Customer Sensitivity to Electronically Reproduced Color Products: Its effect on the Operation of Return Goods

Dennis Krumwiede, Idaho State University, College of Business, Pocatello, ID 83209-8020, krumdenn@isu.edu, Phone: (208)-282-3506

Kevin R. Parker, Idaho State University, College of Business, Pocatello, ID 83209-8020, parkerkr@isu.edu, Phone: (208)-282-4783

Philip S. Nitse, Idaho State University, College of Business, Pocatello, ID 83209-8020, nitsphil@isu.edu, Phone: (208)-282-3707

Thomas Ottaway, Idaho State University, College of Business, Pocatello, ID 83209-8020, ottathom@isu.edu, Phone: (208)-282-2601

ABSTRACT

Return goods management, also referred to as reverse logistics, has become an important topic in recent years. As customers come to expect higher quality products, more items are returned as a result of product dissatisfaction. Further, as governments enact stricter regulations to preserve the environment, the disposition of returned goods becomes a critical issue. Substantial research has been performed by European researchers to assess the impact of environmental protection. Significantly less research has been conducted involving the return of goods for other reasons than waste disposal and its effect on the supply chain. For example, scant research has been performed regarding the effects of product returns due to color inaccuracies from web purchases. This is becoming a critical issue because as the number of Internet purchases increases, the return of goods is also significantly increasing. The increase in returned goods adds new challenges and opportunities for a company. This work, phase two of a three-phase effort, looks at the effect that colors inaccuracies on e-commerce sites have on product returns. Phase one results and phase three plans are also discussed. An interactive survey instrument was designed to capture data necessary to pursue this research. The effort involves studying the customer's perceptual differences of color between computer-generated color and that of the actual product itself.

INTRODUCTION

Companies are selling their products, both goods and services, over the web at an ever-increasing rate. Internet sales of non-travel related products reached $988 million a week, with apparel and home items experiencing a greater increase than other items (Puente, 2002). Apparel has been one of the top eight industries involved in Internet shopping in the United States (Krantz, 1998). According to a 2002 UCLA study, 48.2% of new users (less than one year Internet experience) and 41.8% of experienced users (greater than six years of Internet experience) reported making online clothing purchases (Lebo, 2003).

It has been five years since the term "clicks and mortar," attributed to a Charles Schwab executive, entered the lexicon. Also known as "bricks and clicks," it has quickly become more

than a clever sandwiching of mouse click and brick and mortar. It signifies a monumental shift in thinking about how existing companies can offer both traditional retail outlets (mortar or bricks) as well as online services via the web (clicks). Whether a company is click or brick and click, the rate of customer returns has increased from the e-commerce side of the business. It is estimated that as high as 40 to 50% of items ordered over the Internet are returned (Bunn, 1999). Further, 15% of color-critical items are returned (Businesswire.com, 1999). This is especially true for those who shop for clothing and accessories, since color is often a critical factor in the selection of such items. Industry research has shown that while color is a critical factor in the selection of fashion products, customers have come to distrust color accuracy on the web (Businesswire.com, 1999). Although 76% of web users shopping for color related items indicate that color accuracy is an important characteristic, 60% of the users do not trust the item color as displayed in the product image (Businesswire.com, 1999). Reverse logistics, the movement of goods from the consumer as far as back to the store or the manufacturer, has increased substantially.

Reverse logistics now costs U.S. companies approximately 5% of overall logistics costs (Bunn, 1999). Industry recognized the ramifications of reverse logistics much sooner than the academic world. Most reverse logistics issues are appearing in practitioner-related journals rather than academic journals (Carter and Ellram, 1998). Industry has even started to recognize that proper administration of reverse logistics can be a strategic advantage in the supply chain (Schwartz, 2000). The supply chain can be defined as "the network of entities through which material flows; these entities may include suppliers, carriers, manufacturing sites, distribution centers, retailers, and customers" (Lummus and Alber, 1997). Reverse logistics has even become one of the more important issues in warehouse management (Brockmann, 1999). Yet, logistics managers within many companies do not handle reverse logistics well (Meyer, 1999).

Reverse logistics is becoming very important for many companies trying to compete in the e-commerce market. However, finding time to adequately perform reverse logistics can be difficult if the systems are not effective and efficient (Stock, 2001). Therefore, any reduction in reverse logistics costs provides more profit to their bottom line.

