Internet-Based Rapid Customer Feedback for Design Feature Tradeoff Analyses

by

Meghan P. McArdle

B.S. Mechanical Engineering, Tufts University, 1995

Submitted to the Sloan School of Management and the Department of Mechanical Engineering in Partial Fulfillment of the Requirements for the Degrees of

Master of Science in Management

and

Master of Science in Mechanical Engineering

at the

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

June 2000

©2000 Massachusetts Institute of Technology. All Rights Reserved

Signature of Author:

Certified by:

Sloan School of Management
Department of Mechanical Engineering
May 5, 2000

John R. Hauser
Kirin Professor of Marketing, Sloan School of Management
Thesis Supervisor

Certified by:

David R. Wallace
Assistant Professor of Mechanical Engineering
Thesis Supervisor

Accepted by:

Margaret Andrews, Executive Director of Master’s Program
Sloan School of Management

Accepted by:

Ain A. Sonin, Chairman, Committee on Graduate Students
Department of Mechanical Engineering
Internet-Based Rapid Customer Feedback for Design Feature Tradeoff Analyses

by

Meghan P. McArdle

Submitted to the Sloan School of Management and the Department of Mechanical Engineering in Partial Fulfillment of the Requirements for the Degrees of Master of Science in Management and Master of Science in Mechanical Engineering at the

ABSTRACT

In an increasingly competitive consumer products market, companies are striving to create organizations, processes, and tools to reduce the product development cycle time. As product development teams strive to develop products faster and more effectively, incorporating quantitative market research or customer feedback into the design process in a time and cost effective manner becomes increasingly important. Over the last decade, the Internet has emerged as a new and exciting market research medium, which can provide product development teams with an opportunity to obtain rapid quantitative feedback from their customers before making key design decisions.

This paper outlines a new methodology to incorporate customer feedback into the feature selection process of product development. This methodology was successfully employed in a new product development effort at Polaroid, and aided in the selection of 2 key product features. The research employed web-based conjoint analysis techniques and an innovative drag and drop technique, which allows customers to create their ideal product by selecting their optimal set of features at a given price. Leveraging the capabilities of the Internet to incorporate styled web design, animation, interactive activities and usability considerations into the development of an Internet-based, market research effort can reduce respondent fatigue and provide the respondent with a more enjoyable experience while collecting meaningful quantitative data on customer feature preferences.

Thesis Advisors:
Professor John R. Hauser, Kirin Professor of Marketing, Sloan School of Management
Professor David R. Wallace, Assistant Professor of Mechanical Engineering
ACKNOWLEDGEMENTS

I would like to first thank my parents, Brian and Patricia McArdle, who have sacrificed so much over the years to help me get to where I am today. Together with my sister, Caitlin, they have been my most loyal and vocal supporters throughout my life.

I also extend my sincerest gratitude to John Hauser, my Sloan advisor, whose extraordinary guidance and support proved to be the most instrumental factor in the success of my research effort.

Furthermore, I would like to thank the Polaroid Corporation for providing me with the great opportunity to work on such an exciting new product development opportunity. There were many people at the Polaroid Corporation whose support and assistance proved invaluable; namely, Peter Carcia, Fara Faramarzpour, Jason Han, and Eve Donahue.

I was very fortunate to work with, Limor Weisberg for her diligence, artistic ability and web-design skills, and Anthony Johnson for his programming skills, and ability to work quickly under heavy time pressure. Limor and Anthony both deserve a lot of the credit for the success of this web-based research application. Moreover, I would like to thank David Wallace for his assistance and guidance as my engineering advisor.

Additionally, I am grateful to the Leaders for Manufacturing program for providing me with the most extraordinary academic experience. In my two years at LFM, I have had the good fortune to meet some incredibly impressive people, both personally and professionally, especially Tim, Ollie, Erik and Chris. I expect that choosing to enroll in LFM will prove to be one of the best decisions of my career.

And perhaps most importantly, I would like to thank my fiancée, Brian Swartz, who dealt with me during these difficult two years and provided me with a great deal of encouragement and support, I know it has been a tough ride. I love you.
# Table of Contents

1 **INTRODUCTION** ........................................................................................................................................... 8  
   1.1 **PROJECT DESCRIPTION** .................................................................................................................. 8 
   1.2 **CONTRIBUTION TO ACADEMIA- VIRTUAL CUSTOMER** ................................................................. 8 
   1.3 **CONTRIBUTION TO POLAROID** ..................................................................................................... 9 
   1.4 **BENEFITS AND DISADVANTAGES OF RESEARCH ON THE WEB** .............................................. 10 

2 **BACKGROUND** ........................................................................................................................................ 13  
   2.1 **COMPANY BACKGROUND** ............................................................................................................. 13 
   2.1.1 **New Strategy** .............................................................................................................................. 13 
   2.1.2 **Kids Category** .............................................................................................................................. 14 
   2.1.3 **Pocket Cam** ................................................................................................................................. 14 
   2.2 **PAST RESEARCH EFFORTS** ............................................................................................................ 16 
   2.2.1 **Internet-Based Market Research Projects** .................................................................................. 16 
   2.2.2 **DOME** ......................................................................................................................................... 21 

3 **METHODOLOGY** ..................................................................................................................................... 24  
   3.1 **PROJECT DEFINITION** .................................................................................................................... 24 
   3.1.1 **Test and Control Cell Selection and Definition** ........................................................................ 24 
   3.1.2 **Recruiting Methodology** ............................................................................................................ 26 
   3.2 **PRODUCT DESIGN FEATURES** ...................................................................................................... 30 
   3.2.1 **Feature Selection** ....................................................................................................................... 30 
   3.2.2 **Feature Representation** ............................................................................................................. 31 
   3.3 **DATA COLLECTION TECHNIQUES** ................................................................................................. 32 
   3.3.1 **Straight Comparison** .................................................................................................................. 33 
   3.3.2 **Conjoint Analysis** ...................................................................................................................... 34 
   3.3.3 **Drag and Drop** .......................................................................................................................... 40 
   3.3.4 **Miscellaneous** ............................................................................................................................ 42 
   3.4 **WEBSITE EXECUTION** .................................................................................................................... 43 
   3.4.1 **Goals** .......................................................................................................................................... 43 
   3.4.2 **Development** ............................................................................................................................ 44 
   3.4.3 **Collaboration and Assistance** ..................................................................................................... 51 
   3.4.4 **Use Testing** .................................................................................................................................. 51 

4 **RESULTS AND ANALYSIS** ...................................................................................................................... 52  
   4.1 **SURVEY RESULTS** .......................................................................................................................... 52 
   4.1.1 **Control Cell** .................................................................................................................................. 52 
   4.1.2 **Test Cell** ....................................................................................................................................... 53 
   4.1.3 **Recruiting Process** ....................................................................................................................... 61 
   4.2 **DATA ANALYSIS** ............................................................................................................................. 63 
   4.2.1 **Straight Comparison** .................................................................................................................. 63 
   4.2.2 **Conjoint Analysis** ....................................................................................................................... 65 
   4.2.3 **Drag and Drop** ............................................................................................................................ 71 
   4.2.4 **Miscellaneous Questions** ........................................................................................................... 77
5 CONCLUSIONS .................................................................................................................. 82
  5.1 SURVEY TECHNIQUE........................................................................................................ 82
  5.2 AFFECT ON PRODUCT DEVELOPMENT AND POLAROID.................................................. 85
  5.3 FUTURE DOME INTEGRATION ...................................................................................... 85
6 REFERENCES..................................................................................................................... 86

TABLE OF APPENDICES

APPENDIX 1 : PROJECT COLLABORATION AND REVIEW ....................................................... 89
APPENDIX 2 : ANALYSIS OF RECRUITING OPTIONS ............................................................... 90
APPENDIX 3 : TEST CELL CONTACT EMAIL ........................................................................ 93
APPENDIX 4 : TEST CELL RECRUITING SCREENERS ........................................................... 94
APPENDIX 5 : EXCERPTS OF DRAG AND DROP SOURCE CODE ........................................... 99
APPENDIX 6 : WEBSITE FLOW DIAGRAM ........................................................................... 104
APPENDIX 7 : CONJOINT DESIGN PAIRS ............................................................................. 105

TABLE OF TABLES

TABLE 1: WHAT MAKES A WEB SITE FUN ........................................................................ 43
TABLE 2: CONTROL CELL DEMOGRAPHICS ........................................................................ 53
TABLE 3: RECRUITED DEMOGRAPHICS- TEST CELL .......................................................... 57
TABLE 4: YIELD DEMOGRAPHICS- TEST CELL ................................................................... 59
TABLE 5: REGRESSION ANALYSIS- CONTROL CELL ............................................................ 67
TABLE 6: REGRESSION ANALYSIS- TEST CELL ................................................................ 69
TABLE 7: CHOW TEST RESULTS- CONTROL CELL ............................................................... 70
TABLE 8: DRAG AND DROP CORRELATION ANALYSIS- CONTROL CELL ......................... 74

TABLE OF FIGURES

FIGURE 1: I-ZONE INSTANT POCKET CAMERA .................................................................... 15
FIGURE 2: HARRIS POLL KIDZONE WEBSITE .................................................................. 18
FIGURE 3: DOME SCHEMATIC ............................................................................................. 22
FIGURE 4: CONTROL CELL REGISTRATION PAGE .............................................................. 28
FIGURE 5: TEST CELL GIFT CERTIFICATE SELECTION ................................................... 30
FIGURE 6: STRAIGHT COMPARISON ..................................................................................... 33
FIGURE 7: CONJOINT DESIGN ............................................................................................ 35
FIGURE 8: CONJOINT ANALYSIS INSTRUCTIONS PAGE ..................................................... 38
FIGURE 9: DRAG AND DROP EXERCISE ............................................................................. 41
FIGURE 10: MISCELLANEOUS QUESTIONS ........................................................................ 42
FIGURE 11: AGREEMENT PAGE .......................................................................................... 45
FIGURE 12: PRIVACY LINK FOR PARENTS ......................................................................... 46
FIGURE 13: ORIENTATION PAGE ........................................................................................ 47
FIGURE 14: PRODUCT DESCRIPTION ................................................................................... 48
1 Introduction

1.1 Project Description

As product development teams strive to develop products faster and more effectively, incorporating quantitative market research or customer feedback into the design process in a time and cost effective manner becomes increasingly difficult to achieve. Over the last decade, the Internet has emerged as a new and exciting market research medium, which can provide product development teams with an opportunity to obtain rapid feedback from their customers before making key design decisions. Ultimately we hope that a new methodology to gather quantitative data on customer feature preferences will improve the chance of product success in the marketplace. Furthermore, we anticipate that a well designed and interactive survey will provide more enjoyable experiences for respondents, resulting in a greater attention span and better data quality.

1.2 Contribution to Academia- Virtual Customer

The Virtual Customer is a program driven by the Marketing Department at the MIT Sloan School of Management in collaboration with the Center for Innovation in Product Development (CIPD) and largely funded by the National Science Foundation. Research for the Virtual Customer program aims to develop a series of methods that can be used throughout the product development process to aid product development teams to make customer driven design decisions using techniques such as Voice of the Customer (VOC) and conjoint analysis methods [14], [13]. The approach of the Virtual Customer project is to focus on the Internet as the new medium for these methods of market research. The two main reasons for this focus on Internet methodologies are:

1. The Internet has the greatest potential for fast and cost effective market research.
2. The field of market research in other media is mature, and research in this new medium is most likely to yield innovations and breakthroughs.

Internet-based market research is a young field, but it is not new. Digital Marketing Services (DMS), a division of AOL, conducts over 1 million Internet interviews annually for over 1000 clients. Additionally, ACNeilsen has been conducting BASES panels online since November
1998 for large consumer products companies such as Kraft, Colgate-Palmolive, Kellogg, Proctor & Gamble, Johnson & Johnson and Campbell Soup Company [35]. Furthermore, some market research firms have done web-based conjoint analysis; however, these methods simply move older paper and pencil methods or computer aided interview forms (CAI), from software companies such as Sawtooth, onto the Internet. The Virtual Customer project aims to fully understand the needs of product development teams and develop research methods with incremental advantages over existing techniques, which can integrate easily into the product development process.

1.3 Contribution to Polaroid

The Polaroid Corporation has embarked upon a new corporate strategy, which calls for the launch of 20 to 30 new products each year [26]. In order to rapidly and successfully develop and launch new products, Polaroid needs to develop a method to incorporate customer feedback into the product development process in a timely and cost effective manner.

Historically, Polaroid has used qualitative methods such as focus groups or the expertise and opinions of engineers or marketing professionals in the feature selection process. Focus groups can be a useful research technique; however, they can often introduce bias because of ineffective moderation, overly vocal participants and peer pressure. With kids and teens, peer pressure can be a strong negative influence in focus groups, causing participants to overstate or understate their ideas and opinions.

Using the opinions and expertise of product development team members as a primary method of feature selection can also pose significant problems. Leaving critical design decisions up to the opinions of a few members of the development team, can result in a "not invented here" mentality for other team members who may not support or agree with the design direction. The "second-guessing" that can result from this can cause significant delays and contribute to team breakdowns.

Additionally, when designing products for the kid and teen market, leaving key design decisions up to the opinions of adults on the development team can lead to unsuccessful products that do
not meet the needs or wants of the younger consumer. The incorporation of quantitative customer driven data into the design decision process can eliminate or dramatically reduce any “NIH” mentality and improve the decision making quality of the team, leading to a potentially more successful product in the marketplace.

Quantitative data can provide accurate and actionable data for decision making during the product development process. However, incorporation of customer driven, quantitative data into the product development process has historically has been costly and time consuming. Techniques such as conjoint analysis would typically take at least four to six weeks to field and the data collection and entry process could extend the time requirement to get actionable data even further.

Polaroid, a company that historically has made technically driven product design decisions, could benefit greatly from a rapid and cost effective survey technique to gather quantitative customer data. The Internet provides an opportunity to develop this new method.

### 1.4 Benefits and Disadvantages of Research on the Web

The emergence of the Internet as a medium for market research has resulted in praise and criticism from market research professionals. This section highlights the benefits and disadvantages of using the Internet as a vehicle for market research.

**Benefits:**
The web has the potential to improve market research techniques and methods in many ways. The following list highlights many of the benefits of Internet-based market research [19], [7]:

- **Reduced research costs:** Faster recruiting and data collection, elimination of need for physical prototypes in many instances, lower incentive requirements for more convenient surveys, elimination of need for facilitators, etc.
- **Ease of data collection:** Centralized and automated data collections, no duplication of data entry needed.
- **Improved data quality:** No duplication of data entry needed
• **Speed**: Market research can be conducted in a more rapid manner, providing faster feedback to companies.

• **Controlled display of information**: No bias induced by facilitator tone or lack of knowledge about the product.

• **Geographic flexibility**: The Internet allows market researchers to reach respondents in any geographic location without the usual restriction to market research firm site locations.

• **Convenience for respondents**: The Internet allows for more convenient and flexible survey response time and location for the respondents. Research conducted by DMS showed that 94% of participants felt that on-line surveys are more convenient[8]. Although the sample of this research was possibly biased, due to an Internet medium, it may suggest that the Internet can be used by researchers to reach respondents who are no longer willing to participate in other survey methods, such as mail, phone or mall surveys[8].

• **Increased intimacy with the customer**: On-line respondents have been shown to be more verbose and honest in their Internet responses [35]. The Internet provides respondents with anonymity and eliminates peer pressure effects.

Disadvantages:

Internet-based market research does have some disadvantages. The following list highlights some concerns about Internet-enabled research [7], [21], [19], [17], [22] [35]:

• **Bandwidth requirements**: As survey techniques become more advanced, using graphics, animation, video, and virtual reality experiences, bandwidth requirements increase for respondents answering surveys on their own computers. Currently approximately 94.2% of US households, with Internet access, are using modems of speed 56Kbps or less, leaving only 5.8% with high-speed access; which includes ISDN, T-1 lines, satellite, cable modem service, and digital subscriber lines.¹ However, this will become less of a problem as more users are turning to high-speed Internet access. In the meantime, websites can be designed appropriately to deal with these bandwidth limitations.

• **Sample Bias:** Many researchers have expressed concern about whether or not the Internet can be representative of the general population. Gordon Black of Harris Black international believes that the concern about the Internet population not being representative of the general population is becoming less of a concern[19]. However, only 37% of US households have Internet access, according to Forrester Research [4], which leaves a significant percentage of households unconnected, and unreachable for at-home Internet market research efforts.

• **Self-selection:** Since the Internet allows respondents to answer the survey if and when it convenient for them, the sample can be self-selected which may introduce sample bias, unless appropriate steps are taken to eliminate self-selection.

• **Sensory Experiences:** Sensory experiences such as touch, smell and taste cannot currently be duplicated in a virtual environment. However, research by Dahan and Srinivasian show that visual and auditory stimuli can be represented effectively over the Internet through animation techniques[7].

• **Survey Proliferation:** “Now everyone can do it.” Since the web has become an easily accessible medium for market research, there has been a proliferation of surveys designed and executed by people who are not trained or skills market research professionals[12]. This poses a danger to the unwilling recipients (possibly product development teams) of biased or unscientific data.

