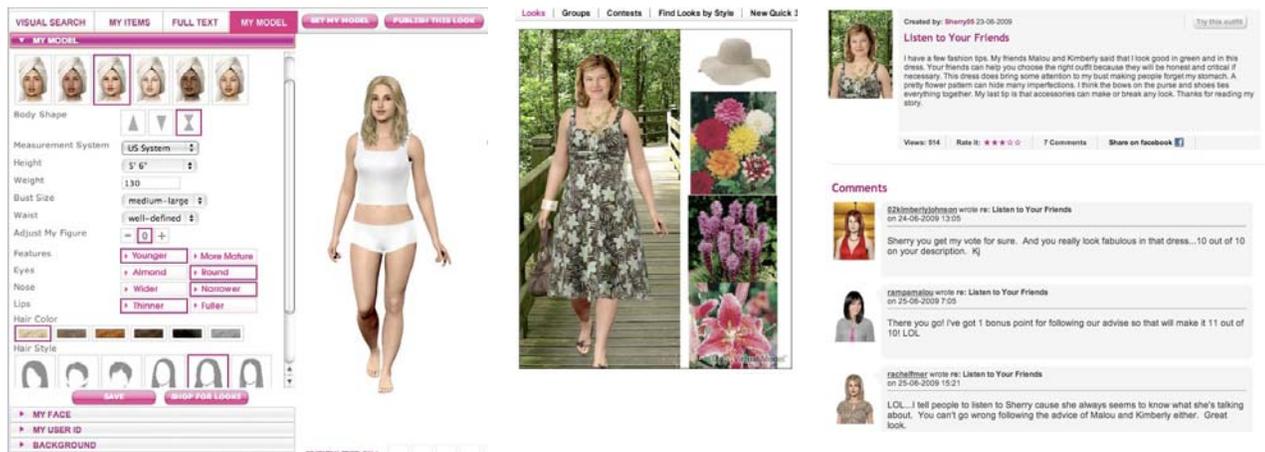
3D Virtual Prototyping Software

This 3D Virtual Prototyping Software allows a user to design the clothing from the 2D patterns existing in the database, digitized into the database, or drafted in the software. 2D patterns can be virtually assembled and draped on a 3D virtual avatar for simulation of a constructed virtual prototype garment. With this tool, you can design clothing, test and customize it to fit and flatter you before it is made.



Online Social Networking

Online social networking allows users to communicate with other people in the same town, college, or in other groups that share similar interests. This is the technology behind websites like Facebook, MySpace, or My Virtual Model (MVM) community. The MVM online community is a commercial application of virtual try-on. In this community, users can customize the artificial 'virtual avatar' by entering their basic measurements such as bust, height, waist and hip, and choosing some facial features. They can also paste their own pictures of their faces to make the virtual model look more personal. Then, they try on some garments and share these images with their friends as can be seen below.



HOW THESE TECHNOLOGIES WOULD WORK TOGETHER:

Imagine that you are introduced to a **new apparel design environment** where you can get your exact three dimensional body image using the **3-D Body Scanner** and create your realistic virtual avatar to see the fit of garments that you design and pattern for yourself.

The **3D Virtual Prototyping Software** allows you to design and customize the garments easily, and you have the opportunity to see these garments on your virtual avatar from every aspect (by rotating, zooming in/out) before you make the decision to make the garment or have it made for you.

You can share your designs and virtual avatars with your closest friends in an **Online Social Networking Website**, and get their feedback to improve your designs and make a decision about the design.

The following questions ask you to indicate **your attitudes towards using customized garments designed and created with the help of these Integrated Technologies.**

Customized Garments

For the following questions, please consider '**these customized garments**' as '**the customized garments designed by using 'Integrated Technologies'**'

Please tell us to what extent you agree with the following statements

	Strongly Disagree		Neither Disagree or Agree		Strongly Agree
	1	2	3	4	5
1-I believe that I would feel emotionally connected to these customized garments	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2-I believe that I would have a bond with these customized garments	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3-These customized garments would have no special meaning for me	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4-I believe that these customized garments would be very dear to me	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5- I would be more likely to keep and wear these customized garments for many seasons because they would be hard to replace	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6-I would enjoy keeping and wearing these customized garments for many seasons because they would be different and unusual.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7-I would prefer keeping and wearing these garments for many seasons because they would be customized rather than being ready-to-wear	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please tell us to what extent you agree with the following statements

	Strongly Disagree			Neither disagree or agree			Strongly Agree
	1	2	3	4	5	6	7
8-Keeping and wearing these customized garments for many seasons would a good idea	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9-I would like to keep and wear these customized garments for many seasons	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

What would other people you know think about these customized garments you created?