This research project investigates the effect of Internet-purchased color sensitive products on reverse logistics operations in the supply chain system. This project is cross-disciplinary involving operations, marketing, and computer information systems. The study began with a series of e-mail messages and telephone interviews with Internet marketers to determine whether they agree that the problem of accurate color representation on the web actually exists. Information gathered in this phase of the study revealed that a problem exists but that only some Internet marketers are aware of it. Attempts to locate existing research into the problem uncovered some industry studies, such as those commissioned by CyberDialog (BusinessWire, 1999) and Imation (Imation, 2001), but found no independent academic studies. The next step involved the development of a survey instrument and running an initial study to test and validate the instrument. The results of the initial study have been accepted for publication (Nitse, et al., 2004). Based on validation results, the instrument was refined to place emphasis on color perception issues associated with reverse logistics, and an online infrastructure for administrating the actual survey was developed. Results of the second phase are reported in this paper. Future research, referred to as phase three, involving information technology related issues will also be discussed.

PHASED RESEARCH APPROACH

When products purchased from e-commerce sites are portrayed using inaccurate colors, there can be several consequences. The investigation into those consequences has been divided into phases. The first phase of the study determined the general effects that color has on consumer behavior, such as willingness to purchase, probability of complaining, and probability of returning. In addition to these factors, the second phase investigates the error rate between actual color and the color representation on the web, and the effect that inaccuracies have on the number of items that are returned. Future phases will investigate information technology issues with regard to the causes of color inaccuracies on the production side of product representations as well as on the delivery side, and will examine possible solutions to alleviate the problem.

PHASE ONE – HISTORICAL OVERVIEW: CONSUMER BEHAVIOR

Phase one involved a survey structured to investigate consumer behavior with respect to e-commerce, both in general and with color-related products. This phase entailed the design, administration, and analysis of a questionnaire. The questionnaire was administered to a diverse group of approximately 300 university students and was structured to provide information about purchase behavior, purchase intention, complaint behavior and product return behavior.

Phase One Results

Overall, 14.8% of respondents indicated that they have had personal experience with inaccurate color on-line. Some 78.3% of our respondents had purchased on-line within the year preceding the research point. For those who purchased on-line, the number of purchases ranged from 1 to 60, with four being the median number of purchases. Most of the respondents (61%) indicated that they made between one and eight purchases, while 19% of the respondents indicated that they made ten or more purchases during the last year.

Among those who purchased in the last year, 12.1% complained to the on-line merchants if an item delivered did not adequately match the on-line image, and 10.9% returned an item that was delivered in a color different from what was expected. Over a third (67.9%) of those who complained also returned the item in question. Of those who complained, only 41.9% indicated that they would continue to purchase from a merchant even if they had a color problem.

In summary, phase one corroborates with industry studies that indicate a substantial color inaccuracy problem exists and does impact on-line purchasing behavior. When on-line customers are conditioned to distrust what they see on e-commerce sites, they may make complaints about unsatisfactory items, return those items, or even stop making on-line purchases altogether. The 10.9% who return items because of color inaccuracies are especially significant to reverse logistics. Phase one was an initial investigation into the pre- and post-sale ramifications of inaccurate color representation on the Internet. The second phase, as reported here, was designed to analyze the color discrepancy between actual swatches of images of those swatches on a monitor. The following sections address this phase of the research effort.

PHASE TWO – CURRENT RESEARCH: COLOR-CRITICAL PRODUCTS

One of the authors assisted in decision making for the implementation of a return goods program for a large U.S. logistics company. A high-ranking executive officer in charge of logistics operations in the company stated that customers who returned goods due to color dissatisfaction often indicated that color misrepresentation on monitors contributed significantly to their returns of products purchased over the web. He indicated that a large number of returns could be attributed to the variation between the color that was anticipated based on the product representation and the actual color of the product received. This work focuses on this concept, investigating whether high consumer return rates can be attributed to color representation errors on the web.

