2013

The Informavore Shopper: Analysis of Information Foraging, System Design, and Purchasing Behavior in Online Retail Stores

Jeff Min Teck HONG
Singapore Management University, minteck.2010@msis.smu.edu.sg

The Informavore Shopper:

Analysis of Information Foraging, System Design, and Purchasing Behavior in Online Retail Stores

HONG MIN TECK JEFF

SINGAPORE MANAGEMENT UNIVERSITY

2013

The Informavore Shopper:

Analysis of Information Foraging, System Design, and Purchasing Behavior in Online Retail Stores

by

HONG Min Teck Jeff

Submitted to School of Information Systems in partial fulfillment
of the requirements for the Degree of Master of Science in Information Systems

Thesis Committee:

Narayan Ramasubbu (Supervisor/Chair)
Assistant Professor of Information Systems
Singapore Management University

Richard C. Davis (Co-Supervisor/Co-Chair)
Assistant Professor of Information Systems
Singapore Management University

Ilse Baumgartner
Assistant Professor of Information Systems (Education)
Singapore Management University

Singapore Management University
2013

The Informavore Shopper: Analysis of Information Foraging, System Design, and Purchasing Behavior in Online Retail Stores

HONG Min Teck Jeff

Abstract

Global online retail sales are on the rise and are predicted to experience a double digit growth annually over the next three years. Given little marginal cost involved in adding new products and brands to their catalogues, online retailers tend to increase product and brand offerings to increase sales by selling products that could not have been sold due to space constraints in physical stores. Frank Urbanowski, Director of MIT Press, attributed the 12% increase in sales of backlist titles directly to increased accessibility to these titles through the Internet. For consumers, the ability to buy products that they would not have otherwise bought increases their consumer surplus.

Despite preferring a large assortment of products in online retail stores due to product variety and diversity in brand choices, this poses a problem to consumers as the number of alternatives and attributes reduces their confidence in the selection of a product to purchase; product comparison and evaluation also becomes a difficult task. Thus, an online retail store that does not facilitate easy product information search, comparison, and evaluation would cause consumers to make poor purchase decisions. In this thesis, I investigate how the design parameters of online stores such as the presentation of product information, product comparisons, consumer reviews, and recommendations influence consumers' information seeking and decision-making processes.

Specifically, the objectives of this thesis are to learn the individual and joints effects of such design parameters on the effort that consumers expend in the shopping process, quality of their purchase decisions, and their satisfaction with the shopping experience. A controlled experiment was conducted online using six variants of an online retail store to understand the effects of such design features. While the result was modest, the study found that presentation of information that allows consumers to have a preview of the subsequent page after clicking on a link has moderate effects on consumers' physical and cognitive effort in seeking product information, the purchase decision they made, and their satisfaction with an online store.