Although there are some disadvantages to web-based market research, the biggest concern currently being sample bias, many professionals agree that time will quickly solve this problem as more households adopt the Internet. For instance, Maguire [20] describes a study that indicated that most buying habits, behaviors, and attitudes of Internet users increasingly mirror those of the general population; an indication that the demographics of the web have moved to mainstream America. For companies concerned about sample bias, research has shown that careful respondent recruiting can eliminate the effects of sample bias from a randomly recruited Internet population, section 2.2.1 discusses this research in detail.
2 Background

2.1 Company Background

Polaroid Corporation, with revenues totaling approximately $2 Billion in 1999, is the leading manufacturer of instant photography products in the world. Founded in 1937 by Edwin Land, Polaroid was a company driven by breakthroughs in science and technology. Land’s business philosophy was summarized in a Harvard Business Review case as follows:

“He ignored the financial and consumer markets, viewing attention to future earnings as a distraction from the important work of generating innovations and inventions and marketing as unnecessary, given his belief that good products would sell themselves and people would pay any price for a product they wanted.” [24]

This philosophy and strategy worked very well up until and through the 1980’s, propelling Polaroid to create a successful and profitable instant imaging market, in which they enjoyed a virtual monopoly. Land’s focus remained almost solely on Polaroid’s core business, instant photography [24]. However, with the advent of one-hour photo development, single use cameras, videotape camcorders and digital cameras, imaging options increased while the cost per picture decreased. As a result, Polaroid’s sales through the 1990’s remained stagnant around $2 billion, while profits had turned to losses [26].

2.1.1 New Strategy

In October of 1995, Gary DiCamillo, a marketing expert from Black and Decker, took over as CEO. His new strategy for the company shifted heavily to an external, customer driven focus, from the historical internal, technological focus of the company. He wanted to return the focus of the company back to the core consumer photography business, place an emphasis on marketing, and repackage existing technology. Instead of shooting for “home run” products that would require enormous investment costs and development time, the new strategy called for many modest product successes through launching 20 to 30 new products each year [26]. DiCamillo’s approach was a “departure from the 62-year-old company’s legacy of world-beating engineering and pioneering products” [26].
In order to support this new market-driven strategy, DiCamillo restructured the company along business categories rather than business function. These cross-functional teams, consisting of marketing, sales, research, engineering and manufacturing personnel, were all co-located. The aim of the reorganization was to improve communication and decrease the product development time by at least fifty-percent [24]. Furthermore, the reorganization was an effort to ensure that the products developed met the critical customer needs and market requirements for commercial viability [24].

2.1.2 Kids Category

With stagnant sales at $2 billion since 1991, part of the new strategy for Polaroid was to discover new applications for their core business, instant photography. As a result, Polaroid created the Kids Category to capitalize on the absence of instant photography in the toy industry and the relatively untapped market of Kids photography. The public initially reacted with some skepticism to this new strategy. As an article in the June 21\textsuperscript{st}, 1999 issue of Fortune Magazine described, “Now he’s (DiCamillo) banking Polaroid’s 1999 recovery- and his own- on a risky strategy: selling low-priced cameras to young people” [28]. However, the strategy, in early 2000, seems to be working well for now. With new products such as the I-Zone instant Pocket Camera, JoyCam and PopShots fourth quarter sales in 1999 propelled past the same period in 1998. Sales in the Americas segment were up 21 percent, with U.S. sales up 23 percent; European segment sales were up 11 percent; and Asia/Pacific sales were up 29 percent\textsuperscript{2}.

2.1.3 Pocket Cam

The first major product released globally from the new Kids Category was the I-Zone pocket camera. An earlier version of this product, the Xiao Pocket Camera, had been introduced in Japan by Tomy, in collaboration with Polaroid. This product introduced a novel instant film format, small pictures sized 1 x 1 ½ inches, and was driving a craze with female teenagers in Japan where they were taking little pictures of friends and family and sticking them on their books as a sort of status and popularity symbol. Recognizing the opportunity this new product presented in the US and Europe, a more stylish I-Zone Pocket Camera was developed and

\textsuperscript{2}Press Release: 1999 4\textsuperscript{th} quarter results source: http://www.polaroid.com/polinfo/press_releases/january00/012600a.html
introduced into the US market in the fall of 1999. Figure 1 shows the I-Zone Instant Pocket Camera and Pocket Film.

![Image of I-Zone Instant Pocket Camera]

Figure 1: I-Zone Instant Pocket Camera

The Pocket Camera was met with great success in the market, it won several major awards in 1999 including: Dr. Toy's Best Product of the Year, Oppenheim Toy Portfolio, Platinum Toy Awards 2000 -"Best of the Best", the National Parenting Center Seal of Approval, FAO Schwartz #2 Toy, Newsweek's "Gadget of the Year," MTV's "What We Want" gift idea, and Biography's "Top 10 Christmas Gifts to Get in 1999." Furthermore, according to ACNielsen US retail data, the I-Zone camera was the number-one selling camera in the United States for the fourth quarter of 1999.

In order to continue the momentum, propelled by the initial success of the I-Zone Pocket Camera, Polaroid now must embark upon rapid product development projects to keep a fresh influx of new products into the marketplace and drive growth and maintain market share in the new kid and teen (instant) photography market.

---

3 Aggregated information in an internal Polaroid communications memo released on February 14th, 2000.

2.2 Past Research Efforts

The emerging field of Internet-based market research and product development has yielded many new research efforts. This section will highlight the research that contributed to the motivation for this study.

2.2.1 Internet-Based Market Research Projects

Academic Research:

Professors Ely Dahan, from MIT’s Sloan School of Management, and V. Srinivasian, from Stanford’s Graduate School of Business, developed a groundbreaking Internet-based product concept testing method to test virtual prototypes of bike pumps, substituting them for physical prototypes. The objective of this research was to allow product development teams to select the best of many product concepts without having to realize the, often hefty, time and cost requirements of generating physical prototypes for testing. Dahan and Srinivasian found that the Internet-based tests of the virtual prototypes produced market share values, for the top three product concepts in order, which closely matched those obtained through traditional testing techniques using physical prototypes [7]. The virtual prototypes were tested in static and animated form, with no major statistical differences between the accuracy of either approach. However, using animation to represent product concepts over the Internet was a breakthrough in Internet-based market research. Dahan is furthering this research technique with a major office equipment manufacturer and has taken the approach one step further by employing advanced drag and drop techniques [6]. The animation and drag and drop survey techniques, pioneered by Dahan, provided the motivation for and contributed significantly to many of the techniques used in the research effort outlined in this paper (see 3.3.3).

Unleashing the potential of the Internet to create multimedia virtual experiences, Urban, et.al. [30], [31] describe an innovative methodology, called Information Acceleration (IA), which helps to forecast the success of really new products, using virtual product representations combined with a complete virtual shopping experience. IA was shown to be a very powerful tool; however, the costs required to implement an IA prototype can be very high, and the information required to simulate the virtual shopping experience has high bandwidth requirements, which makes at-home survey participation difficult or unlikely. The aim of the
research, outlined in this thesis, is to provide respondents with an experience with some of the richness and interactivity of the IA process, but in a more cost effective, simple and widely accessible manner.

In an attempt to develop new methodologies for implementing conjoint analysis over the Internet, Chan[3] used the Internet to research Non-Monetary Incentives in the workplace. She developed an Internet-based hybrid conjoint analysis technique to reduce respondent fatigue while obtaining utility profiles for each respondent. This study provided a baseline methodology to employ conjoint analysis over the Internet, and serves as another example of the successful use of the Internet as a market research media.

Interactivity, media richness and well-designed websites are key elements for successful Internet-based market research. Ariely [2] and Klein [18] highlight the importance of interactivity and media richness in improving the memory and decision quality of respondents. Urban, et. al. [32] detail how a well-designed website not only provides ease of use and information, but can also contribute to increased levels of trust. The aim of this research is to incorporate these ideas into the development of an easy to use, interactive and aesthetically pleasing Internet-based survey. We would expect this survey would provide respondents with a more enjoyable task experience, thereby improving the quality of data, which would be driven by better decisions through improved memory, attention and trust.

In another attempt to link development teams with the customer, Urban, et. al. have developed a method called Listening In which creates a Virtual Engineer to monitor the click streams of a consumer as they search for information on products. Through an analysis of the click streams, the Virtual Engineer can identify gaps in the available product offerings and may be able to identify new market opportunities. One of the breakthroughs of this approach is its passive nature; companies can conduct market research without requiring the customer to answer any questions or surveys, ultimately reducing or eliminating respondent fatigue.
Commercial Applications:

Commercial applications of Internet-based market research are well underway. Harris Black International (HBI) now conducts Harris (opinion) Polls online with all ages[19]. Figure 2 shows the Logon Page for the Harris Poll Kidzone website. Harris uses colorful graphics and fun questions for kids ages 8 through 12 to attract them to register their polls. Parents are required to provide the information, however no personal contact with the parent is required, which allows kids to register themselves, while pretending to be the parent.

Figure 2: Harris Poll Kidzone Website

Zoomerang.com, is a website, which allows anyone to conduct online surveys for free, using templates and color schemes to make survey creation easy: “Creating your own survey may sound intimidating, but Zoomerang makes it simple. Choose from more than 100 survey ideas - each one contains sample questions in a ready-to-send template. If you have particular needs or
are just feeling creative, you may build your own survey from scratch.” Furthermore, data collection and representation is automated: “Answers to survey questions are tabulated in real time and presented in clear graphic charts and tables. You can begin checking survey responses hours (or even minutes) after deploying your survey.” Zoomerang.com has recently added new features, which for $17 a month allow for uploading of images, spreadsheet data collection, data storage and demographic analysis.

As mentioned in section 1.2, DMS, a division of AOL, conducts Internet interviews for over 1000 clients annually. Willke, et. al.[35], detail a landmark study, sponsored by ACNeilsen BASES, Kraft, Colgate-Palmolive, Proctor & Gamble, Adams, SmithKline Beechham, Johnson & Johnson, Campbell Soup Company, and Reynolds Metals Company, which investigated the differences between Mall Intercept and On-line interviewing in the United States. This study, an analysis of 50 parallel tests representing seventeen different manufacturers across a broad spectrum of product categories, showed that the Internet could be used for research on mainstream consumer packaged goods (CPG) products. They found a high degree of correlation between the mall-intercept responses and the responses of Internet panelists. Additionally they found that Internet respondents were more likely to give more thoughtful, detailed and candid answers when protected by the anonymity of the Internet.

The key in the Willke study was to recruit a demographically representative Internet panel to mirror the mall-intercept demographics, and calibrate the responses of the panel through extensive parallel testing. The Internet panel recruiting process was difficult and costly, but the Internet panelists were used more than once, as they participated in a survey about once every month. One question the results of this study might pose is how these results would have differed with a randomly recruited Internet panel. This research outlined in this paper helps to shed some light on this question.

Lastly, GMTV, a British TV broadcaster, has been conducting Internet-based research with kids and teenagers since November 1998 [11]. The research, called The Youth On Line Research

---

5 http://zoomerang.com/quicktour/index2.zgi
Investigation, is carried out 3 times a year over the Internet, on school computers, and involves over 7000 children between 7 and 15 years of age. This research including questions about savings, spending patterns, wish lists, media use, food, drink, fashion, music, leisure activities, advertising and Internet awareness, was done in cooperation with local schools, which received multimedia computers and school specific results.

In summary, there has been a great deal of work and research in the field of Internet-enabled marketing, market research, product concept testing, consumer packaged goods research, conjoint analysis, and interviewing kids and teenagers. Collectively, these bodies of work have contributed to the motivation, feasibility analysis and proof of concept that led to the research outlined in this thesis.
2.2.2 DOME

Overview:
DOME is a new tool under development in the MIT CADlab (http://cadlab.mit.edu) in collaboration with the Center for Innovation in Product Development (CIPD) and other organizations. DOME, or Distributed Object-based Modeling Environment, is a web-based application that will allow members of geographically dispersed design teams to work together over the Internet on an evolving product development model.

During a design cycle, team members serve varied functions from CAD modeling to cost modeling to market analysis to FEA analysis and more. Shared knowledge of key aspects of each of these functions is an essential part of a successful, integrated and efficient design process. For instance, designers and engineers need to understand the market needs, cost implications and manufacturing ramifications of their design decisions and vice versa. However, too often, communication among the various groups of the design teams is limited or ineffective. As information gets filtered down through multiple meetings and presentations, often times the information that reaches a team member can be inaccurate and/or late.

DOME creates a product development environment ("marketplace") that uses the Internet to allow engineering, marketing, manufacturing, suppliers, accounting, and other team members alike, to make critical pieces of their knowledge and expertise ("services") instantly available (via "publishing") to the development team in an integrated, uniform and simple interface. "Expert participants and organizations publish their geometric design, CAE, manufacturing, or marketing capabilities as live services over the Internet." [34] DOME integrates these functions by linking different software models together (or "modules"); for example, a module containing a CAD Solid Works model can be integrated and linked with modules containing Excel cost models, FEA model, or customer preference models. As a design engineer changes key design parameters in the Solid Works model, these changes will propagate throughout the integrated product development model in DOME and show the effects of this change on product cost, stress analysis and customer satisfaction accordingly. This integration allows for rapid design iterations and optimizations against corporate, customer, policy and or market objectives, which
take minutes or hours to complete, rather than weeks or months. Figure 3 shows DOME in a fully integrated enterprise. DOME servers reside at each of the various geographical locations of the development team, and serve as the Internet backbone, which link the various functional modules together to represent the total model of the development process.

![DOME Schematic](image)

**Figure 3: DOME Schematic**

Need for Integration with Customer:
Wallace, et. al., recently completed a DOME pilot study at the Ford Motor Company that modeled the development of an automobile door [34]. DOME linked technical models for engineering analysis models, CAD, supplier cost and performance tradeoffs to quickly evaluate different design iterations and configurations.

Tine Savage, in her master’s thesis, worked with DOME and Polaroid to model the development of an LCD projector [27]. She developed customer preference models based on customer needs.
research, using the Voice of the Customer methodology [14], and incorporated this indirect link with the customer into the DOME environment. She then performed tradeoff analyses for the LCD projector product to arrive at an optimal projector design. Voice of the Customer data is often taken early in the design process to arrive at a preliminary design. However, as the development process progresses, this early data is often not revisited or taken into account when design changes are made. DOME allows the design team to link customer data with design attributes; in essence keeping a “virtual” customer involved throughout the entire design process.

Ultimately, DOME would benefit from an ability to link directly with real customers to allow development teams to test the ramifications of design iterations and changes on overall customer satisfaction and projected market success throughout the development process. For instance if the development team wants to add a new feature(s) to the product design, Voice of the Customer data can only provide inferences into how this feature(s) addition will be perceived by the customer. Asking the customer directly about feature preferences can provide the development team with more actionable and accurate data. The research outlined in this paper is an attempt to develop an early methodology to ask the customer directly about their design feature preferences. Ultimately, this methodology, coupled with automated data analysis, could be employed in the DOME environment to enhance the accuracy and success of the product development process (see section 5.3).
3 Methodology

3.1 Project Definition

In defining the scope of the project, Polaroid was approached in an effort to determine how they would typically go about selecting product features using quantitative data. Typically, the product feature selection process at Polaroid is done qualitatively through focus groups or using the experiences and/or opinions of marketing or engineering. It had been Polaroid’s experience in the past that quantitative research, such as conjoint analysis, has been too time and cost consuming to meet the needs of the increasing speed requirements of the product development process. Nonetheless, the market research group revealed that they would use a mall intercept recruiting methodology and conjoint analysis to quantitatively understand product feature preferences and tradeoffs. This research investigates how the emergence of the Internet, as a market research medium, can provide Polaroid with an opportunity to address the time and cost concerns of obtaining quantitative and actionable data for incorporation into the product development process.

3.1.1 Test and Control Cell Selection and Definition

Since Polaroid commonly uses mall intercept for most of its other quantitative market research, such as BASES, the mall intercept methodology was selected to recruit respondents for this research. Although some may criticize mall intercept for biases it can introduce, the two primary goals of this research were to develop an Internet-based methodology to select product features, and to provide Polaroid with actionable data that they would use in the development of a next generation camera. Since Polaroid feels confident in mall intercept studies, mall recruit was selected as the primary recruiting technique to eliminate any question from the company regarding this aspect of the study. Furthermore, the aim of this research was not to explore the virtues or applicability of various recruiting techniques for Internet research. However, research was conducted to explore some of the benefits and disadvantages of other recruiting techniques for comparison purposes and reference for future research. Appendix 2 highlights these benefits and disadvantages as well as illustrates the estimated cost differentials between techniques.
Polaroid’s primary concern with Internet-based research was whether the respondent sample would be representative of their target market. Forrester Research estimates that 37% of US household have Internet access, and that number will reach 63% in 2003 [4]. However, Teenage Research Unlimited suggests that households with teenagers are more likely to have Internet access and estimates that 50% of teenagers are online at home\(^6\). Nonetheless, with only half of teens online at home, it was believed that conducting the test, solely with kids at home, could prove to be misleading if the pursuit of this project was to provide Polaroid with data that would be representative of their target market. Consequently, two cells were defined in this study:

**Control Cell:** 235 respondents aged 13 through 18, recruited at a mall to take the survey on an Internet-enabled computer at the mall facility.