	Strongly Disagree			Neither disagree or agree			Strongly Agree
	1	2	3	4	5	6	7
10-Most people who are important to me would think it would be a good idea to keep and wear these customized garments for many seasons	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11-My friends would keep and wear these customized garments for many seasons	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12-My friends would think that I should keep and wear these customized garments for many seasons	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please tell us to what extent you agree with the following statements

	Strongly Disagree			Neither disagree or agree			Strongly Agree
	1	2	3	4	5	6	7
13-I am confident that I would be able to keep and wear these customized garments for many seasons	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14-I have the design knowledge to keep and wear these customized garments for many seasons	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15-I would not fully control the fact that I can keep and wear these customized garments for many seasons	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16-I would plan to keep and wear these customized garments for many seasons	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
17-I would keep and wear these customized garments for many seasons if the technology was available	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please respond to questions below in your own words

For the following questions, please consider 'these customized garments' as 'the garments designed by using the previously mentioned 'Integrated Technologies'

1- Would you be willing to wear **“these customized garments”** compared to the way you wear other garments that you purchase?

2- I believe that **“these customized garments”** would be a part of my wardrobe for

- One season
- Two seasons
- Three seasons
- More than three seasons
- Until it is worn out
- Other

3- After having received information about the new technological possibilities, how do you think that these **“Integrated Technologies”** might affect your choices about the number of the garments you buy and the way you consume them?

4- How might using these **“Integrated Technologies”** change the meaning that your clothing has for you?

5- How would using these **“Integrated Technologies”** help you to design clothing more easily and successfully for yourself?

6- Do you have any other comments about these integrated technologies, for example regarding their use in designing clothing in the future or your use of these technologies, or ways in which the technologies might change the number of clothing items you buy or the frequency and length of time that you wear them?

(For the intervention Group Only)

1-How understandable was the video in explaining sustainability issues in the textiles and apparel area?

2-Do you think you learned something from it? Can you describe what you learned?

Please tell us to what extent you agree with the following statements

	Disagree		Neither disagree or agree			Agree	
	1	2	3	4	5	6	7
7-Chemical pollutants are produced during manufacturing of synthetic or manufactured fibers such as polyester	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8-Chemical pollutants are not produced during processing of natural fibers such as cotton	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9-Pollution occurs during the transportation of textiles goods	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10-Dyeing and finishing processes use a lot of water	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11-Garments cannot be commercially recycled	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12-Fast fashion have substantially contributed to the quantity of textile products discarded in landfills	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13-Phosphate-containing detergents can be a source of water pollution	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14-The reuse of larger quantities of garments will not significantly decrease energy consumption	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Lastly, please tell us to what extent you agree with the following statements.

	Strongly Disagree		Neither Disagree or Agree		Strongly Agree
	1	2	3	4	5
15-If I had more money, I would definitely buy more and more things	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16-I buy fewer things than the average person my age	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
17-When I go shopping, I usually plan out what I am going to buy beforehand and I usually end up buying only what I planned	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18-I read and compare labels to look for environmentally safe ingredients/practices	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19-I consider myself as an 'environmentally conscious' consumer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20-I do not feel I have enough knowledge to make well-informed decisions on environmental issues	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
21-My local environment would really have to deteriorate before I would consider altering the way I consume	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

(For the Control Group only)

BEFORE YOU LEAVE...

We would like to ask you to watch a short video by clicking on the following the link. Your password is: **video1**

Please note that the video will be opened in New Window.

You can finish the survey by clicking on the 'Finish' button now.

<http://vimeo.com/11049048>

FINISH

THANK YOU FOR YOUR PARTICIPATION IN THIS STUDY!

Your response has been recorded and a \$10 gift card from Amazon will be sent to your e-mail address within 24 hours.