Table of Contents

Chapter 1: Introduction 1

1.1 Background and Motivation 1

1.1.1 Benefits of online retail stores to retailers and consumers 1

1.1.2 Problems consumers face on online retail stores 3

1.2 Research objective 3

1.3 Organization of this Thesis 4

Chapter 2: Literature Review 5

2.1 Types of consumers on an online retail store 5

2.2 Information foraging theory & consumer decision-making process 8

2.2.1 Information foraging theory 8

2.2.2 Consumer decision making process 11

2.3 Information scents that support consumers' information goals 12

2.4 Decision-aiding features that support consumers' buying process 14

2.5 Significance of this research 18

Chapter 3: Research Question & Hypotheses 19

3.1 Research questions 19

3.2 Hypotheses 20

Chapter 4: Methodology & Measurement 30

4.1 Experimental Design 30

4.1.1 High degree of information scents on product listing page 32

4.1.2 High degree of information scents on comparison matrix page 32

4.1.3 High degree of information scents on product details page 33

4.2. Data collection methods 35

4.2.1 Using Amazon Mechanical Turk as a subject pool 35

4.2.2 Experimental procedures 38

4.2.3 Metrics, data, and analyses 43

Chapter 5: Finding and Analysis 48

5.1. Screening of participants 48

5.2. Statistical diagnostics 50

5.3. Analysis of results 51

5.3.1 Effort – Number of pages accessed on shopping task 58

5.3.2 Effort – Average total time spent per page on shopping task 59

5.3.3 Effort – Average active time spent per page on shopping task 61

5.3.4 Satisfaction with shopping experience 62

5.3.5 Decision Quality - Match of purchased products with requirements 64

5.3.6 Decision Quality - Deviation of purchase price with budget 65

5.3.7 Other findings 66

Chapter 6: Discussion and Conclusion 68

6.1. Findings from the experiment 68

6.1.1 Preference to use menu bar for access to list of products 68

6.1.2 Effects of information scent 69

6.1.3 Effects of Decision-aiding features 70

6.2. Limitations 71

6.2.1 Small sample size 71

6.2.2 Non-usage of decision-aiding features 71

6.2.3 Complications in multiple data sources 72

6.2.4 Generalizability of results 73

6.3. Future Research 74

6.4. Conclusion 75

References 76

Acknowledgements

Completing this thesis would not have been possible for the guidance, motivation and support given by my supervisor Asst Professor Narayan RAMASUBBU and co-supervisor Asst Professor Richard C. DAVIS. I'd like to take this opportunity to express my sincere gratitude for their supervision in the course of writing this thesis. Also, special thanks to my thesis committee member Asst Professor Ilse BAUMGARTNER for her invaluable advices on the topic from the practical perspective.

Not forgetting the professors who have imparted me skills and knowledge needed to conduct the experiment for this research: Assoc Professor Angela LEUNG who taught me research methods in social and behavioral sciences, and Asst Professors Serena WEE and William TOV from the School of Social Sciences who taught me statistics. I couldn't be more thankful to have benefitted from their experience conducting experiments in the realm of behavioral sciences.

This thesis would also not been possible without the financial and administrative support from Singapore Management University, as well as initial support from the Director of Postgraduate Research Programmes at the School of Information Systems, Professor PANG Hwee Hwa, and recommendation from Professor Randy WEINBERG, Director of the Information Systems program at the Carnegie Mellon University.

Last but not least, I would like to thank my family for their relentless personal support and great patience at all times throughout my course of study.

Chapter 1: Introduction

1.1 Background and Motivation

Forrester Research predicted that U.S. consumers will spend $327 billion online in 2016, up 65% from $202 billion in 2011 (Mulpuru, Sehgal, Evans, Hoar, & Roberge, 2012); online retail sales in 17 major European markets will increase from €96.7 billion in 2011 to €172 billion by 2016, comprising a compounded annual growth rate of 12.2% (Gill, Evans, Sehgal, & Da Costa, 2012); and in Asia Pacific, the compounded annual growth rates in the mature electronic commerce markets of Japan, South Korea, and Australia are expected to rise 11% to 12% annually from 2011 to 2016, and in the emerging markets of China and India, growth rates are predicted to rise 25% and 57% per annum, respectively (Wigder, Noble, Sehgal, & Varon, 2012).

As more people buy online, that translates to greater revenue for online retailers. Given that the barrier to entry for retailing online is low, more intense competition is expected to follow as physical retailers and new entrants from around the world enter this lucrative market. To compete, it is imperative for online retailers to be competitive on all fronts, including the ability to enhance consumers' experience and the prompt delivery of purchases, other than price.

1.1.1 Benefits of online retail stores to retailers and consumers

In contrast to physical stores, online retail stores have no limits on the number of products that can be put on display. Given little marginal cost in adding another product or brand to an online store, retailers tend to overload products to maximize sales. To visualize the variety and wide magnitude of products sold on

an online retail store, *Table 1.1* juxtaposes the number of products that could be placed on an online retail store versus that of a physical store:

Product Category	Amazon.com	Typical large brick-and-mortar stores
Books	2,300,000	40,000 – 100,000
CDs	250,000	5,000 – 15,000
DVDs	18,000	500 - 1,500
Digital cameras	213	36
Portable MP3 players	128	16
Flatbed scanners	171	13

Table 1.1 Comparison between online and physical store
(Brynjolfsson, Yu, & Smith, 2003)

Providing a wider range and deeper variety of products is just one of the means to maximize sales. Selling products which consumers would not have been able to buy at low cost from a physical store (e.g. music record from the fifties, vintage jeans) could also increase the sales of online retailers (Brynjolfsson et al., 2003). Frank Urbanowski, Director of MIT Press, attributed the 12% increase in sales of backlist titles directly to increased accessibility to these titles through the Internet (Professional Publishing Report, 1999).