**Test Cell:** 300 respondents, aged 13 through 18, recruited at a mall to take the survey at home on their own Internet-enabled computer. They would be sent an email inviting them to the survey website providing them with a log-on ID and password. Appendix 3 shows the email message sent to the test cell respondents at their home email address.

The following yield assumptions were used to determine how many respondents to recruit in order to obtain 200 responses in each cell:

**Control Cell**- Assumed a yield of 85% yield. All of the respondents would be immediately taken to a computer after the recruiting process, which would significantly reduce the drop out rate. Most of the yield loss was assumed to be from respondents who abandoned or ignored the task while taking the survey.

**Test Cell**- Assumed a yield of 66%. Yield loss in the test cell could come from recruited respondents who do not answer the survey upon receiving an email inviting them to the survey website, or from respondents who abandoned or ignored the task while taking the survey. Since there would be a time lag between recruiting the respondent and emailing

---

\(^{6}\) Source: Internal Polaroid Presentation on November 19, 1999.
the website address, I assumed the drop out rate could be significant. This yield estimate was an educated guess based on the advice of market research experts and the research conducted by Chan [3] and Willke, et. al. [35] which seemed to suggest 66% was a reasonable assumption.

3.1.2 Recruiting Methodology

Site Selection:
In order to eliminate geography as a variable in this study, five mall sites were selected across the country where both the test and control cells would be recruited. The five mall sites selected were located in Akron, OH, Waterbury, CT, Phoenix AZ, Los Angeles, CA and Atlanta, GA. The main criteria for selecting these five sites were geographic dispersion across the United States and mall area demographics, which approximately matched the demographics of the United States population. Available data on US demographics show that in 1998 the average household income was approximately $38,885 according to the US Census Bureau7 and the percentage ethnicity breakdown was approximately as follows: 82.5% Caucasian, 13% African American, and 4.8% other with 11.2% of these reporting as Hispanic8.

In order to avoid diluting the control cell from respondents with Internet access at home, the two cells of the test were conducted in series. In order to provide Polaroid with actionable data as early as possible, the control cell was conducted first between the dates of December 10th, 1999 to January 3rd, 2000. Given the holiday shopping season, this would ensure a large number of available respondents and a higher likelihood of teenagers shopping at the mall with their parents. The test cell recruiting process started in late January, and the respondents answered the survey from home between the dates of February 12, 2000 to April 12, 2000.

---

7 Web source: http://www.census.gov/hhes/www/income98.html
8 Web source: http://www.census.gov/statab/www/part1.html
Screening Criteria
Respondents were recruited using the following criteria and targets:

1. Age: Evenly dispersed from 13 through 18
2. Gender: Target 50% male, 50% female
3. Ethnicity: Target 75% Caucasian, 13% African American, 9% Hispanic, and 3% other\textsuperscript{9}.
4. Photography use: At least 2 times in last year\textsuperscript{10}.
5. Home Internet Access: Required for test cell, recorded for comparison purposes for control cell.
6. Parental Permission: Required for both cells.
7. Household Income: Collected for data analysis and comparison purposes but was not used as a screening criterion.

See Appendix 4 for an example of the complete screener and parental permission slip used to recruit the test cell respondents.

For the control cell, an employee at the market research facility entered the data collected from the screening process using the registration page shown in Figure 4. For the test cell, each mall site recruited 60 respondents each, using the demographic criteria outlined in section 3.1.2, compiled the respondent information in an excel spreadsheet and emailed me in small waves as respondents were recruited. As the sets of respondent data came in, a unique user ID for each respondent and password was emailed to the respondents.

\textsuperscript{9} Criteria provided by Polaroid market research

\textsuperscript{10} This is a commonly used criterion at Polaroid for recruiting respondents for camera based market research.
Parental Permission

According to Net Family News, 73% of parents have concerns about their children’s online safety and privacy\textsuperscript{11}, therefore obtaining parental permission for respondents under 18 became a critical element of the recruiting process. On October 20, 1999, the Federal Trade Commission approved the Children’s Online Privacy Protection Act, which would take effect April 2000, and outlines the steps required to obtain parental permission for children under 13 when collecting personal information. These guidelines were a more formal set of regulations than the previously established self-regulatory guidelines released by the Children’s Advertising Review Unit (CARU)\textsuperscript{12}, of the Council of Better Business Bureaus. These guidelines were allied during respondent recruiting even though they were all 13 years of age or older. The acceptable forms

\textsuperscript{11} Source: http://netfamilynews.org/sl991217.html

\textsuperscript{12} These guidelines can be located online at http://www.bbb.org/advertising/caruguid.html.
of parental permission as suggested by the FTC and CARU guidelines were written or verbal (over the phone or in person). Refer to Appendix 4 for permission information.

Incentive Selection
An incentive of $5 was selected for both cells. Willke et. al. [35] used a $5 incentive for their study, with surveys that lasted fifteen to twenty minutes. Additionally, the advice of market research professionals suggested that $5 would be sufficient to recruit the population sample required by the study.

For the control cell, the respondent received $5 in cash or check after completing the survey in the mall facility. The test cell posed a larger challenge since the incentive is meant to be a reward for completing the survey. This requires that the incentive reach the respondent at home, after they have completed the survey. At the end of the survey, each test cell respondent was provided a choice of three gift certificates, which would be mailed to him or her at home (Figure 5).
3.2 Product Design Features

For the next generation pocket camera, there were ten possible product features to evaluate. For this survey we wanted to reduce the available set to 6 features plus price. Since each feature would require additional time spent by the respondent to “learn” about the feature, we decided that more than 6 features would lengthen the survey unnecessarily and risk excessive respondent fatigue. Usability experts and market research professionals were consulted to arrive at this estimate.

3.2.1 Feature Selection

Due to time and cost considerations, a lengthy and quantitative approach to select the six features for the survey was not practical or feasible. Therefore, two approaches were used to select which

Figure 5: Test Cell Gift Certificate Selection
six features to include in the survey. The first approach was to watch available focus group tapes of teenagers and scan available market research data to see which features might meet or address customer needs. The second approach was to poll the product development team. Each member of the team ranked the ten features in order of which features they felt should be included in the survey. More voting weight was given to the appropriate team members who might have a closer insight into the needs of the customer or more experience in the instant photography market. The combination of these two approaches allowed for easy selection the top 6 features for the survey; Picture Quality, Picture Removal, Styling Covers, Picture Taking, Camera Opening, and Light Selection. For each feature there were two options available, which would represent the high and low level options for the purpose of the data analysis. For instance, the Picture Removal feature had a low-level option of Manual Picture Delivery and a high level option of Automatic Picture Removal.

Prior to developing the feature explanations and animations for the survey, the final six features and their options were presented to the development team. The purpose of this presentation was to ensure that the team had a clear understanding of the types of design direction the survey might provide and to assure that the members of the team had a chance to voice any concerns or questions about the features and options selected.

3.2.2 Feature Representation

Each feature was represented with a heading such as Picture Removal and two feature options, such as Automatic and Manual Picture Removal. In order to represent these features to the teenage respondents in a simple and efficient manner, animation (where appropriate), was supplemented with explanatory text.

The following steps were taken to develop the representation of the six features with options:

Step 1: Met with engineers and image quality experts to gain an understanding of the technical issues involved with implementing each feature in the product design, such as the interaction between picture quality and light selection, or possible camera size implications of certain features.
Step 2: Contracted industrial design firm to create three-dimensional CAD files in PRO-Engineer for animations. The lead-time for this was approximately 1 1/2 weeks.

Step 3: Worked with usability and instruction experts to write short one to two sentence descriptions of each feature. Extra care was taken to ensure that the descriptions did not induce bias in the respondent's preference for one feature option over the other.

Step 4: Reviewed these descriptions with the design engineers and marketing experts for accuracy and simplicity.

Step 5: Outlined the sequence of animation needed to adequately explain and represent how each product feature worked.

Step 6: Generated GIF animation files with no more than 5 frames, shown in sequence, to represent feature use. Superimposed digital images of a human hand, where appropriate, to show scale and enhance animation.

Step 7: For the "Picture Quality" feature, image quality experts were consulted to accurately represent the two Picture Quality options in the survey.

Step 8: Assembled the six product feature representations into HTML pages and tested them with 6 kids, ages 11-15 over the Internet.

Step 9: Incorporated the feedback from these kids into text or animation changes.

Generating the feature animation posed a slight challenge. Requiring the use and/or downloading of a plug-in such as SGI's Cosmo Player to view more sophisticated VRML animation files, would limit our ability to reach respondents in the test cell. Requesting that a respondent download, what might be an un-trusted or unknown plug-in, might breed skepticism and result in a loss of that respondent. Therefore, simple GIF animation was used to represent how the features would work.

3.3 Data Collection Techniques

Three methods were employed in this survey to collect customer preferences for the six design features plus price: straight comparisons, conjoint analysis and a drag and drop exercise where the respondents could create their own camera. The results of data analysis from these three
methods was compared for respondent consistency and used to compare the benefits and disadvantages of each technique.

### 3.3.1 Straight Comparison

In the straight comparison the respondent was asked to pick which option they preferred for each feature. For example: they were asked to select their preference between automatic and manual picture delivery. See Figure 6 for a view of the straight comparison task. The data generated by the straight comparison could provide the design team with directional information about which options were preferred for each product feature.

![Figure 6: Straight Comparison](image)

The shortcoming of straight comparisons is that they will not provide relative preferences or tradeoffs between the features and their options. For instance, a price of $24.99 might be preferred to $34.99, and Automatic Picture Removal might be preferred to Manual Picture Removal.
Removal, but the straight comparison won't provide information about how much $24.99 is preferred to Automatic picture removal. The conjoint analysis in the survey provided the data for feature tradeoff analysis.

### 3.3.2 Conjoint Analysis

In order to determine which features and options the respondents valued when given a choice between different feature and option sets, a pair wise attribute-based conjoint analysis [13] was employed in the survey. Attribute based conjoint analysis provides a measure for the part worth of an individual attribute (feature level). The simplest approach from a data analysis standpoint would have been a fractional $2^7$ design (6 features and price). The concern with this approach was that answering questions, which require simultaneous consideration of 7 features, many of which are unfamiliar, would be too daunting of a task and accelerate respondent fatigue.

**Conjoint Design:**

The goal of this survey was to keep respondent fatigue to a minimum, therefore we used a crossover design and split the conjoint into two half fraction $2^4$ designs, generating 8 cards each. Price was the constant (crossover) feature in each design. Using price in both halves would allow for indirect comparisons between the features of each separate conjoint, assuming there were no interactions (or preferential independence) between the factors of the separate designs.

In order to test preferential independence, 10 respondents were asked simple questions about their preferences for product features to determine if there might be any possible interactions between the features. The results of this investigation showed that an interaction might exist between two features, therefore these 2 features were included in the same half of the cross over design.

The conjoint design was generated using a simple conjoint card generation software application, Conjoint Designer v2. Both half fraction $2^4$ conjoints were identical in design, only the features differed. Figure 7 shows the conjoint design for the both halves of the conjoint. A “1” denotes the high-level feature option and a “0” denotes the low-level feature option.
For each half of the conjoint, the 8 cards were paired randomly (for a total of 8 pairs) to maximize and equalize the number of tradeoffs made across the features feature. Appendix 7 shows the final 16 pairs used in the conjoint analysis.

Conjoint Theory:
A trade-off analysis investigates the value the customer places on Camera B versus Camera A. A tradeoff occurs when two cards (in this case camera options) are paired. For example consider card 4 when paired with card 8, note that price, picture quality and picture taking all vary between the two cameras.

For this survey a data collection method called constant-sum paired comparisons (CSPC) was used to evaluate the tradeoffs. With CSPC the respondent is shown two products and is asked to indicate relative preference by allocating 100 points between the pairs [16]. To illustrate this approach, consider the two cameras A and B above. Let $c_{ab}$ be the points allocated to product $a$ when product $a$ and product $b$ are compared. Using a constant sum approach, $c_{ba} = 100 - c_{ab}$ if the respondent is allowed 100 points to allocate between the two products. Therefore if a respondent has a complete preference for Camera B, $c_{ba} = 100$ and $c_{ab} = 0$. The data matrices below show the pair wise comparison for the conjoint analysis in this survey, with example values for $c_{ba}$ and $c_{ab}$. The first row of the table compares card 4 and card 8. The 0 in the $c_{ba}$- $c_{ab}$
column indicates that the respondent is indifferent between the two cameras as represented by their indicated features.

<table>
<thead>
<tr>
<th>1st Half</th>
<th>Camera A</th>
<th>Camera B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>styling covers</td>
<td>picture quality</td>
</tr>
<tr>
<td>Pair 1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Pair 2</td>
<td>25</td>
<td>0</td>
</tr>
<tr>
<td>Pair 3</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Pair 4</td>
<td>25</td>
<td>0</td>
</tr>
<tr>
<td>Pair 5</td>
<td>-100</td>
<td>0</td>
</tr>
<tr>
<td>Pair 6</td>
<td>-100</td>
<td>1</td>
</tr>
<tr>
<td>Pair 7</td>
<td>-100</td>
<td>1</td>
</tr>
<tr>
<td>Pair 8</td>
<td>100</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2nd Half</th>
<th>Camera A</th>
<th>Camera B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>light setting</td>
<td>picture removal</td>
</tr>
<tr>
<td>Pair 9</td>
<td>25</td>
<td>0</td>
</tr>
<tr>
<td>Pair 10</td>
<td>50</td>
<td>0</td>
</tr>
<tr>
<td>Pair 11</td>
<td>75</td>
<td>1</td>
</tr>
<tr>
<td>Pair 12</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Pair 13</td>
<td>-100</td>
<td>0</td>
</tr>
<tr>
<td>Pair 14</td>
<td>-100</td>
<td>1</td>
</tr>
<tr>
<td>Pair 15</td>
<td>-75</td>
<td>1</td>
</tr>
<tr>
<td>Pair 16</td>
<td>75</td>
<td>0</td>
</tr>
</tbody>
</table>

To analyze the data from the tables above, we used linear utility functions and regression analysis; Hauser and Shogun [16] describe this method in detail. To prepare the paired evaluations for data analysis, we subtract the levels (0 or 1) for each feature of Camera A from Camera B. For example in pair 9 above, price will be represented as a 1 (1-0), light setting will be represented as a 0 (1-1), picture removal as a −1 (0-1), and camera opening as a −1 (0-1).

This shows that for pair 9, the respondent will be making tradeoffs for price, picture removal and camera opening. Since light setting is present at the high level for both cameras, there is no tradeoff on light setting in the new matrix (represented by a value of 0).

The following data table represents how the data is prepared for analysis on all 16 pairs, where the difference, \( c_{ba} - c_{ab} \), is the dependent measure. The values of in the table below are the same for each pair in the previous tables; we simply condensed the representation of the product.
comparisons made (tradeoffs).

<table>
<thead>
<tr>
<th>Pair</th>
<th>$c_{ba} - c_{ab}$</th>
<th>price</th>
<th>styling covers</th>
<th>picture quality</th>
<th>picture taking</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>-1</td>
<td>-1</td>
</tr>
<tr>
<td>2</td>
<td>25</td>
<td>1</td>
<td>0</td>
<td>-1</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>-1</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>25</td>
<td>0</td>
<td>-1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>-100</td>
<td>0</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
</tr>
<tr>
<td>6</td>
<td>-100</td>
<td>-1</td>
<td>0</td>
<td>-1</td>
<td>-1</td>
</tr>
<tr>
<td>7</td>
<td>-100</td>
<td>-1</td>
<td>0</td>
<td>-1</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>100</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pair</th>
<th>$c_{ba} - c_{ab}$</th>
<th>price</th>
<th>light setting</th>
<th>picture removal</th>
<th>camera opening</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>25</td>
<td>1</td>
<td>0</td>
<td>-1</td>
<td>-1</td>
</tr>
<tr>
<td>10</td>
<td>50</td>
<td>1</td>
<td>0</td>
<td>-1</td>
<td>0</td>
</tr>
<tr>
<td>11</td>
<td>75</td>
<td>0</td>
<td>1</td>
<td>-1</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>100</td>
<td>1</td>
<td>-1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>-100</td>
<td>0</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
</tr>
<tr>
<td>14</td>
<td>-100</td>
<td>-1</td>
<td>0</td>
<td>-1</td>
<td>-1</td>
</tr>
<tr>
<td>15</td>
<td>-75</td>
<td>-1</td>
<td>0</td>
<td>-1</td>
<td>1</td>
</tr>
<tr>
<td>16</td>
<td>75</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

A regression of the data with $c_{ba} - c_{ab}$ as the dependent variable, price, styling covers, picture quality, picture taking and a constant as the independent variables (for example on the first half of the conjoint) will show any significant utility values. The resulting significant utility values provide a measure of how much the respondent values the tradeoff from moving from the low level to the high-level option for each feature. For this research, all significant utility values were within a confidence interval of 95%.