Phase Two Research Process

As noted above, phase 2 required that the instrument be refined to place emphasis on color perception issues associated with reverse logistics, and an online infrastructure for administrating the actual survey was developed. As in the earlier phase, the questionnaire was developed to assess the level of color accuracy depicted in a digital image with the color of the actual swatch of cloth used to generate the image. A seven-point scale was used to capture the perceived level of accuracy of the digital image. Two other areas of interest – return behavior and complaint behavior – were also included on the questionnaire. One question asks if the respondent would return an item if the color of the actual product differed from its representation on the Internet. Those indicating that they would return the item were then asked to indicate the likelihood, on a four-point scale, that they would return the item. Another item on the questionnaire was designed to assess whether the respondents would complain about color discrepancies to the merchant. Again, for those indicating that they would complain, a four-point scale captures the likelihood that they would do so. This phase involved the research model shown in figure 1.

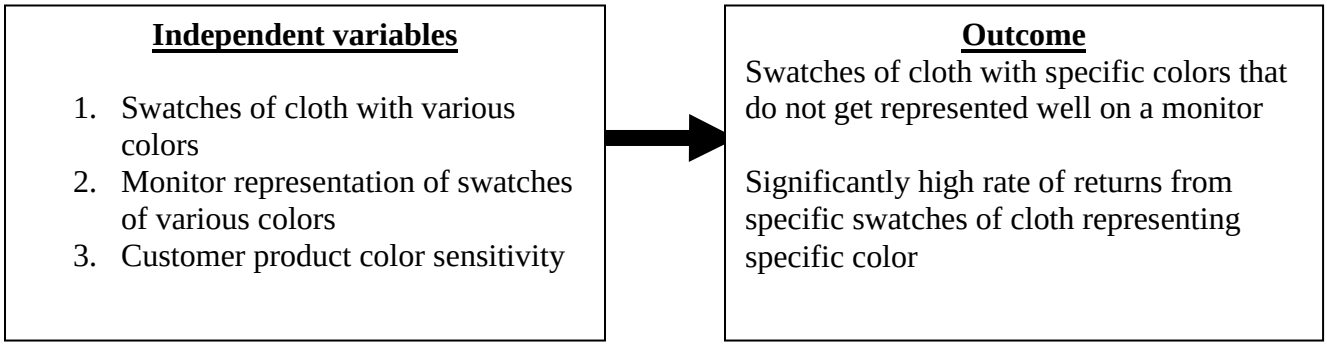

Figure 1 – Phase 2 Research Model

Respondents answered these questions for each of the eleven swatches of colored fabric used in the study. The eleven swatches were selected from a fabric store using a simple criterion that limited the selection to bold colors, plain fabric without design or heavy texturing, and

commonly accepted colors. The selection included red, navy blue, light blue, orange, black, yellow, grey, light green, dark green, purple, and rust swatches.

The survey was administered in a computer lab. Each respondent was given an instruction sheet and a packet of eleven folders, each of which was numbered and contained a swatch of cloth. The respondents logged into the survey site with their unique student identification number and a password that was provided on the instruction sheet. The identification number was used to prevent the respondent from participating in the survey multiple times. Respondents compared the colored swatches to the digital image on the screen, and rated the accuracy of the image on a seven-point scale, with one being very different and seven being identical. Standard demographic questions were included in the questionnaire for classification purposes.

The questionnaire was administered to university students because of the availability of a large number of subjects and because students represent a cross section of both experienced and inexperienced Internet shoppers. It is critical to involve experienced users, because their familiarity provides them with a more realistic perspective of Internet shopping than inexperienced users. Other research dealing with Internet purchases uses a similar sample (Griffith, et al., 2001). Three hundred questionnaires were collected from the students who participated in this study.

A majority of the respondents (84.6%) are attending full time, and 71.5% were between the ages of 18 and 26. The gender distribution includes 58.4% males and 41.6% females. Income level was on the lower end (56.8% under $20,000), as was expected due to the age distribution and the fact that most are full-time students. The student population was deemed acceptable since the demographics of the school are not traditional, with an older than normal student body. In our sample, 20.1% of the subjects were over the age of 30, and 53.6% were over the age of 23. In addition, almost half of the subjects (46.2%) are married, and about a third (36.7%) have children. Thus, the sample does not suffer from homogeneity to the degree found in many student samples. Only the 97.8% of the respondents who were not colorblind were considered in the analysis of color accuracy.

The computer-based web survey was carefully constructed so that only acceptable answers are available to the respondents, and as a result the data is all within the appropriate ranges for the answer sets. Any missing data is automatically captured and coded accordingly.