In sum, the potential increase in earnings from retailing online far outweighs that of a physical store. However, retailing online does not only benefit the retailers. Consumers also benefit by having access to a wider selection of products and brands, and items that are difficult to access in the physical world.

1.1.2 Problems consumers face on online retail stores

Though consumers universally prefer larger than smaller assortments of products on an online retail store due to product variety and diversity in brand choices, having large assortment of products on the stores poses a problem to them as the number of alternatives and attributes reduces their confidence in the selection of product to purchase (Chernev, 2003). As such, maintaining a large assortment of products while keeping information search, comparison between alternatives and product evaluation simple on an online retail store are important for consumers to buy with ease. When consumers are confident of their purchases, they are satisfied with their purchase and shopping experience on an online retail store. Having more satisfied consumers potentially increase a retailer's revenue with more repeated sales and referrals.

All in all, an online retail store that provides easy access to product information, comparison over alternative products, and selection of a product that best matches a consumer's requirements are critical to her online shopping experience. Ultimately, these positive attributes translate to more sales for retailers and benefits the consumers with greater satisfaction over their shopping experience.

1.2 Research objective

Given the background and motivation outlined in *Section 1.1*, the objective of this research is to investigate how design parameters of online retail stores such as presentation of product information, product comparisons, consumer reviews, and recommendations influence consumers' information seeking and decision-making processes.

Specifically, a controlled experiment was conducted to examine the effects of selected online store features on consumers' effort in seeking relevant information, making good purchasing decisions, and consumers' satisfaction with their shopping experience.

1.3 Organization of this Thesis

The remainder of the thesis is organized as follows: *Chapter 2* is a literature review of consumers' information seeking behavior on an online retail store, and features currently in the market that facilitate their shopping process. In *Chapter 3*, I propose my hypotheses that hinge on the constructs that were mentioned in *Chapter 1*. *Chapter 4* describes the methodology for this experiment, while *Chapter 5* presents the findings. Finally, *Chapter 6* concludes the thesis with a review of the results, and sets the agenda for future research.

Chapter 2: Literature Review

Consumers' motivations to shop online can be attributed to a plethora of reasons: convenience factor that includes time savings and lesser effort in seeking product information, social interactions gained from shopping process, shopping as a recreational experience, the tendency to seek variety, and the desirability of immediate possession (Rohm & Swaminathan, 2004). Overall shopping convenience was identified as the key motivation to shop online (Rohm & Swaminathan, 2004). This finding aligns with my proposition in *Sub-section 1.1.2* that consumers prefer online retail stores to provide large assortment of products but required to expend minimal amount of effort in the shopping process.

2.1 Types of consumers on an online retail store

Each visit a consumer makes to an online retail store could be accompanied by a different goal. For example, in one visit she may just be browsing around, but in a subsequent visit a couple of days later, she may wish to make a purchase for a product she browsed earlier. In the marketing literature, researchers classify the strategies consumers adopt while shopping online as browsing and searching strategies (Moe, 2003; Olston & Chi, 2003; Schlosser, 2006) - a concept derived from understanding the motivations why people uses the Internet (Hoffman & Novak, 1996). In the scenario described earlier in this paragraph, the consumer was a browser in the first visit, but became a searcher who searched for a specific product in the subsequent visit.

Searchers and browsers have different informational goals and adopt different strategies when seeking information. Searchers are likely to adopt an efferent stance where they "approach a web site to glean the facts more than focus

on the experience", while browsers likely adopt an aesthetic stance where they "approach a web site to be entertained" (Schlosser, 2003).

Expanding on the classification of information seeking strategies between searchers and browsers, a more detailed taxonomy was proposed where a purchase horizon dimension was included in the taxonomy (Moe, 2003). The author outlined four types of shopping strategies generally adopted by online shoppers: directed buying, search or deliberation, hedonic browsing, and knowledge building (see *Table 2.1*). I have also labeled the type of shoppers in the table to enable ease of reference in this thesis.

The concept of "Directed Search Behavior" described in the taxonomy is similar to searching strategy, while "Exploratory Search Behavior" is akin to the browsing strategy discussed in prior work. The purchase horizon dimension further segregates between shoppers who are searchers and browsers. That is, on top of information seeking strategy, they are further segregated by their intention to make a purchase. Given the different types of shoppers we could expect on an online retail store, it was proposed that click-stream data – record of pathways reflecting a series of choices made by a user both within a web site and across websites (Bucklin et al., 2002) - could be used to predict a shopper's motivation (Moe, 2003). It is not my intention to question the efficacy of such predictive model or to propose a new prediction model in this research. However, my objective is similar to the motivations of prior research - to understand how specific online stores' design parameters could be tailored to different groups of shoppers.