Conjoint Execution:
Again, since the goal of this survey was to keep respondent fatigue to a minimum, the 16 total pairs, generated in the cross over design, were deemed too many for any one respondent to answer. Therefore, each respondent was randomly given 8 of the 16 possible pairs during the survey. Figure 8 shows the instruction page for this task and the presentation of the conjoint questions.
Figure 8: Conjoint Analysis Instructions Page

As Figure 8 shows, we used a qualitative scale for the product comparisons. Instead of asking the respondent to think quantitatively and allocate 100 points between each camera option, they were provided with a categorical scale to improve the ease of the task. The two extreme qualitative descriptors are shown above, and were provided as starting actors for the respondents. However, as the respondent moved the cursor over the yellow dots shown above, the corresponding qualitative descriptor appeared. This 9 point qualitative scale had the following descriptors and assumed mathematical values for $c_{ba} - c_{ab}$:
<table>
<thead>
<tr>
<th>Qualitative Descriptor</th>
<th>Numerical Value $(c_{ba} - c_{ab})$</th>
</tr>
</thead>
<tbody>
<tr>
<td>I like A completely more than B</td>
<td>-100</td>
</tr>
<tr>
<td>I like A a lot more than B</td>
<td>-75</td>
</tr>
<tr>
<td>I like A more than B</td>
<td>-50</td>
</tr>
<tr>
<td>I like A a little more than B</td>
<td>-25</td>
</tr>
<tr>
<td>I like A and B the same</td>
<td>0</td>
</tr>
<tr>
<td>I like B a little more than A</td>
<td>25</td>
</tr>
<tr>
<td>I like B more than A</td>
<td>50</td>
</tr>
<tr>
<td>I like B a lot more than A</td>
<td>75</td>
</tr>
<tr>
<td>I like B completely more than A</td>
<td>100</td>
</tr>
</tbody>
</table>

The format of the conjoint questions was tested on a small scale with teenagers to evaluate different scale options, varied page layouts and scale resolution (5 to 11 point scales). The layout shown in Figure 8 depicts the best layout and scale, which was developed using this small-scale test.

To eliminate any positioning bias, the order of each question, the side of the screen for each camera (A or B) and the order of the features listed were randomized. The order and position of each question was recorded in the database for later analysis.

Data Analysis:
Since each respondent was randomly assigned 8 of the 16 pairs, individual utility profiles could not be calculated. Therefore, the data was aggregated across respondents for the linear regressions. The gender, age, and income segmentations were analyzed for significance using the Chow Test [16].
3.3.3 Drag and Drop

An experimental drag and drop technique was employed at the end of the survey. The reason for employing this method of data collection in the survey was two-fold. The first reason was to provide the respondent with a more interesting and interactive activity where they were empowered to tell “us” what they really wanted. The second reason was to introduce another use of this novel Internet survey methodology for research purposes and advancement of the technique. Ely Dahan, a professor at the Sloan School of Management, had successfully employed this technique in a survey for an office equipment company.

Description:
In the drag and drop exercise, the respondents were shown a baseline camera with a starting price of $24.99 and a list of feature options that were consistent with the options they were shown throughout the survey. They were then provided with a list of 6 feature options (all high level options) that they could “buy”. In order to “buy” an option, they would drag the icon, next to the option they wanted, onto the camera and the price would change accordingly with that option. The costs of each option were derived using estimated manufacturing costs, provided by engineering, and a subsequent profit margin, consistent with camera margins at Polaroid. After the respondent had “created” the camera of their choice, they were asked if they would purchase this camera with their own money. Figure 9 shows the drag and drop exercise.

At the end of the drag and drop exercise, the respondent is asked about their intent to purchase the camera that they created. They are given 5 possible responses, “Definitely”, “Probably”, “Maybe”, “Probably not” and “Definitely not”. Ultimately, the data collected from this “intent” scale could be an important tool for forecasting demand for a new product.
Technology:
Layers were used in the JavaScript to attain the drag and drop functionality Appendix 5 shows an excerpt from the source code of this page. One of the new capabilities introduced in this application was the ability to swap images of the camera during the drag and drop exercise. Therefore if a respondent selected a feature that would result in a change in the camera appearance, the central camera image would change when the icon was dragged from the “what you can buy” column onto the camera.

Placement:
The placement of the drag and drop exercise at the end of the survey was deliberate, because the high level options and low level options were never differentiated from a cost or value.
perspective throughout the survey. The “value” of each option was left up to the respondent to assume or determine. By placing the drag and drop exercise at the end of the survey, we could be assured that no bias was induced in the other two data collection techniques as a result of respondent knowledge of relative feature option costs.

3.3.4 Miscellaneous

At the end of the survey, each respondent was asked eight questions. The purpose of these questions was two-fold. The first purpose was to collect data about the respondents’ opinions about the survey. The second purpose was to provide Polaroid with some company specific questions. Figure 10 shows the miscellaneous questions asked at the end of the survey.

![Figure 10: Miscellaneous Questions](image-url)
3.4 Website Execution

3.4.1 Goals

According to Teenage Research Unlimited [29], Table 1 shows the factors which teenagers say makes a website fun. One of the main goals of this website development was to make it as enjoyable for the teenage respondents as possible while maintaining enough integrity to ensure data integrity.

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Great Info</td>
<td>45%</td>
<td>44%</td>
</tr>
<tr>
<td>Regular Updates</td>
<td>42%</td>
<td>41%</td>
</tr>
<tr>
<td>Easy to Navigate</td>
<td>35%</td>
<td>34%</td>
</tr>
<tr>
<td>Chat/ E-mail options</td>
<td>27%</td>
<td>41%</td>
</tr>
<tr>
<td>Music Clips</td>
<td>28%</td>
<td>37%</td>
</tr>
<tr>
<td>Quick download time</td>
<td>34%</td>
<td>29%</td>
</tr>
<tr>
<td>Great Graphics</td>
<td>35%</td>
<td>26%</td>
</tr>
<tr>
<td>Good Links</td>
<td>28%</td>
<td>23%</td>
</tr>
<tr>
<td>Video Clips</td>
<td>26%</td>
<td>25%</td>
</tr>
<tr>
<td>Games</td>
<td>29%</td>
<td>22%</td>
</tr>
</tbody>
</table>

Table 1: What Makes a Web Site Fun

Based on some of the information provided above, highlighted in bold text, a key goals for the website and survey were establish and used as a constant measure to evaluate development efforts and progress.

Ease of use:

- The site should be intuitive and forward moving. Which means that the respondent does not get lost in the site through unnecessary links or diversions.
- Instructions should be short and simple.
- The language in all descriptions and instructions should be worded in a manner most appropriate for a teenage audience. The tone should be light-hearted but so as not to take away from the importance of the task.
- Download speed should be minimized wherever possible to reduce respondent fatigue.
- Reminders about the details of product features and options should be readily available whenever a respondent is asked answer any feature-related questions.
Visual Appeal
- The web pages should be vibrant and colorful, without being distracting.
- The site should have a similar feel to other popular teen sites, for familiarity.
- Pages should not be cluttered with too much text or graphics.

Enjoyability
- Interactive activities and animation should be used wherever possible to increase the enjoyability of the site.

3.4.2 Development

Prior to any website design, page layouts or HTML code, a flow diagram representing the intended website functionality was created (see Appendix 6). This served as the template for all future site development. The basic sections of the website were:

1. Privacy and security assurance
2. Respondent Introduction
3. Product Orientation
4. Feature Descriptions
5. Data Collection

1. Privacy and Security Assurance:
Privacy is a concern that needed to be addressed for the respondent, their parent and Polaroid Corporation. The following methods were employed to assure the privacy of all the parties involved in the survey:

- For the test cell, each respondent was emailed the web address with a unique password and logon ID number. This ensured that no one could enter the site without access.
- Once a respondent had completed the survey successfully, they were locked out of the system so no repeat visits were allowed. This protected Polaroid from having a respondent revisit the site to show friends the camera or print out images (although there is no way to ensure this doesn’t happen during the first visit).
- Each respondent at home was asked to begin the survey with a parent or guardian present to read an agreement. This agreement page, see Figure 11, detailed how the respondents...
privacy would be protected and asked that they agree not to discuss the information included in the survey with anyone else.

- A “Privacy Info for Parents” link was included on the first few pages of the website to provide parents with information on the study sponsors, contact information and other privacy related facts. Figure 12 shows this page and the information provided.
- All identifying data to a respondent’s name and address was disassociated from the responses for data analysis purposes. Furthermore, this identifying data was destroyed 6 months after the data analysis and gift certificate mailings were completed.

The privacy and security measures employed in this survey were of a high priority during the development process. Polaroid legal as well as the Committee On the Use of Humans as Experimental Subjects (COUHES) at MIT was consulted to ensure the appropriate privacy and security measures were taken to protect the respondents and Polaroid Corporation.

Figure 11: Agreement Page
2. Respondent Introduction:
Once the privacy of the respondent and Polaroid was established through the agreement page, the next section of the survey oriented the respondent to the purpose of the survey (Figure 13 shows the orientation page of the survey). This section had two main purposes. The first purpose was to provide motivation to the respondent by highlighting the importance of their participation in the survey. The second was to provide an estimation for the amount of time it would take the respondent to answer the survey.
3. Product Orientation:
Because the I-zone camera was released into the US market in the fall of 1999, many of the respondents would not have seen the product by the time they were taking the survey in December of 1999 and early 2000. Furthermore, since the product was a completely new instant film format, measuring 1” x 1 ½”, with an adhesive backing, the uses for these pictures might differ significantly than what the respondent would typically use pictures for. Therefore, the respondents needed to learn some basic information about the camera and see how these small pictures might be used. Figure 14 shows the product description page for the camera, and Figure 15 shows some of the use examples provided.
Dan, we want to ask you some questions about a camera that takes personal, fun-sized*, INSTANT COLOR PICTURES that develop in about 1 minute right before your eyes (so you don't have to get them developed!).

*Actual Size is 1" X 1.5"
4. Feature Descriptions:
Once the respondent was briefed on the product purpose and possible uses, the next critical step was to provide them with an understanding of the different features and options that the camera
might have. This section was one of the more critical elements of the survey, because accurate and understandable feature descriptions are paramount to obtaining actionable preference data on the features. Therefore many members of the development team provided input into the descriptions and representations of the feature options. Design layout and instructions experts provided significant input into the development of the feature description pages.

A single format was developed to ensure consistent representation between the features. The two options were shown side by side for each of the 6 features. Figure 16 shows an example of the feature description page for the Picture Taking feature. For the animation sequences, digital images of a real hand were superimposed on the CAD images to illustrate actual use and to continue to provide a size reference for the respondent.

Figure 16: Feature Description Example
Additionally, representative icons were developed for each feature as a visual reminder. Graphics design experts as well as instruction designers were employed in the development of these important "ease of use" tools. These icons were used throughout the site to serve as links back to the feature description pages each time the respondent was asked to think about a feature. Figure 17 shows these icons.

![Feature Icons](image)

**Figure 17: Feature Icons**

Refer to Figure 6, Figure 8, and Figure 9 show examples of icon use in the survey. Each time a respondent was asked to select a feature option or a camera option, they were provided with icon links, which would provide them with a completed animated reminder about the feature options.

5. Data Collection:
The data collection portions of the survey were described in detail in section 3.3. However the data transfer between the website and the database software (PostgreSQL, version 6.5.3) was done using CGI scripts, written in Perl. The website was run on a Linux system for compatibility with the code and database software as well as speed and reliability.

### 3.4.3 Collaboration and Assistance

During the development of the website many experts were consulted in the areas of web design, market research, instructions, page layouts, text and feature representation/animation. Appendix 1 lists the people who were instrumental in the development and refinement of this website.

### 3.4.4 Use Testing

The website was evaluated for ease of use and functionality with a small group of 12 teenagers and adults. The fine-tuning and modifications, which resulted from this evaluation, consisted of minor instruction, text and page layout modifications. Overall, the continual evaluation of text, instructions and page layouts throughout the development process with design, marketing and instruction experts within and outside Polaroid, contributed significantly to the small amount of modifications required from this pre-test.
4 Results and Analysis

4.1 Survey Results

4.1.1 Control Cell

Yield:
A total of 239 respondents answered the survey in the control cell. The yield of usable responses from these respondents was 209, or 87%, which closely matched the original yield estimate of 85% (see section 3.1.1). In order to evaluate which respondents did not take the task seriously the following data was evaluated:

- The time to complete the conjoint questions for each respondent was compared to the average time for all respondents. This comparison highlighted those likely respondents who were blowing off the task.
- The values for $c_{ba} - c_{ab}$ from the conjoint questions, coupled with positioning data collected for each question, was used to evaluate if the respondent always selected the radio buttons on one side of the screen. For example if the data for a respondent showed all the values for $c_{ba} - c_{ab}$ were 100 or -100 and they were always clicking on a radio button on the right side of the screen, this was an indication of task neglect.

Demographics:
The demographics of the control cell are outlined in Table 2. This data represents the information collected during the recruiting process and entered in the mall registration page. The number of respondents indicating Internet access at home, 76%, was a surprising amount. This could be a result of one or many of the following reasons:

- There may have been a bias from mall recruiting: Are kids who hang out at the mall more likely to have Internet access?
- During recruiting, the respondents were told the survey was an Internet survey, which could have been self-selecting.
- The respondent may have misinterpreted the question to be “Do you have Internet access?” If this was the case they could have answered yes if they had access at school, home, the library or a friend’s house.
• It may be an accurate reflection of the demographics in the mall’s catchment area.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Internet at Home?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>47% Yes 76%</td>
</tr>
<tr>
<td>Female</td>
<td>53% No 24%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age</th>
<th>Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age 13</td>
<td>Less than $25,000 8%</td>
</tr>
<tr>
<td>Age 14</td>
<td>$25,000-$49,999 32%</td>
</tr>
<tr>
<td>Age 15</td>
<td>$50,000-$75,000 22%</td>
</tr>
<tr>
<td>Age 16</td>
<td>Over $75,000 22%</td>
</tr>
<tr>
<td>Age 17</td>
<td>Did Not Disclose 17%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>State</th>
<th>Ethnicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arizona</td>
<td>Hispanic 8%</td>
</tr>
<tr>
<td>Connecticut</td>
<td>African American 12%</td>
</tr>
<tr>
<td>Georgia</td>
<td>Asian 1%</td>
</tr>
<tr>
<td>California</td>
<td>Caucasian 74%</td>
</tr>
<tr>
<td>Ohio</td>
<td>Other 5%</td>
</tr>
</tbody>
</table>

Table 2: Control Cell Demographics

4.1.2 Test Cell

Yield:
The original yield assumption of 66% for the test cell was a dramatic overshoot, and difficulties and delays with the market research firm, resulted in 228 active contact emails for the test cell versus the original target of 300. The market research firm recruited 304 respondents; however, 24% of the records had inactive, inaccurate or misreported email accounts. Of the 231 active email contacts, only 38%, or 87 respondents, visited the website after receiving the invitation email, versus the 66% predicted. This yield was attained by sending 2nd, 3rd and 4th email reminders to respondents in order to increase this yield, the 4th reminder increased the incentive to $10. Possible reasons for this lower than expected yield are as follows:

• Anecdotal evidence from discussions with parents of teenagers indicates that some parents will not open emails from email addresses that are unknown. This may resulted in some respondents never opening the email.
• Parents may have control over email usage. If the email was set aside by the respondent in order to answer the survey at a later (possibly parental-approved) time, some respondents may have forgotten to take the survey.

• Some respondents emailed back that the survey would not work on their computer, which is an indication that JavaScript was probably not enabled. We do not know what percentage of respondents did not have JavaScript enabled; however, data from StatMarket shows that close to 90% of Internet users use browsers that are JavaScript enabled. Therefore, the lower yield may be attributable, by 10%, to respondents who did not have JavaScript enabled or available.

• Spam email (unwanted or unsolicited email) is becoming more prevalent and mailboxes are increasingly becoming cluttered with email addresses that are unknown to the email user. Forrester Research reports that many marketers worry that the growing popularity of email marketing will overwhelm consumers and reduce effectiveness. Consequently, users may delete messages from unknown email addresses, such as the one used in this survey, because they are perceived to be Spam messages.

• The market research firm employed for the recruiting process was very unresponsive in passing on the data for the recruited respondents in a timely manner. This may have resulted in delays as long a three weeks between when a respondent was recruited at the mall and when the respondent received the email at home inviting them to the survey web site. Therefore, the respondent may have forgotten about being recruited or become annoyed about the delay.

• Self-selection of respondents with an interest in photography. Figure 18 shows a comparison between the test and control cells of the study in response to the question “How interested are you in taking picture?” A significantly higher percentage of the test cell respondents indicated they were “very” interested in taking pictures.