Phase Two Results

The results of phase two are revealing. Specific colors are more problematic when depicted on an e-commerce site. Table 1 lists the mean value of the perceived level of color accuracy for each of the eleven colors. In this seven-point scale a score of 7 is an identical match, a score of 4.0 is neutral, and anything above that indicates a close match. Only five of the eleven colors – navy blue, black, grey, light green and light blue – scored above the mid-point. Black scored the highest with a mean of 5.88. Of the non-accurate colors, purple scored the lowest with a mean of 1.71. Table 1 indicates that there is clearly a problem with colors as they are depicted on computer monitors. The next step is to determine the ramifications of those problems.

Again, for some colors the likelihood is very high that a respondent will return an item because of color discrepancies. Generally, the percentage of respondents who indicated that they would return and the mean of the likelihood of returning correspond. Table 2 displays the percentage of respondents who indicated they would return a specific color and the mean of the likeliness to return on a four-point scale. Here the respondents indicated that Purple and Yellow are the colors that they would most likely return, and they also had the highest likelihood mean score. Black and Light Blue again had the least number of potential returns, although the respondents who would return items in the color black are more likely to do so than those returning items in several other colors. Light Blue had the second lowest number of people indicating they would return the color and the least likelihood of being returned by those who indicated that they would return the item.

TABLE 1
Color Accuracy
Mean Value of Color Swatches
(1=very different to 7=identical match)

Swatch# & Color	Mean (n=268)
SW 1 -- Navy Blue	4.31
SW 2 -- Black	5.88
SW 3 -- Yellow	1.96
SW 4 -- Grey	4.18
SW 5 -- Orange	2.29
SW 6 -- Light Green	4.11
SW 7 -- Rust	3.84
SW 8 -- Light Blue	5.30
SW 9 -- Dark Green	3.09
SW 10 - Purple	1.71
SW 11 - Red	3.03

TABLE 2
Likelihood of Returning Item
Mean Value of Color Swatches
(1=very likely to 4=very unlikely)

Swatch# & Color	Percent	Mean
SW 1 -- Navy Blue	33.1	1.92
SW 2 -- Black	9.6	1.87
SW 3 -- Yellow	83.1	1.51
SW 4 -- Grey	34.5	2.00
SW 5 -- Orange	77.4	1.47
SW 6 -- Light Green	39.1	1.99
SW 7 -- Rust	40.6	1.88
SW 8 -- Light Blue	10.0	2.08
SW 9 -- Dark Green	63.2	1.62
SW 10 - Purple	83.9	1.31
SW 11 - Red	65.1	1.83

As noted, Purple and Yellow are problematic for operations. Representation of those colors is not accurate, and if color-critical items in those colors are ordered from an e-commerce site, companies should expect that they will be returned at a higher rate than the other colors that were studied. E-tailers are faced with the decision of either continuing to market items in these colors with the expectation of a high return rate, or eliminating items in these colors from e-commerce sites. If the decision is made to continue marketing items in these colors, then operations should develop a redistribution process designed to handle these returns in a manner that would minimize costs.

A related research question was designed to assess if the inaccuracy and inconsistency of color representation using computer display equipment increases the likelihood that a consumer will return an on-line purchase of color-critical items. Respondents who made an on-line purchase in the last year were asked if they had returned an item to the merchant. 13.8% indicated that they have returned an item that was delivered in a color different from what was expected. When asked about specific color critical items, the following responses were provided:

- 45.3% would return cosmetics due to color inaccuracies.
- 58.6% would return shoes due to color inaccuracies.
- 81.6% of the respondents would return clothing due to color inaccuracies.
- 59.4% of the respondents would return clothing accessories due to color inaccuracies.
- 31.3% would return outdoor furniture due to color inaccuracies.
- 59.4% would return indoor furniture due to color inaccuracies.
- 70.7% would return home decorations due to color inaccuracies.
- 26.6% would return kitchen appliances due to color inaccuracies.
- 47.7% would return an automobile due to color inaccuracies.

Phase Two Summary

Phase two has provided important preliminary information for a company trying to reduce return costs. The results confirmed that inaccurate color representation has an impact on customer returns, and that some colors are susceptible to return at a higher rate than other colors. This information can help operations and marketing by providing potential return expectation information. With this information these people can more effectively prepare for returns if those colors are offered, or remove those colors from offerings over the Web to reduce returns.