---

13 Source: www.statmarket.com
The second yield from the test cell, which is the percent of the 87 respondents who completely answered the survey completely and without task neglect, was 86%, yielding 75 usable responses. This yield was consistent with findings in the control cell, which had a yield of 85%. The same analysis, described in Section 4.1.1, was used to evaluate “task neglect”. This finding suggests that respondents are no more or less likely to neglect the survey task in a mall facility or at home. Figure 19 depicts a yield “tree” to illustrate the flow and loss of respondents.
Figure 19: Yield “Tree” for Test Cell Respondents

Demographics:

For the test cell, we were able to control the demographics through the mall recruit process for the initial recruited population as outlined in section 3.1.2, Table 3 details these demographics for the respondents recruited with active email accounts (N=231).
An original hypothesis was that the control cell, which did not screen for at-home Internet access, would yield a higher reported income across the test population. Figure 20 compares reported income for the recruited populations for the test and control cells. Interestingly, a greater percentage of respondents in the test cell (at-home sample) reported income between $25,000 and $49,999, and a greater percentage of the control cell (mall-site sample) respondents reported income above $75,000. This may indicate that the test cell methodology does not induce a bias toward respondents of higher income families than the control cell methodology, as originally assumed.
Although we controlled the demographics of the recruited population, we were unable to control the demographics of the respondents who chose to visit the survey upon receiving the email. Table 4 details the demographics of the respondents who completed the survey satisfactorily (N=75). Although the original recruited population had 50% female respondents, the final yield was 65% female. Other than gender, possible other factors that may have influenced yield are:

- **Age**: 19% of the recruited population was 13 years of age, versus 24% of the yield demographics, and for 18 year olds, these numbers were 18% and 13%, respectively. In short the youngest teens may be more likely to answer the survey than the oldest teens. There was no discernable difference between ages 14 through 17.

- **Ethnicity**: 8% African American respondents were recruited, 3% of the yield was African American, and the comparison for Hispanic was 6% versus 9%, respectively, and 79% versus 83%, respectively, for Caucasian respondents.
State: Respondents from Georgia composed 16% of the recruited population; only 11% of the yield population was from Georgia. For Ohio, these numbers were 24% and 29%, respectively.

<table>
<thead>
<tr>
<th>Gender</th>
<th>35%</th>
<th>65%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Internet at Home?</th>
<th>100%</th>
<th>0%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age</th>
<th>24%</th>
<th>16%</th>
<th>15%</th>
<th>17%</th>
<th>15%</th>
<th>13%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age 13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age 14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age 15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age 16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age 17</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Income</th>
<th>1%</th>
<th>41%</th>
<th>21%</th>
<th>9%</th>
<th>27%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than $25,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$25,000-$49,999</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$50,000-$75,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Over $75,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did Not Disclose</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>State</th>
<th>12%</th>
<th>29%</th>
<th>11%</th>
<th>17%</th>
<th>29%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arizona</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connecticut</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Georgia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>California</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ohio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>9%</th>
<th>3%</th>
<th>0%</th>
<th>83%</th>
<th>5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hispanic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>African American</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4: Yield Demographics- Test Cell

Response Timing
For the test cell, Figure 21 depicts the response rate as a function of the number of invites that the respondents received. The majority of the respondents, 56% answered the survey after receiving one email. The higher yield for the fourth versus the third email invitation was likely due to the increased incentive offered in this email. Figure 22 shows the response rate in days, 80% of the respondents answered the survey within 16 days.
Response Rate from Survey Invites

![Graph showing response rates over days](image)

**Figure 21: Email Invite vs. Response rate - Test Cell**

**Figure 22: Survey Response Rate in Days - Test Cell**
4.1.3 Recruiting Process

Parental Permission:
Overall, the sites related that the process of obtaining parental permission went smoothly for the control cell. Recruiting for the test cell posed some minor challenges because some parents were reluctant to provide their email and mailing addresses, which were required to email the website address password and to mail the gift certificates after the survey completion. The site managers relayed that about half of the respondents were recruited in the company of a parent and the other half obtained parental permission over the phone. Given that the market research facilities were located in local malls, many parents have seen the facilities; this may have contributed to increased trust and the parent's willingness to provide permission. In future recruiting efforts, for younger respondents, who require parental permission, the relationship between the mall facility and the community should not be underestimated.

Control Cell Timing:
There were some technical difficulties in 3 of the 5 sites due to the novelty of using the Internet for survey techniques. Consequently some of the networking equipment and software was not functioning properly. This project was the first Internet survey that the market research firm had conducted; therefore there were some delays inherent in the learning curve of the process. However, 2 of the 3 sites completed the recruiting and administration of the Internet the survey with 47 respondents for the control sample in 8 days, which may be indicative of what this recruiting process is capable of. However, with an Internet savvy market research firm, these times are likely to drop even further. Additionally, using teenage respondents the recruiting time was limited to afternoons and weekends due to school attendance.

The remaining three sites took 11 to 17 days to complete the recruiting and administration of the Internet survey, which subtracts for missed time due to Christmas, New Years and Y2K provisions. Two of the three sites only had one computer, and at one site, there was a 1½ week delay for new equipment to be shipped to the site.
Test Cell Timing:
The recruiting process for the test cell posed some difficulties. The Test Cell recruiting process started in mid-January, after the completion of the control cell. The five mall sites were instructed to recruit 60 respondents each, using the demographic criteria outlined in section 3.1.2, compile the information of the respondents in an Excel spreadsheet and email them to the survey manager, the author. The responsiveness of the market research firm dropped dramatically after completion of the control cell of the study. This resulted in significant delays in the recruiting process, which lasted a total of 3 months. In theory, based on the data from the control cell, the recruiting process should have taken approximately a week and a half for each site to complete, considering the sites did not have to administer the survey for the test cell.

In future efforts, the registration of the test cell respondents should be completed in the same manner to reduce transcription errors, and make data readily available to the managers of the study. Ideally the recruiting process of the at-home (test cell) participant would involve registration of the respondent’s data in a manner similar to Figure 4. An email would then be automatically sent to the respondent with the survey website address and password, which is current practice at some internet-savvy market research firms. Lastly, selection of a market research firm is critical and can contribute significantly to the speed of the entire research process.

Cost:
Overall the recruiting costs for the test and control cell did not differ significantly on a per recruit basis. The cost per respondent for the control cell was $31, and the cost per respondent for the test cell was $29.75. However, when considering the significantly lower yield of the test cell for completed survey responses, the resulting cost per complete survey is $91.64. Given the timing differential between the test and control cell, and the demographic differences discussed above, and the higher cost per completed survey, the control cell methodology may be most desirable for this survey methodology.
4.2 Data Analysis

Data from the PostgreSQL database, which collected the data from the survey using CGI scripts, was transferred into a master file in SPSS. SPSS was used to perform the data analysis discussed in the following sections. Future research and development to automate the data collection and transfer into a statistical analysis packages as well the data analysis would help to maximize the speed and efficiency of employing the methodology outlined in this paper. Julio Faura, a Management of Technology student at MIT is designing the architecture to do this as part of his thesis[10].

4.2.1 Straight Comparison

Control Cell:

In the straight comparison, respondents were asked to select which option they preferred for each feature. Return to section 3.3.1 for a review of the straight comparison section of the website. For the control cell, Figure 23 shows the aggregate results for this analysis.

![Aggregate Data: Straight Comparison- Control Cell](image)

Figure 23: Straight Comparison Results- Control Cell
For the straight comparison, all of the high level features were significantly preferred with the exception of Feature 7 (with a standard error of ± 4.5%). It is important to note that the features in this study are such that some respondents will prefer the high level option and some will prefer the low level option, just as some consumers prefer hot tea and some prefer iced tea. The most significantly preferred features were the high levels of Price, Features 2, 4 and 5; all were over 80% preferred. Significance was tested as follows. To derive the standard error, with 95% confidence, the following equations were employed. Where p is the percent of respondents selecting the high level factor, N is the number of respondents.

\[ \sigma = \sqrt{\frac{p(1-p)}{N}} \]

\[ t = 1.95 \times \sigma \]

Test Cell:
For the control cell, the straight comparison results are summarized in Figure 24. The most significantly preferred features were the high levels of Price, Feature 2 and Feature 4; all were over 80% preferred. Due primarily to sample size, the preferences for the high levels of Features 6 and 7 could not be computed as significant, using Equation 1. Comparing Figure 23 and Figure 24, the high level of Feature 5 was not as preferred in the test cell as in the control cell; 71% versus 80% respectively. Furthermore, the high level of Feature 3 was not significantly preferred in the test cell.

15 Feature names are hidden to protect the confidentiality of Polaroid Corporation.
4.2.2 Conjoint Analysis

For a review of the conjoint analysis methodology refer to section 3.3.2. In order to reconcile the crossover design and combine the regressions of both halves of the conjoint design, the utilities for price were set equal from both halves. Then the other significant utilities were normalized against price.

Control Cell:

The regression analysis, using SPSS software, yielded the following significant utility values (at a 95% confidence interval) for the high-level features. Figure 25 shows these relative utilities for the control cell of the study. It is important to note that the utility values are defined relative to the utility for the price change, which is set arbitrarily to 10.0.
As Figure 25 shows, the only high-level features significantly preferred were Price, Features 2, 4 and 5. These results were promising as they corresponded to the most preferred high-level options from the straight comparison. Table 5 shows more detailed results for the control cell regression analysis.

### Aggregate Conjoint Analysis Results - Control Cell

![Bar Chart: Aggregate Conjoint Analysis Results - Control Cell](chart.png)

**Figure 25: Aggregate Conjoint Analysis Results - Control Cell**

<table>
<thead>
<tr>
<th></th>
<th>Price</th>
<th>Feature 2</th>
<th>Feature 3</th>
<th>Feature 4</th>
<th>Feature 5</th>
<th>Feature 6</th>
<th>Feature 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative Utility Value</td>
<td>10.0</td>
<td>13.5</td>
<td>0.0</td>
<td>9.3</td>
<td>7.5</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>R</th>
<th>R square</th>
<th>Adj R</th>
<th>Std. Error of</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Half</td>
<td>0.457</td>
<td>0.209</td>
<td>0.205</td>
<td>61.44</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>R</th>
<th>R square</th>
<th>Adj R</th>
<th>Std. Error of</th>
</tr>
</thead>
<tbody>
<tr>
<td>2nd Half</td>
<td>0.330</td>
<td>0.109</td>
<td>0.104</td>
<td>65.29</td>
</tr>
</tbody>
</table>

### Control Cell Regression

<table>
<thead>
<tr>
<th>Model Summary 1st Half</th>
<th>R</th>
<th>R square</th>
<th>Adj R</th>
<th>Std. Error of</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>0.457</td>
<td>0.209</td>
<td>0.205</td>
<td>61.44</td>
</tr>
<tr>
<td>Residual</td>
<td>0.330</td>
<td>0.109</td>
<td>0.104</td>
<td>65.29</td>
</tr>
</tbody>
</table>

### ANOVA - 1st Half

<table>
<thead>
<tr>
<th>Model</th>
<th>SSQ</th>
<th>df</th>
<th>Mean Sq</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>816568.9</td>
<td>4</td>
<td>204142.20</td>
<td>54.077</td>
<td>0.000</td>
</tr>
<tr>
<td>Residual</td>
<td>3099288.0</td>
<td>821</td>
<td>3775.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>3915857.0</td>
<td>825</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### ANOVA - 2nd Half

<table>
<thead>
<tr>
<th>Model</th>
<th>SSQ</th>
<th>df</th>
<th>Mean Sq</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>437004.7</td>
<td>4</td>
<td>109251.17</td>
<td>25.631</td>
<td>0.000</td>
</tr>
<tr>
<td>Residual</td>
<td>3584798.6</td>
<td>841</td>
<td>4262.54</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>4021803.3</td>
<td>845</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Coefficients - 1st Half

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized</th>
<th>Standardized</th>
<th>B</th>
<th>Std. Error</th>
<th>Beta</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>15.509</td>
<td>5.672</td>
<td>2.734</td>
<td>0.006</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price</td>
<td>22.645</td>
<td>3.043</td>
<td>0.748</td>
<td>0.454</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feature 4</td>
<td>21.151</td>
<td>3.164</td>
<td>0.253</td>
<td>0.632</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feature 2</td>
<td>30.505</td>
<td>6.334</td>
<td>-0.016</td>
<td>-0.479</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feature 3</td>
<td>-0.838</td>
<td>2.776</td>
<td>-0.060</td>
<td>0.014</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Coefficients - 2nd Half

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized</th>
<th>Standardized</th>
<th>B</th>
<th>Std. Error</th>
<th>Beta</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>4.407</td>
<td>5.888</td>
<td>0.748</td>
<td>0.454</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price</td>
<td>21.376</td>
<td>3.298</td>
<td>0.748</td>
<td>0.454</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feature 7</td>
<td>-1.541</td>
<td>3.218</td>
<td>-0.016</td>
<td>-0.479</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feature 5</td>
<td>16.088</td>
<td>6.560</td>
<td>0.102</td>
<td>0.014</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feature 6</td>
<td>4.823</td>
<td>2.906</td>
<td>0.060</td>
<td>0.097</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 5: Regression Analysis - Control Cell**

Test Cell:

Figure 26 compares the aggregate conjoint results for the test and control cell. The only high-level features significantly preferred in the test cell were Price, Features 2, 4 and 7, which corresponds to the top 3 preferred features as detailed in the straight comparison in Figure 24. The test and control cells both have the same top 3 feature preferences, although the magnitude of the utility values for the test cell was greater for Features 2 and 4. Furthermore, the test cell showed a preference for Feature 7, and no preference for Feature 5, which is different than the control cell results. Table 6 shows more detailed results for the test cell regression analysis, which can be compared to Table 5 for the control cell.
Figure 26: Aggregate Conjoint Analysis Results - Test Cell
### Control Cell Regression

#### Model Summary 1st Half

<table>
<thead>
<tr>
<th>R</th>
<th>R square</th>
<th>Adj R</th>
<th>Std. Error of</th>
<th>df</th>
<th>SSQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.455</td>
<td>0.207</td>
<td>0.196</td>
<td>60.27</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Model Summary 2nd Half

<table>
<thead>
<tr>
<th>R</th>
<th>R square</th>
<th>Adj R</th>
<th>Std. Error of</th>
<th>df</th>
<th>SSQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.338</td>
<td>0.114</td>
<td>0.103</td>
<td>63.09</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### ANOVA - 1st Half

<table>
<thead>
<tr>
<th>Model</th>
<th>SSQ</th>
<th>df</th>
<th>Mean Sq</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>274050.2</td>
<td>4</td>
<td>68512.55</td>
<td>18.863</td>
<td>0.000</td>
</tr>
<tr>
<td>Residual</td>
<td>1049700</td>
<td>289</td>
<td>3632.18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1323750</td>
<td>293</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### ANOVA - 2nd Half

<table>
<thead>
<tr>
<th>Model</th>
<th>SSQ</th>
<th>df</th>
<th>Mean Sq</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>154910.5</td>
<td>4</td>
<td>38727.63</td>
<td>9.730</td>
<td>0.000</td>
</tr>
<tr>
<td>Residual</td>
<td>1198041</td>
<td>301</td>
<td>3980.20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1352951</td>
<td>305</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Coefficients - 1st Half

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized</th>
<th>Standardized</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>9.206</td>
<td>9.120</td>
<td>1.009</td>
<td>0.314</td>
</tr>
<tr>
<td>Price</td>
<td>17.648</td>
<td>5.191</td>
<td>0.220</td>
<td>3.400</td>
</tr>
<tr>
<td>Feature 4</td>
<td>25.675</td>
<td>4.992</td>
<td>0.276</td>
<td>5.143</td>
</tr>
<tr>
<td>Feature 2</td>
<td>31.302</td>
<td>10.435</td>
<td>0.205</td>
<td>3.000</td>
</tr>
<tr>
<td>Feature 3</td>
<td>-5.749</td>
<td>4.472</td>
<td>-0.074</td>
<td>-1.286</td>
</tr>
</tbody>
</table>

#### Coefficients - 2nd Half

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized</th>
<th>Standardized</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>-5.479</td>
<td>9.917</td>
<td>-0.552</td>
<td>0.581</td>
</tr>
<tr>
<td>Price</td>
<td>21.760</td>
<td>5.123</td>
<td>0.277</td>
<td>4.248</td>
</tr>
<tr>
<td>Feature 7</td>
<td>14.822</td>
<td>5.426</td>
<td>0.154</td>
<td>2.732</td>
</tr>
<tr>
<td>Feature 5</td>
<td>10.636</td>
<td>11.169</td>
<td>0.068</td>
<td>0.952</td>
</tr>
<tr>
<td>Feature 6</td>
<td>-1.506</td>
<td>4.591</td>
<td>-0.020</td>
<td>-0.328</td>
</tr>
</tbody>
</table>

Table 6: Regression Analysis- Test Cell
Segment Analysis:

Segmentation analysis using the Chow test yielded no significant segments in the study. Therefore only aggregate results are presented in this section. The Chow test is used to evaluate if a “group of segmented regressions can be thought of as a single regression applied to the entire population, but with more variables than the unsegmented regression. The F-test then determines whether the added variables can significantly improve prediction.” The $F$-statistic is computed by:

\[
F = \frac{(SS_g - \sum_{n} SS_n) / K(S - 1)}{\sum_{n} SS_n / (N - SK)}
\]  

(Equation 2)

Where there are $K$ variables in the preference regression, $S$ segments, and $N$ observations. $SS_g$ is the sum of squared residuals for the total group and $SS_n$ is the sum of squared residuals for the $n^{th}$ segment. Table 7 shows the results of the $F$-test for the various segmentation analyses. An $F$-test was run for each half of the cross over conjoint design and showed that no significant segment preferences were found by this method.

<table>
<thead>
<tr>
<th>Segment Analysis</th>
<th>1st Half</th>
<th>2nd Half</th>
<th>F- Critical</th>
</tr>
</thead>
<tbody>
<tr>
<td>By Gender (Male, Female)</td>
<td>0.79</td>
<td>0.28</td>
<td>2.21</td>
</tr>
<tr>
<td>By Age (13-15, 16-18)</td>
<td>0.76</td>
<td>0.71</td>
<td>2.21</td>
</tr>
<tr>
<td>By Age (13-14, 15-16, 17-18)</td>
<td>0.77</td>
<td>0.97</td>
<td>2.21</td>
</tr>
</tbody>
</table>

**Table 7: Chow Test Results- Control Cell**

Due to the unexpected lower sample size of the test cell in this study, segmentation analysis could not be conducted for the test cell.
4.2.3 Drag and Drop

Control Cell:
For the control cell, only 45% of the respondents added any features to the camera in the drag and drop exercise, refer to section 3.3.3 for a review of the drag and drop exercise. This lower than expected participation could be for a few reasons:

1. Since the drag and drop was placed at the end of the survey, tired respondents may have ignored the task.

2. Many of these respondents may not have wanted to spend more than $24.99, given the existing feature set, therefore they chose not to increase the price by adding any high level features.

3. Instructions may not have been clear, although these pre-tested well before the survey website was launched.

In aggregate, the average price of the drag and drop results was $30.11. Of those who added features to the camera, the average price was $35.94. Figure 27 shows the percent that added each high-level feature, for the group of respondents who added at least one feature to the camera in the control cell.
Conjoint Correlation

Comparing the results of the drag and drop in Figure 27 to the results of the conjoint analysis in Figure 25, Features 2 and 4 remain as 2 of the most preferred features. Feature 5, which had been significantly preferred in the conjoint exercise, was less preferred than Feature 7, which had previously not been preferred at all. Again, as this technique is experimental, it is difficult to draw conclusions about why the preferences for the high levels of features 5 and 7 were different between the Straight Comparison and Conjoint Analysis and the Drag and Drop Exercise. A few possible explanations might be:

1. The high level for Feature 5 cost $5, versus $3 for the high level of Feature 7.
2. The icon for Feature 7 was the last icon in the “What You Can Buy” column of the drag and drop exercise and was nearest the price box (Figure 9 shows the drag and drop exercise page). There may have been a natural tendency to select this feature due to the icon location on the page. Future efforts should try to randomize the icon order to eliminate icon position bias. However, the results from the test cell indicate that there might be a real preference for this feature.
Correlation analysis, using logit transformation, showed that on an aggregate level the predicted and actual drag and drop percentages had a correlation of 0.93, which falls just short of the 95% significance level. Further analysis by gender shows a very high correlation of 0.998 between predicted and actual drag and drop percentages for female respondents. The correlation for the male respondents was only 0.75, which may be an indication that the female respondents were more diligent and consistent during the completion of the survey than the male respondents were. Correlation analysis by age showed no significant results. Table 8 summarizes the results of the correlation analysis for the control cell of the study.

**Summary of logit tests**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Conjoint</th>
<th>Predicted</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feature 2 ($2)</td>
<td>1.30</td>
<td>37%</td>
<td>34%</td>
</tr>
<tr>
<td>Feature 4 ($1)</td>
<td>0.92</td>
<td>33%</td>
<td>36%</td>
</tr>
<tr>
<td>Feature 5 ($5)</td>
<td>0.77</td>
<td>35%</td>
<td>24%</td>
</tr>
<tr>
<td>Feature 6 ($2)</td>
<td>0.21</td>
<td>23%</td>
<td>23%</td>
</tr>
<tr>
<td>Feature 3 ($7)</td>
<td>ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feature 7 ($3)</td>
<td>ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price ($10)</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Correlation 0.93
Significance 0.07

<table>
<thead>
<tr>
<th>Feature</th>
<th>Conjoint</th>
<th>Predicted</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feature 2 ($2)</td>
<td>0.87</td>
<td>34%</td>
<td>34%</td>
</tr>
<tr>
<td>Feature 4 ($1)</td>
<td>0.82</td>
<td>35%</td>
<td>36%</td>
</tr>
<tr>
<td>Feature 5 ($5)</td>
<td>0.65</td>
<td>22%</td>
<td>21%</td>
</tr>
<tr>
<td>Feature 6 ($2)</td>
<td>0.15</td>
<td>18%</td>
<td>18%</td>
</tr>
<tr>
<td>Feature 3 ($7)</td>
<td>ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feature 7 ($3)</td>
<td>ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price ($10)</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Correlation 0.998
Significance 0.002
Male Data

<table>
<thead>
<tr>
<th>Feature</th>
<th>Conjoint</th>
<th>Predicted</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feature 2 ($2)</td>
<td>2.06</td>
<td>68%</td>
<td>35%</td>
</tr>
<tr>
<td>Feature 4 ($1)</td>
<td>1.06</td>
<td>42%</td>
<td>37%</td>
</tr>
<tr>
<td>Feature 5 ($5)</td>
<td>0.97</td>
<td>29%</td>
<td>27%</td>
</tr>
<tr>
<td>Feature 6 ($2)</td>
<td>0.29</td>
<td>21%</td>
<td>28%</td>
</tr>
<tr>
<td>Feature 3 ($7)</td>
<td>ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feature 7 ($3)</td>
<td>ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price ($10)</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Correlation: 0.75
Significance: 0.25

Table 8: Drag and Drop Correlation Analysis- Control Cell

Purchase Question:
At the end of the drag and drop exercise, respondents were asked, “If you had to use your
money, would you buy this camera you just created?” Figure 28 shows the results of this
question for the control cell.

Drag & Drop: Purchase Intent- Control Cell

Figure 28: Drag and Drop Purchase Intent Results- Control Cell
Test Cell:

71% of the test cell respondents added at least one feature to the camera in the drag and drop exercise, compared to 45% of the control cell respondents. Possible reasons for the difference between the test and control cells are as follows:

- Less time pressure at home than at the mall
- Higher concentration on task, due to time pressure and/or at-home comfort
- Self-selection toward interested respondents.

In aggregate, the average price of the drag and drop results was $30.81 compared to $30.11 for the control cell. Of those who added features to the camera, the average price was $32.90 compared to $35.94 for the control cell.

In future drag and drop research efforts, it would be interesting to evaluate the differences in responses between a purchase intent question asked before the drag and drop exercise and one asked after the drag and drop exercise. This would indicate whether respondents are more likely to purchase a self-designed camera.

Figure 29 shows a comparison of the results of the drag and drop exercise for both the test and control cell. The top 3 features selected were consistent between the test and control cell; Features 2, 4 and 7.
Purchase Question:
The results of the purchase intent question for the test cell, in aggregate, are summarized in Figure 30 and compared to the control cell. Gender comparisons were not evaluated due to the lower sample size in the test cell. The respondents in the test cell were more likely to select “probably” than the control cell.
Drag & Drop Purchase Intent Comparison

Figure 30: Purchase Intent Comparison

4.2.4 Miscellaneous Questions

At the end of the survey, the following key questions were asked in order to get an indication about how the respondents perceived the survey:

- How much did you enjoy taking this survey?
- How do you feel about the amount of time that it took to answer the survey?

Control Cell:

Figure 31 shows the responses to these questions in aggregate and by gender for the control cell. In aggregate, the majority of respondents had neutral to very positive responses to both of these questions. There were some gender differences in responses about the amount of time it took to answer the survey. Female respondents were more likely to indicate that they thought the survey was “long” (33%), versus the male respondents (17%). This may be because female respondents were more likely to pay attention throughout the survey. This inference is supported by the correlation analysis from the drag and drop exercise discussed in section 4.2.3. Future research
may be needed to further investigate this hypothesis about the differences between male and female respondents.

Figure 31: Miscellaneous Question Responses- Control Cell
Overall, the feedback from these miscellaneous questions was encouraging and indicative that we had reached our goal of making a survey that was enjoyable, while allowing us the time to collect enough data for thorough analysis. Originally it was anticipated that the 15-20 minute survey duration would have resulted in the majority of respondents indicating they thought the survey was “long” or “too long”. It is the opinion of the author that the design and execution of the survey, to make the website more interactive and visually appealing, contributed to the positive responses about the enjoyability of the survey. The level to which the respondents enjoyed the survey could have contributed to their perception about the amount of time it took to answer the survey. A correlation analysis for the responses of these two questions (enjoy the survey and time to take the survey) yielded a correlation of 0.400, significant at the 0.01 level.

Test Cell:
Previously cached images and animation files would speed up the survey download time considerably, therefore, the original hypothesis was that the test cell respondents would report that they felt the survey was longer than the control cell respondents, who were using computers at the mall facility, which already had the cached files due to previous use. Nonetheless more of the test cell respondents said they thought the survey was “Really Fun” or “Kind of Fun” and they were more likely to say the survey length was “Perfect.” Figure 32 shows the comparison results for the test and control cells in aggregate.
Figure 32: Miscellaneous Question Responses- Comparison
A correlation analysis for the responses of these two questions (enjoy the survey and time to take the survey) was similar to the control cell and yielded a correlation of 0.393 versus 0.400, both significant at the 0.01 level.

Lastly, 52% of the control cell answered the open-ended question “What would you recommend of we were to do this survey with other Teenagers you age?” compared to 60% of the test cell. Anecdotally, the responses from the test cell were longer, more complete sentences, with suggestions such as:

- “Great, I think it is a good way to get the teenagers opinion on your new products. I would love to do any more surveys you may have!”
- “Speed up the time between questions...we like instant stuff...not waiting too long.”
- “I would recommend having messages on the pictures when they are developed for every type of occasion. Ex. "Happy Birthday", "Merry Christmas", "Happy New Year", and have the month, day and year printed on them”

Whereas the responses of the control cell had a large number of one or two word responses such as, “Nothing”, “Good”, “Less Questions” and “Yes.” This finding supports the suggestion that less time pressure and anonymity allows the respondent to provide more thoughtful and lengthy answers.
5 Conclusions

5.1 Survey Technique

Overall, the methodology described in this paper proved to be a very powerful tool for the feature selection process of the product development process. Leveraging the capabilities of the Internet to incorporate styled web design, interactive activities and usability considerations into the development of an Internet-based, market research effort can reduce respondent fatigue and provide the respondent with a more enjoyable experience. Furthermore, the test cell and control cell methodology yielded the same top 3 feature preferences (not necessarily in order) for each of three data collection methods; straight comparison, conjoint analysis and drag and drop. Therefore, if the aim of the research is to select the top 1-3 features in a product development effort, either recruiting methodology would suffice, although yield and cost considerations might suggest that the control methodology is currently the most effective.

Recruiting and Demographics:

The data analysis between the test and control cells in this study highlights potential concerns with recruiting methodologies for at-home teenage respondents. One possible recommendation for future research efforts with teenage respondents is to use the control cell methodology (mall site survey) if a balanced gender sample is critical. This study showed that using the test cell methodology, the demographics of the recruited population could be tightly controlled; however, the demographics of respondents who choose to answer the survey at home cannot be controlled. Mall recruit, with on-site survey completion, allows market researchers to control the demographics of respondents who answer the survey. However, another recommendation would be to dramatically improve the “at home” recruiting and respondent management using the test cell methodology. Hiring a more capable, Internet-savvy market research firm is one way to begin to address this issue.

The author does not mean to suggest we should not continue to strive for at-home Internet survey participation. At-home surveys have many advantages, such as respondent convenience, attention, and anonymity, which might contribute to better data on a per respondents basis. Additionally, as Figure 18 (Picture Taking Interest Comparison) and Figure 30 (Purchase intent...
comparison) indicate, the self-selection inherent in the test cell methodology may actually be a more effective way to access and obtain data from those respondents who are more interested in the product and more willing to purchase the product. Furthermore, the respondents taking the survey at home indicated that they were less likely to perceive the survey as "Long" or "Too Long" and more likely to find the length "Perfect." This may indicate that respondent fatigue is less likely in at-home conditions where the respondent can answer the survey when it is most convenient for them.

If the goal is to balance response demographics, particularly gender, the following actions may help:

- Over recruit for lower yield demographics.
- Increase incentive amount, or providing incentive at the time of recruiting to give a sense of obligation to the respondent to complete the survey.
- Reduce time lag between recruiting and invitation to website via email, via automatic email to respondent at time of recruiting, as discussed in section 4.1.3.
- Hire more responsive market research firm.
- Prior recruiting of a balanced panel, with higher incentives, to participate in multiple surveys over a pre-determined amount of time. This is the direction the industry seems to be going, e.g. BASES panels, on-line Harris Polls.

The number of households with Internet access is expected to rise dramatically. Forrester Research estimates that 63% of US household will have Internet access 2003 [4]. Moreover, according to NUA Internet surveys, a new report from the National Center for Education Statistics in the US shows that currently 95 percent of US schools have access to the Internet. This may indicate that in the near future, almost all kids and teens will have access to the Internet somewhere, such as home, school, library or friends house.16 As mainstream American demographics move to the web, at home Internet survey participation will also become a more mainstream market research activity. In the meantime, two approaches can be taken for recruiting teenaged Internet respondents:

16 Source: http://www.nua.ie/surveys/analysis/weekly_editorial/archives/issue1no114.html
1. If demographic representation is an essential element of the research, then great care should be taken to recruit a demographically representative panel for at home surveys, and over recruit enough respondents in the lower yield demographics, such as male respondents in this research.

2. For product development research, a randomly recruited Internet panel can be viewed as “lead users” whom are more likely to be early adopters of technology, trends and products.

Survey Length:

Although the majority of respondents showed that they felt the survey length was “Perfect” to “Too short”, see section 4.2.4, in response to the open-ended question “What would you recommend of we were to do this survey with other Teenagers you age?” many respondents suggested that we shorten the survey. Following are representative responses about the survey length for both cells of the test:

“Speed up the time between questions...we like instant stuff...not waiting too long.”

“Shorten it. It gets a little repetitive.”

“Make it shorter, not as many questions.”

“This survey should be much shorter.”

“Less questions.”

“Faster download speed. Less Questions”

The results of this research suggest that future Internet survey efforts might be able to reduce the question burden on the respondent as the drag and drop technique becomes more refined. If researchers can understand the reasons why some respondents, specifically the male respondents in this research, were less consistent in their responses between the conjoint analysis and drag and drop responses, future research efforts may be able to solely use the drag and drop exercise to extract customer feature preferences. It is important to note that there is no evidence to suggest that the male responses from the conjoint analysis are more or less valid than the male responses for the drag and drop. Olivier Toubia, a graduate student at MIT, is working with math programming to shorten the questioning methods; Toubia will graduate in 2001.
5.2 Affect on Product Development and Polaroid

Using the Internet as a means to employ market research can provide product development teams with timely cost effective quantitative data to improve the feature selection process. Furthermore, employing the method outlined in this paper can improve team relationships by eliminating the results of the “not invented here” syndrome. At Polaroid, the development team was split in their opinions about one particular feature option. A lot of time was being spent debating during team meetings on whether this feature should be included in the product. The data from this study helped to show the team that the teenagers clearly preferred the feature option, and the debate stopped, allowing the development team to move on to more productive development efforts to prepare this new product for market. The methodology discussed in this paper helped to provide Polaroid with design direction and/or guidance on 4 key design features.

5.3 Future DOME Integration

The methodology described in this paper can ultimately become an integrated tool within the DOME environment, described in section 2.2.2. The vision for the integration is that the development team itself could set up the Internet survey through answering a few simple questions about desired survey format, the number of features, the number of feature levels and the maximum number of questions they wanted the respondent to answer. After providing some simple animation files and wording for the feature descriptions and product descriptions, the survey would be generated and ready for distribution (Faura, 2000).

As the survey is in the field, a module within DOME could automatically perform the statistical analysis of the data in real time and link the results of this analysis with engineering models, cost models, market share simulations and manufacturing models. The survey module would probably be encompassed within the larger “Customer” module shown in Figure 3, which might also have additional customer preference modules. This would allow authorized members of the product development team to look at survey results such as aggregate analysis, segmentation analysis and correlation analysis. However, further research is needed to develop the survey generation software as well as the automation of the data analysis before this vision can become a reality.
6 References


Appendix 1: Project Collaboration and Review

Participants & Consultants

A1.1 Usability
- Polaroid Human Factors Manager
- Web Designers
- Polaroid Instructions/Text/and Graphics Designers

A1.2 Technical
- Polaroid Image Quality Experts
- Polaroid Product Industrial Designers and Design Engineers
- Center for Innovation in Product Development at MIT

A1.3 Market Research Experts
- Sloan School Marketing Department
- Applied Marketing Sciences
- DMS (Digital Marketing Services), The Delphi Group: Online experience
- Polaroid Market Research

A1.4 Teen Marketing Experts/Teen Segment
- Polaroid Marketing- Gen-I Group (Kids and Teens)

A1.5 Legal
- Polaroid Legal
- Committee On Use of Humans as Experimental Subjects (COUHES) at MIT
Appendix 2: Analysis of Recruiting Options

Figure 33: Estimated Cost Per Recruit for Test Cell

TEST CELL RECRUITING OPTIONS: DETAILS & ASSUMPTIONS

1. **Website Banners**- Place advertising banner on targeted kids websites. Banner directs kids to registration site for study.
   - $10000 guarantees 250,000 people see add.
   - A 2% click through estimate, which might be higher if banner calls out an incentive, yields 5000 visiting registration site.
   - Further rate of registration at an estimate of 2%, again this could easily be higher, yields 100 kids registering for on-line study.
   - Total cost per recruit of approximately $100.
   - No face or voice contact, to ensure the respondent is who they say they are. Therefore, purity of sample is difficult to prove.
   - No easy way to prove parental consent.
   - Not a statistically random sample.
   - May not be able to ask for certain demographic data on-line.