CONCLUSION AND FUTURE RESEARCH

Conversations with Internet marketers during the initial stages of this undertaking revealed that many people think that color accuracy is not a major problem. This study indicates that they may be deluding themselves as almost 14% of those surveyed indicated they have actually returned an item that was delivered in a color different from what was expected. Furthermore, 45.3% would return cosmetics due to color inaccuracies, 58.6% would return shoes, 81.6% would return clothing, 59.4% would return clothing accessories, and 70.7% would return home decorations. Such levels of returns lead to high reverse logistics costs.

The results obtained from this study also provide a better understanding of colors that are associated with higher return rates for product. E-tailers must be made aware that color accuracy is a critical issue, especially with certain colors, and they must modify the reverse logistics process to address this issue in order to reverse costs.

Future phases will examine various information technology issues that either cause or alleviate inaccurate color representation. Computer systems play a major role in e-commerce and in reverse logistics or returned goods. The presentation of the product is dependent not only upon the quality of the product image represented on the e-commerce site, but also on the shopper's monitor that receives and displays the image. This phase will attempt to determine the variables that come into play in the production and transmission of accurate product images. This effort will include analysis of graphics cards and the format for appropriate storage of data for transfer and retrieval. One thrust will evaluate currently available color correction software to determine if any packages adequately correct color inaccuracies, and the likelihood that consumers will put forth the effort to use such software. Another study will assess the practicality and affordability of monitor calibration software, which involves a USB-connected colorimeter and software that displays a series of color screens in order to insure that a monitor produces accurate colors.

Once all phases of this study have been completed, the authors will report results and conclusions. Further research to duplicate and expand on this process will be conducted, and a wider cross section of Internet shoppers will be surveyed and evaluated.

REFERENCES

Brockmann, T. (1999), "21 warehousing trends in the 21st century", *IIE Solutions*, v 21 (7), pp. 36-40.

Bunn, J. (1999), "Centralizing Reverse Logistics: How to understand if it will work for you," Consumer Markets, August, pp.11-12.

Businesswire.com (1999), "Study Finds Lack of Color Consistency Hampers Electronic Commerce; Cyber Dialogue Reports Consumer Awareness of Monitor Color Variance", April 06, 1999. Available http://www.businesswire.com/webbox/bw.040699/ 190960050.htm

Carter, C. and Ellram, L. (1998). "Reverse Logistics: a review of the Literature and Framework for Future Investigation", *Journal of Business Logistics*, v 19 (1), pp. 85-102.

Griffith, D.A., Krampf, R.F., and Palmer, J.W. (2001), "The Role of Interface in Electronic Commerce: Consumer Involvement with Print Versus On-Line Catalogs," International Journal of Electronic Commerce, v 5 (4), pp. 135-153.

Imation (2001), "Imation tames unruly web color with verifi technology", March 14, 2001. Available http://www.verifi.net/HeadLines/ press_releases3.asp

Krantz, M. (1998), "Click Till You Drop", Time Magazine, 152(3), 34-37+.

Lebo, H. (2003), "The UCLA Internet Report: Surveying the Digital Future- Year Three", UCLA Center for Communication Policy, February, 2003, Available http://ccp.ucla.edu/pdf/UCLA-Internet-Report-Year-Three.pdf

Lummus, R.R. and K.L Alber (1997), *Supply Chain Management: Balancing the Supply Chain with Customer Demand.* Falls Church, VA: The Educational and Resource Foundation of APICS.

Meyer, J. (1999). "Many Happy Returns", *The Journal of Business Strategy*, v 30 (2) pp. 27-31.

Nitse, Philip S., Parker, Kevin R., Ottaway, Thomas A., & Krumwiede, Dennis W. (2004). "The Impact of Color in the E-commerce Marketing of Fashions: An Exploratory Study." *European Journal of Marketing -- Special Issue on Fashion Marketing*, 38 (7/8).

Puente, M. (2002), "On-line Experience is now a much better fit", USA Today, December 4, p. 2e.

Schwartz, B. (2000), "Reverse Logistics Strengthens Supply Chain", *Transportation and Distribution*, v 41 (5), pp. 95-100.

Stock, J. R. (2001), "The 7 Deadly Sins of Reverse Logistics", *Material Handling Management*, v 56 (3), March Cleveland, pp. 5-12.