- Requires a different approach for recruiting the respondents from the control population, which adds a new variable into the study.

2. **Targeted Email Campaign**- Send email messages inviting kids to registration website.
   - More effective than website banner.
   - $10000 guarantees 20,000 click-throughs to the registration site.
   - An estimated 2% rate of registration yields 400 kids registering for on-line study.
   - **Total cost per recruit of approximately $25.**
   - No face or voice contact, to ensure the respondent is who they say they are. Therefore, purity of sample is difficult to prove.
   - No easy way to prove parental consent.
   - Not a statistically random sample.
   - May not be able to ask for certain demographic data on-line.
   - Requires a different approach for recruiting the respondents from the control population, which adds a new variable into the study.

3. **Random Direct Dialing**- Hire telemarketing firm to randomly dial phone numbers.
   - **Total cost per recruit range of $30-$75.**
   - This approach guarantees a random sample, but it is a far more expensive cost per recruit than a targeted telephone campaign (see option 5).
   - Provides voice contact and an opportunity to obtain verbal parental approval.
   - Can obtain demographic data over the phone.
   - Can also recruit control sample.

4. **Targeted Mailing List**- Send postcards inviting targeted kids to registration website.
   - Lowest cost option by far, but more time and resource consuming to send postcard and wait for responses.
   - No face or voice contact, to ensure the respondent is who they say they are. Therefore, purity of sample is difficult to prove.
   - Self-selecting approach may not yield a statistically pure sample.
   - No easy way to prove parental consent.
   - $300 per 1000 names, plus postage, with an approximate yield of 3-10%.
   - **Total cost per recruit of approximately $10.**
   - May not be able to ask for demographic data on-line.
   - Can also recruit control sample with this methodology.

5. **Database List & Direct Dialing**- Buy targeted database list (such as Survey Sampling LITe database, Targeted Listed or Specific Age sample) then use phone center to dial numbers on database list directly.
   - LITe records are self-reported household with teenagers and Internet access.
   - Self-reported databases such as LITe, not a projectable sample
   - Can use PRIZM codes for Targeted Listed database, which would provide a more projectable sample.
   - **Total cost per recruit of approximately $38.**
   - Provides voice contact and an opportunity to obtain parental approval.
6. **Omnibus Study & Direct Dialing** - Buy questions on telephone omnibus study to get database, then use phone center to dial numbers on database list directly.
   - Longer process (3-4 weeks) than using available databases.
   - Guarantees random and projectable database.
   - Can obtain demographic data through omnibus study and receive it on a disk.
   - 3 waves of interviews per week, 1000 interviews per wave.
   - $720 per wave.
   - Needs follow-up phone calls for survey recruiting at cost per interview of ~ $10 per call.
   - Total cost per recruit of approximately $38.
   - Follow-up calls provide voice contact and an opportunity to obtain parental approval.
   - Can also recruit control sample with this methodology.

7. **In-Person Invites** - Recruit kids to focus groups and invite them to participate in on-line study.
   - Most expensive approach, $2000-4000 per invite group.
   - Total cost per recruit of approximately $200.
   - Incentives would need to be higher to ask respondent to come to facility with a parent.
   - Provides face and voice contact and an opportunity to obtain parental approval.
   - Best way to establish a relationship and obtain commitment.
   - Can obtain demographic data over the phone during the invite group recruiting.
   - Can also recruit control sample with this methodology.

8. **Mall Recruiting** - Recruit kids at a mall, and invite them to participate in the test or control study at nearby facility.
   - If you use test group in a mall facility, you can’t learn about at home survey responses.
     However, the test panel could be recruited and then asked to answer the survey at home.
   - Total cost per recruit of approximately $32.
   - Don’t need to over recruit for control sample.
   - Sample bias can be significant.
   - Incentive pay can be less by about 1/3 of pre-recruit.
   - Can recruit kids with their parents or call their parents to obtain parental approval.
   - Good way to establish a relationship and obtain commitment.
   - Can obtain demographic data easily with parental permission.
   - Can also recruit control sample with this methodology.
Appendix 3: Test Cell Contact Email

FIRST EMAIL INVITATION:
To: respondent@isp.com
From: Study Manager feedback@mit-sloan.org
Subject: The survey you requested... time to get your gift certificate!

Hi First Name,

Are you ready to get your gift certificate to Sam Goody/Musicland, Blockbuster or Loews Cinema? Do you remember being recruited a while ago to take a survey about photography products? Are you ready to take the survey? Well... It's time to start! I just wanted to thank you again and remind you that your help is very appreciated and important to us.

So you might be wondering... "So now what do I do!?"

Follow these steps:
1. Go to the web site at http://hoover.mit.edu/feedback
2. Enter the following information on the Log-on
   Your Logon ID is 186745
   Your Password is (First Name)
3. If you are under 18 please have a parent with you at the beginning of the survey to read a short agreement letter after you log-on.
4. The survey should take about 15 minutes to finish.
5. At the end of the survey you will get to pick one of 3 gift certificates, which will be mailed to your home.

(You will need to have Java Script enabled on your browser for the survey to work properly)

Keep this email so you can email me with any questions or problems you might run into. Also, please let your parent or guardian know that they can contact me at any time with their own questions or concerns.

Have fun!

Meghan
Survey Manager

The Massachusetts Institute of Technology, the National Science Foundation and Polaroid Corporation are the sponsors of this study.
Appendix 4: Test Cell Recruiting Screeners

ON-LINE COMPUTER SURVEY SCREENER
(MALL RECRUIT- At Home respondents)

Approach respondents ages 13-18 year olds, if possible in the presence of their parents.

Hello, my name is ________________, and I am from Cunningham Field Service.

We are working with the Massachusetts Institute of Technology, the National Science Foundation and Polaroid to identify teenagers ages 13-18 to participate in a quick 15-minute online survey at home. If you qualify for the survey, you will receive a $5 gift certificate for your time.

1. Ask the questions and insert in spaces below:

<table>
<thead>
<tr>
<th>GENDER?</th>
<th>Exact Age (13-18 yrs)</th>
<th>ETHNIC GROUP Check one</th>
</tr>
</thead>
</table>
| M / F   |                      | 1=Caucasian
          |                      | 2=AfroAmerican
          |                      | 3=Asian
          |                      | 4=Hispanic
          |                      | 5=Other

2. Do you or does any one in your family or close friends or relatives work for:

Advertising agency or advertising department ______ No ______ Yes (TERMINATE)
Marketing Research company or department ______ No ______ Yes (TERMINATE)
Manufacturer of cameras or video cameras ______ No ______ Yes (TERMINATE)

3. Have you taken a picture with a disposable, 35 mm or instant camera in the past year?
   ______ 1 NO (TERMINATE + TALLY)
   ______ 2 YES (CONTINUE)

4. Does your family have a computer at home, which has access to the Internet?
   ______ 1 NO (TERMINATE + TALLY)
   ______ 2 YES (CONTINUE)

5. How many times have you taken pictures in the past year?

   Check One
   ______ 5 9 or more times
   ______ 4 5-8 times
   ______ 3 2-4 times
   ______ 2 1 time (TERMINATE + TALLY)
   ______ 1 Never took a picture in the past year (TERMINATE + TALLY)
I would like to invite you to participate in this survey about photography products. Would you be interested in participating?

____ NO (TERMINATE + TALLY)
_____ YES (CONTINUE)

6. At this time, I need to get permission from your parent or guardian for you to participate in the study. Is your parent or guardian here with you at the mall?

____ NO (phone parent (____) or send home permission slip)
_____ YES (get parent’s signature ➔ sign attached form)

6. Parent permission (phone call)

Hello, my name is ________________, and I am calling from Cunningham Field Service, a product testing company. May I please speak with the legal guardian of:

______________________________

_____ 1 NO (TERMINATE + TALLY)
_____ 2 YES (CONTINUE)

We are working with MIT, the National Science Foundation and Polaroid to identify teenagers, ages 13-18, who would be willing to answer a quick 15 minute online survey, at home, about photography products. ________________(insert child’s name) has expressed an interest in participating in the survey but we wanted to speak with you first.

We are NOT selling anything and are not tele-marketers. Your teenager will receive a $5 gift certificate for their time.

As a parent, we would ask you sit with your child at the start of this on-line survey. If you provide permission for your child to participate in the study, we will ask that you both read a privacy agreement at the beginning of the survey, which will explain and guarantee that your privacy will be protected.

1. Would you give your permission for ________________ (insert name of 13-18 year old child) to participate in this online survey.

_____ 1 NO (TERMINATE + TALLY)
_____ 2 YES (CONTINUE)

2. For classification purposes only, which category contains your combined family (including spouse/partner) income? This will be kept confidential. Is it....

Read the first 4 categories, Mark #5 of they refuse to answer

_____ 1 Less than $25,000
2 between $25,000 and $50,000
3 between $50,001 and $75,000
4 Over $75,000
(5 Did not disclose)
**No terminations for no response**

3. In about 1 week, you and your child will receive an email from MIT with the web address, log-on ID and password to the survey. In order to do this we will need an email address where they can send this information. Please be assured that your email address will be kept confidential and will not be used for any purposes other than directing you to the survey website.

   Insert Email Address: ____________________________

Finally, I need to record the following so we can mail your child their $5 gift certificate after completing the survey. This information will also be kept confidential and will be used only to mail your child their gift certificate:

   Teenager's Full Name: ________________________________
   Parent's Full Name: _________________________________
   Mailing Address: __________________________________
   City_________________________State_________________Zip__________
   Home Telephone (________)__________________________
   Confirm E-Mail Address (Q# 3): ________________________________

***THANK YOU FOR YOUR TIME***
Hello, my name is ___________________, and I am with Cunningham Field Service, a product testing company located at __________________________. You may call us at __________________ with any questions or concerns you may have about this request.

We are working with the Massachusetts Institute of Technology, the National Science Foundation and Polaroid to identify teenagers, ages 13-18, who would be willing to answer a quick 15-minute on-line survey, at home, about photography products. We are NOT selling anything and are not tele-marketers.

Your child will receive a $5 gift certificate for their time.

Your child, ________________, has expressed an interest in participating in this survey. As a parent, we would ask you sit with your child at the start of this on-line survey. If you provide permission for your child to participate in the study, we will ask that you both read a privacy agreement at the beginning of the survey, which will explain and guarantee that your privacy will be protected.

1. Would you give your permission for ________________ to participate in this on-line survey? Check one:
   
   _____ YES
   _____ NO

2. For classification purposes only, which category contains your combined family (including spouse/partner) income? This will be kept CONFIDENTIAL. Check one:

   _____ 1 Less than $25,000
   _____ 2 between $25,000 and $50,000
   _____ 3 between $50,001 and $75,000
   _____ 4 Over $75,000
3. In about 1 week, you and your child will receive an email from MIT with the web address, log-on ID and password to the survey. In order to do this we will need an email address where they can send this information. Please be assured that your email address will be kept confidential and will not be used for any purposes other than this survey.

Your Email Address: ________________________________

Finally, please provide the following information so we can mail your child their $5 gift certificate for completing the survey. This information will also be kept confidential and will be used only to mail your child the gift certificate:

Child’s Full Name: ______________________________________

Parent’s Full Name: ______________________________________

Mailing Address: ______________________________________

City__________________________ State ___________ Zip __________

Home Telephone ( ) _____________

Re-enter e-mail Address: ________________________________

***THANK YOU FOR YOUR TIME***

Best Regards,

_____________________________

CFS Representative
Appendix 5: Excerpts of Drag and Drop Source Code

Written by Limor Weisberg, with contributions from Bryant K. Lin and Ori Weisberg

Part One: The Java script code, which provides the guidelines for the browser on how to handle the layers.

```javascript
function MM_dragLayer(objNS, objIE, swaplayer1NS, swaplayer1IE, swaplayer2NS, swaplayer2IE, hL, hT, hW, hH, toFront, dropBack, cU, cD, cL, cR, targL, targT, targLn, targTn, tol, dropJS, etdragJS)
//v2.0
//Copyright 1998 Macromedia, Inc. All rights reserved.
var i, j, aLayer, retVal, curDrag=null, NS=(navigator.appName=='Netscape'), curLeft, curTop;
if (!document.all && !document.layers) return false;
retVal = true; if(!NS && event) event.returnValue = true;
if (MM_dragLayer.arguments.length > 1) {
curDrag = eval((NS)?objNS:objIE); if (!curDrag) return false;
curSwapLayer1 = eval((NS)?swaplayer1NS:swaplayer1IE);
curSwapLayer2 = eval((NS)?swaplayer2NS:swaplayer2IE);
if (!document.allLayers) {
document.allLayers = new Array();
with (document) {
  if (NS) {
    for (i=0; i<layers.length; i++) allLayers[i]=layers[i];
    for (i=0; i<allLayers.length; i++) {
      if (allLayers[i].document && allLayers[i].document.layers)
        for (j=0; j<allLayers[i].document.layers.length; j++)
          allLayers[allLayers.length] = allLayers[i].document.layers[j];
  } else {
    for (i=0; i<all.length; i++)
      if (all[i].style != null && all[i].style.position)
        allLayers[allLayers.length] = all[i];
  }
}
curDrag.MM_dragOk=true; curDrag.MM_targetL=targL; curDrag.MM_targetT=targT;
curDrag.MM_targetLn=targetLn; curDrag.MM_targetTn=targetTn;
curDrag.MM_tL=Math.pow(tol,2); curDrag.MM_tLh=tL; curDrag.MM_tLhT=tLhT;
curDrag.MM_hWidth-hW; curDrag.MM_hHeight-hH; curDrag.MM_toFront=toFront;
curDrag.MM_dropBack=dropBack; curDrag.MM_dropJS=dropJS;
curDrag.MM_everyTime=et; curDrag.MM_dragJS=dragJS;
curDrag.MM_oldZ = (NS)?curDrag.zIndex:curDrag.style.zIndex;
curLeft= (NS)?curDrag.left:curDrag.style.pixelLeft; curDrag.MM_startL = curLeft;
curTop = (NS)?curDrag.top:curDrag.style.pixelTop; curDrag.MM_startT = curTop;
curDrag.MM_bL=(cL<=0)?null:curLeft-cL; curDrag.MM_bT=(cU<=0)?null:curTop-cU;
curDrag.MM_bB=(cD<=0)?null:curTop+cD; curDrag.MM_bR=(cR<=0)?null:curLeft+cR;
curDrag.MM_LEFTRIGHT=0; curDrag.MM_UPDOWN=0; curDrag.MM_SNAPPED=false; //use in your JS!
curDrag.MM_SNAPPEDn=false;
// Ori, local var
curDrag.MM_curSwapLayer1 = curSwapLayer1;
curDrag.MM_curSwapLayer2 = curSwapLayer2;
document.onmousedown = MM_dragLayer; document.onmouseup = MM_dragLayer;
} else {
  var theEvent = ((NS)?objNS.type:event.type);
  if (theEvent == 'mousedown') {
    var aLayer, maxDragZ=null;
```
}
var mouseX = (NS)?objNS.pageX : event.clientX + document.body.scrollLeft;
var mouseY = (NS)?objNS.pageY : event.clientY + document.body.scrollTop;
document.MM_maxZ = 0;
for (i=0; i<document.allLayers.length; i++) {
    aLayer = document.allLayers[i];
    var aLayerZ = (NS)?aLayer.zIndex:aLayer.style.zIndex;
    if (aLayerZ > document.MM_maxZ) document.MM_maxZ = aLayerZ;
    var isVisible = ((NS)?aLayer.visibility:aLayer.style.visibility).indexOf('hid') == -1;
    if (aLayer.MM_dragOk !== null && isVisible) with (aLayer) {
        var parentL=0; var parentT=0;
        if (!NS) {
            parentLayer = aLayer.parentElement;
            while (parentLayer !== null && parentLayer.style.position) {
                parentL += parentLayer.offsetLeft;
                parentT += parentLayer.offsetTop;
                parentLayer = parentLayer.parentElement;
            }
        }
        var tmpX = mouseX-(((NS)?pageX:style.pixelLeft+parentL)+MM_hLeft);
        var tmpY = mouseY-(((NS)?pageY:style.pixelTop+parentT)+MM_hTop);
        var tmpW = MM_hWidth; if (tmpW <= 0) tmpW += ((NS)?clip.width:offsetWidth);
        var tmpH = MM_hHeight; if (tmpH <= 0) tmpH += ((NS)?clip.height:offsetHeight);
        if (0 <= tmpX && tmpX < tmpW && 0 <= tmpY && tmpY < tmpH) {
            curDrag = aLayer; maxDragZ = aLayerZ;
        }
    }
}
if (curDrag) {
    document.onmousemove = MM_dragLayer;
    if (NS) document.captureEvents(Event.MOUSEMOVE);
    curTop = (NS)?curDrag.top:curDrag.style.pixelTop;
    MM_oldX = mouseX - curLeft; MM_oldY = mouseY - curTop;
    document.MM_curDrag = curDrag; curDrag.MM_SNAPPED=false;
    curDrag.MM_SNAPPEDn=false;
    if (curDrag.MM_toFront) {
        eval('curDrag.'+((NS)?'':'style.')+'zIndex=document.MM_maxZ+1');
        if (!curDrag.MM_dropBack) document.MM_maxZ++;
    } else if (theEvent == 'mousemove') {
        if (document.MM_curDrag) with (document.MM_curDrag) {
            var newLeft = Math.max(newLeft,MM_oldX);
            var newTop = Math.min(newTop,MM_oldY);
            if (MM_bL!==null) newLeft = Math.max(newLeft,MM_bL);
            if (MM_bR!==null) newLeft = Math.min(newLeft,MM_bR);
            if (MM_bT!==null) newTop = Math.max(newTop,MM_bT);
            if (MM_bB!==null) newTop = Math.min(newTop,MM_bB);
            MM_LEFTRIGHT = newLeft-MM_startL; MM_UPDOWN = newTop-MM_startT;
            if (NS) {
                (left = newLeft; top = newTop);
            } else (style.pixelLeft = newLeft; style.pixelTop = newTop);
        } else if (theEvent == 'mousemove') {
            document.onmousemove = null;
        }
    } else if (theEvent == 'mousemove') {
        if (MM_dragJS) eval(MM_dragJS);
    }
}
else if (theEvent == 'mouseup') {
    document.onmouseup = null;
    if (NS) document.releaseEvents(Event.MOUSEMOVE);
    if (NS) document.captureEvents(Event.MOUSEDOWN); //for mac NS
}
else if (theEvent == 'mousemove') {
    if (NS) document.captureEvents(Event.MOUSEMOVE);
}
else if (theEvent == 'mouseup') {
    if (NS) document.releaseEvents(Event.MOUSEDOWN); //for mac NS
}
else if (theEvent == 'mouseup') {
    if (NS) document.captureEvents(Event.MOUSEDOWN); //for mac NS
}
Math.pow(MMtargTn-((NS)?top:style.pixelTop),2))<=MM tol)
if (NS) {left = MM_targLn; top = MM_targTn;
else {style.pixelLeft = MM_targLn; style.pixelTop = MM_targTn;
MM_SNAPPEDn = true; MM_LEFTRIGHT = MM_startL-MM_targLn;
MM_UPDOWN = MM_startT-MM_targTn;
// Ori, check if snapped to old position
} else if (typeof MM_targL =='number' & typeof MM_targT == 'number' &
(Math.pow(MMtargL-((NS)?left:style.pixelLeft),2)+
Math.pow(MMtargT-((NS)?top:style.pixelTop),2))<=MM tol) |
if (NS) {left = MM_targL; top = MM_targT;}
else {style.pixelLeft = MM_targL; style.pixelTop = MM_targT;}
MM_SNAPPED = true; MM_LEFTRIGHT = MM_startL-MM_targL;
MM_UPDOWN = MM_startT-MM_targT;
if (MM_SNAPPED || MM_SNAPPEDn) eval(MM_dropJS);
if (MM everyTime & MM_SNAPPEDn) eval(MM dragJS);
if (MM everyTime & MM_SNAPPED) MM_swapImgRestore();
if (MM_dropBack) {if (NS) zIndex = MM_oldZ; else style.zIndex = MM_oldZ;}
returnVal = false; if (!NS) event.returnValue = false;
// Ori, if snapped to new position
if (document.MM curDrag & document.MM_curDrag.MM_SNAPPEDn) {
if (NS) {
  document.MM curDrag.MM_curSwapLayer1.visibility="hide";
  document.MM_curDrag.MM_curSwapLayer2.visibility="show";
} else {
  document.MM_curDrag.MM_curSwapLayer1.style.visibility="hidden";
  document.MM_curDrag.MM_curSwapLayer2.style.visibility="visible";
}
// Ori, if snapped to old position
if (document.MM curDrag & document.MM_curDrag.MM_SNAPPED) {
if (NS) {
  document.MM curDrag.MM_curSwapLayer2.visibility="hide";
  document.MM_curDrag.MM_curSwapLayer1.visibility="show";
} else {
  document.MM_curDrag.MM_curSwapLayer2.style.visibility="hidden";
  document.MM_curDrag.MM_curSwapLayer1.style.visibility="visible";
}
}
document.MM_curDrag = null;
if (NS) document.routeEvent(objNS);
return retVal;
// Code based on Bryant Y Lin's code.
function getPos(nestedLayer){
  var layerRef =
  ((navigator.appName=='Netscape')?document.layers[nestedLayer]:document.all[nestedLayer]);
  var curSnapped = layerRef.MM_SNAPPED;
  var curSnappedn = layerRef.MM_SNAPPEDn;
  var price = parseFloat(document.tracking.hiddenPrice.value)*100.0;
  var componentaddedfield = "hidden"+nestedLayer;
  var componentadded =
  parseInt(document.tracking.elements[componentaddedfield].value, 10);
  var componentpricefield = "hidden"+nestedLayer+"Price";
  var componentprice =
  parseFloat(document.tracking.elements[componentpricefield].value)*100.0;
  var NS=(navigator.appName=='Netscape');
  if (curSnappedn)
if (!componentadded) {
    price = price + componentprice;
    componentadded = 1;
} else if (curSnapped) {
    if (componentadded) {
        price = price - componentprice;
        componentadded = 0;
    }
}
document.tracking.elements[componentaddedfield].value = componentadded;
document.tracking.hiddenPrice.value = price/100.0;
document.tracking.curPriceField.value = price/100.0;

//-->
function MM_preloadImages() { //v2.0
    if (document.images) {
        var imgFiles = MM_preloadImages.arguments;
        if (document.preloadArray==null) document.preloadArray = new Array();
        var i = document.preloadArray.length;
        with (document) for (var j=0; j<imgFiles.length; j++) if (imgFiles[j].charAt(0)=="#"){
            preloadArray[i] = new Image;
            preloadArray[i++].src = imgFiles[j];
        }
    }
}
function MM_swapImgRestore() { //v2.0
    if (document.MM_swapImgData != null)
        for (var i=0; i<(document.MM_swapImgData.length-1); i+=2)
            document.MM_swapImgData[i].src = document.MM_swapImgData[i+1].src;
}
function MM_swapImage() { //v2.0
    var i,j=0, objStr, obj, swapArray=new Array, oldArray=document.MM_swapImgData;
    for (i=0; i < (MM_swapImage.arguments.length-2); i+=3) {
        objStr = MM_swapImage.arguments[(navigator.appName == 'Netscape')?i:i+1];
        if (objStr.indexOf('document.layers[')==0 && document.layers==null) ||
            objStr.indexOf('document.all[') ==0 && document.all ==null))
            objStr = 'document'+objStr.substring(objStr.lastIndexOf('.'),objStr.length);
        obj = eval(objStr);
        if (obj != null) {
            swapArray[i++] = obj;
            swapArray[i++] = (oldArray==null || oldArray[j-1]!=obj)?obj.src:oldArray[j];
            obj.src = MM_swapImage.arguments[i+2];
        }
    }
    if (swapArray[0].src != swapArray[1])
        document.MM_swapImgData = swapArray; //used for restore
    //-->
    </script>

Part Two: Examples of the HTML code to define some of the layers (the position in the page, the name, visibility when the page is loaded etc.)

<div id="covers" style="position:absolute; width:43px; height:25px; z-index:5; left: 380px; top: 218px; visibility: visible"><img src="/images/coverl-icon1-drag.gif" width="43" height="25" vspace="0" hspace="0" border="0"></div>

<div id="pictquality" style="position:absolute; width:43px; height:25px; z-index:1; left: 380px; top: 163px; visibility: visible"><img src="/images/pictquality-icon1-drag.gif" width="43" height="25" vspace="0" hspace="0" border="0"></div>
Appendix 6: Website Flow Diagram

Control Cell

1a. Mall Registration
8. Locker
9. Cell Phone
10. Frame
11. Notebook

13. Feature #1
14. Feature #2
15. Feature #3
16. Feature #4
17. Feature #5
18. Feature #6 Description

5. How can I help?
6. What's the product?
7. How can I use it?
12. Okay... so now what?
19. Tell us what you like
20. How it works...
23. Error Message-Did Not Answer
24. Now It's Your Turn!
25. You Create It
26. A few more...
27a. Thank You & Exit

Test Cell

2. Agreement
1. Welcome & Log On
4. Verify “Don’t Agree”

3. Parents Privacy Policy

21. Question # n Conjoint

22. Help Page

Page 104
## Appendix 7: Conjoint Design Pairs

### FIRST HALF

<table>
<thead>
<tr>
<th>Pair</th>
<th>Camera A</th>
<th>Camera B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Camera A</td>
<td>Camera B</td>
</tr>
<tr>
<td>Price</td>
<td>34.99</td>
<td>24.99</td>
</tr>
<tr>
<td>Styling Covers</td>
<td>Changeable</td>
<td>Changeable</td>
</tr>
<tr>
<td>Picture Quality</td>
<td>Option A</td>
<td>Option B</td>
</tr>
<tr>
<td>Picture Taking</td>
<td>1 step</td>
<td>2 step</td>
</tr>
<tr>
<td>2</td>
<td>Camera C</td>
<td>Camera D</td>
</tr>
<tr>
<td>Price</td>
<td>34.99</td>
<td>24.99</td>
</tr>
<tr>
<td>Styling Covers</td>
<td>Changeable</td>
<td>Changeable</td>
</tr>
<tr>
<td>Picture Quality</td>
<td>Option A</td>
<td>Option B</td>
</tr>
<tr>
<td>Picture Taking</td>
<td>2 step</td>
<td>2 step</td>
</tr>
<tr>
<td>3</td>
<td>Camera E</td>
<td>Camera F</td>
</tr>
<tr>
<td>Price</td>
<td>24.99</td>
<td>24.99</td>
</tr>
<tr>
<td>Styling Covers</td>
<td>Permanent</td>
<td>Changeable</td>
</tr>
<tr>
<td>Picture Quality</td>
<td>Option A</td>
<td>Option B</td>
</tr>
<tr>
<td>Picture Taking</td>
<td>2 step</td>
<td>1 step</td>
</tr>
<tr>
<td>4</td>
<td>Camera G</td>
<td>Camera H</td>
</tr>
<tr>
<td>Price</td>
<td>34.99</td>
<td>24.99</td>
</tr>
<tr>
<td>Styling Covers</td>
<td>Changeable</td>
<td>Permanent</td>
</tr>
<tr>
<td>Picture Quality</td>
<td>Option A</td>
<td>Option A</td>
</tr>
<tr>
<td>Picture Taking</td>
<td>2 step</td>
<td>1 step</td>
</tr>
<tr>
<td>5</td>
<td>Camera I</td>
<td>Camera J</td>
</tr>
<tr>
<td>Price</td>
<td>34.99</td>
<td>34.99</td>
</tr>
<tr>
<td>Styling Covers</td>
<td>Changeable</td>
<td>Permanent</td>
</tr>
<tr>
<td>Picture Quality</td>
<td>Option A</td>
<td>Option B</td>
</tr>
<tr>
<td>Picture Taking</td>
<td>1 step</td>
<td>2 step</td>
</tr>
<tr>
<td>6</td>
<td>Camera K</td>
<td>Camera L</td>
</tr>
<tr>
<td>Price</td>
<td>24.99</td>
<td>34.99</td>
</tr>
<tr>
<td>Styling Covers</td>
<td>Permanent</td>
<td>Permanent</td>
</tr>
<tr>
<td>Picture Quality</td>
<td>Option A</td>
<td>Option B</td>
</tr>
<tr>
<td>Picture Taking</td>
<td>1 step</td>
<td>2 step</td>
</tr>
<tr>
<td>7</td>
<td>Camera M</td>
<td>Camera N</td>
</tr>
<tr>
<td>Price</td>
<td>24.99</td>
<td>34.99</td>
</tr>
<tr>
<td>Styling Covers</td>
<td>Permanent</td>
<td>Permanent</td>
</tr>
<tr>
<td>Picture Quality</td>
<td>Option A</td>
<td>Option B</td>
</tr>
<tr>
<td>Picture Taking</td>
<td>2 step</td>
<td>1 step</td>
</tr>
<tr>
<td>8</td>
<td>Camera O</td>
<td>Camera P</td>
</tr>
<tr>
<td>Price</td>
<td>34.99</td>
<td>24.99</td>
</tr>
<tr>
<td>Styling Covers</td>
<td>Permanent</td>
<td>Changeable</td>
</tr>
<tr>
<td>Picture Quality</td>
<td>Option B</td>
<td>Option B</td>
</tr>
<tr>
<td>Picture Taking</td>
<td>1 step</td>
<td>1 step</td>
</tr>
</tbody>
</table>

### SECOND HALF

<table>
<thead>
<tr>
<th>Pair</th>
<th>Camera Q</th>
<th>Camera R</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Camera Q</td>
<td>Camera R</td>
</tr>
<tr>
<td>Price</td>
<td>34.99</td>
<td>24.99</td>
</tr>
<tr>
<td>Light Setting</td>
<td>Feedback</td>
<td>Feedback</td>
</tr>
<tr>
<td>Picture Delivery</td>
<td>Auto</td>
<td>Manual</td>
</tr>
<tr>
<td>Camera Opening</td>
<td>Slide Open</td>
<td>Fixed</td>
</tr>
<tr>
<td>10</td>
<td>Camera S</td>
<td>Camera T</td>
</tr>
<tr>
<td>Price</td>
<td>34.99</td>
<td>24.99</td>
</tr>
<tr>
<td>Light Setting</td>
<td>Feedback</td>
<td>Feedback</td>
</tr>
<tr>
<td>Picture Delivery</td>
<td>Auto</td>
<td>Manual</td>
</tr>
<tr>
<td>Camera Opening</td>
<td>Fixed</td>
<td>Slide Open</td>
</tr>
<tr>
<td>11</td>
<td>Camera U</td>
<td>Camera V</td>
</tr>
<tr>
<td>Price</td>
<td>24.99</td>
<td>24.99</td>
</tr>
<tr>
<td>Light Setting</td>
<td>3 Settings</td>
<td>Feedback</td>
</tr>
<tr>
<td>Picture Delivery</td>
<td>Auto</td>
<td>Manual</td>
</tr>
<tr>
<td>Camera Opening</td>
<td>Fixed</td>
<td>Slide Open</td>
</tr>
<tr>
<td>12</td>
<td>Camera W</td>
<td>Camera X</td>
</tr>
<tr>
<td>Price</td>
<td>34.99</td>
<td>24.99</td>
</tr>
<tr>
<td>Light Setting</td>
<td>Feedback</td>
<td>3 Settings</td>
</tr>
<tr>
<td>Picture Delivery</td>
<td>Auto</td>
<td>Auto</td>
</tr>
<tr>
<td>Camera Opening</td>
<td>Fixed</td>
<td>Slide Open</td>
</tr>
<tr>
<td>13</td>
<td>Camera Y</td>
<td>Camera Z</td>
</tr>
<tr>
<td>Price</td>
<td>34.99</td>
<td>34.99</td>
</tr>
<tr>
<td>Light Setting</td>
<td>Feedback</td>
<td>3 Settings</td>
</tr>
<tr>
<td>Picture Delivery</td>
<td>Auto</td>
<td>Manual</td>
</tr>
<tr>
<td>Camera Opening</td>
<td>Slide Open</td>
<td>Fixed</td>
</tr>
<tr>
<td>14</td>
<td>Camera AA</td>
<td>Camera BB</td>
</tr>
<tr>
<td>Price</td>
<td>24.99</td>
<td>34.99</td>
</tr>
<tr>
<td>Light Setting</td>
<td>3 Settings</td>
<td>3 Settings</td>
</tr>
<tr>
<td>Picture Delivery</td>
<td>Auto</td>
<td>Manual</td>
</tr>
<tr>
<td>Camera Opening</td>
<td>Slide Open</td>
<td>Fixed</td>
</tr>
<tr>
<td>15</td>
<td>Camera CC</td>
<td>Camera DD</td>
</tr>
<tr>
<td>Price</td>
<td>24.99</td>
<td>34.99</td>
</tr>
<tr>
<td>Light Setting</td>
<td>3 Settings</td>
<td>3 Settings</td>
</tr>
<tr>
<td>Picture Delivery</td>
<td>Auto</td>
<td>Manual</td>
</tr>
<tr>
<td>Camera Opening</td>
<td>Fixed</td>
<td>Slide Open</td>
</tr>
<tr>
<td>16</td>
<td>Camera EE</td>
<td>Camera FF</td>
</tr>
<tr>
<td>Price</td>
<td>34.99</td>
<td>24.99</td>
</tr>
<tr>
<td>Light Setting</td>
<td>3 Settings</td>
<td>Feedback</td>
</tr>
<tr>
<td>Picture Delivery</td>
<td>Manual</td>
<td>Manual</td>
</tr>
<tr>
<td>Camera Opening</td>
<td>Slide Open</td>
<td>Slide Open</td>
</tr>
</tbody>
</table>