	Directed Search Behavior	Exploratory Search Behavior
Immediate Purchase Horizon	**Directed Buying (*Directed Buyer*)** Visits are said to follow a directed-buying strategy that would likely result in an immediate purchase. The in-store behavior is very focused and targeted toward a specific and immediate purchase.	**Hedonic Browsing (*Hedonic Browser*)** Visits to the store are motivated less by the utilitarian motives of making better purchasing decisions and more by the hedonic utility derived from the in-store experience (Babin, Darden, & Griffin, 1994; Hirschman, 1984; Sherry, McGrath, & Levy, 1993). In-store behavior tends to be more stimuli driven and occasionally results in impulse buying.
Delayed Purchase Horizon	**Search and Deliberation (*Comparison Buyer*)** Visits are similar to directed-buying behavior where shoppers are goal-directed with planned purchase in mind. However, the difference is that the objective of these visits is to acquire relevant information to make a well-informed purchase decision.	**Knowledge Building (*Knowledge Builder*)** Visitors are motivated by acquiring a bank of relevant product information potentially useful in the future. Their objective is to increase product and/or marketplace expertise. Search patterns are exploratory in nature but the utility derived from the experience is utilitarian rather than hedonic.

Table 2.1. Typology of online shoppers (Moe, 2003)

For *hedonic browsers*, prior research discovered that hedonic experiences (i.e. experiences characterized by pleasure) increases browsers' purchasing intention (Babin et al., 1994; Schlosser, 2003), and impulse purchases (Rook, 1987). Internet retail research found that three-dimensional display of products that enable consumers to interact with them are good stimuli to elevate consumers' purchasing intention (Schlosser, 2003). Also, showing products through rich media like videos improves consumers' understanding and thus

intention to return to the web site (Jiang & Benbasat, 2007). Thus, providing information through stimulating pleasure could lead to increase sales and improve satisfaction among hedonic browsers.

As for *knowledge builders* and *directed buyers*, design parameters that are aligned with their goals are pretty straightforward. The prior requires provision of information that is easily accessible, understood, and extracted (e.g. frequently asked questions section, or a downloadable list of products and their attributes), while the latter requires quick access to a specific product (e.g. a direct hyperlink or a search bar).

Since there have been numerous studies that evaluate the effect of online store features that could increase sales and shopping experience of *hedonic browsers*, and features that are aligned with the goals of *directed buyer* and *knowledge builders* are straightforward, I will focus on studying design parameters for *comparison buyers* in this thesis.

2.2 Information foraging theory & consumer decision-making process

This section discusses related work in the human-computer interaction and management fields. Specifically, the background of information foraging theory and its application on real world applications, and how consumers make decisions online will be discussed. While going through these theories and concepts from previous research, I focus on *comparison buyers* category.

2.2.1 Information foraging theory

In the human-computer interaction field, the information foraging theory (Pirolli, 2009) explains how humans, or commonly known as information

carnivores (herein known as informavores) seek information from multiple sources. It is a concept adapted from the optimal foraging theory in biology where it relates how human seek information to animals foraging for food in multiple patches of food sources (Stephen & Krebs, 1986). Information foraging is defined as activities associated with assessing, seeking, and handling information sources; informavores continuously seek and extract relevant information from a source until the cost exceeds the value of the task (Pirolli & Card, 1995). In essence, informavores seek to maximize their gains of valuable information per unit cost (Pirolli & Card, 1999).

The activities involved in the information foraging process are organized into two major loops of activities (see *Figure 2.1* for illustration) - *foraging loop* and a *sense-making loop* (Pirolli, 2009; Pirolli & Card, 2005). The *foraging loop* involves processes aimed at seeking information, searching and filtering it, and reading and extracting information (Pirolli, 2009; Pirolli & Card, 1999). The *sense-making loop* involves iterative development of a mental model (a conceptualization) that best fits the evidence (Pirolli, 2009; Russell, Stefik, Pirolli, & Card, 1993). Applying it to the behavior of *comparison buyers*, these shoppers forage for products that are relevant to their needs and shortlist those that are close to their requirements in the *foraging loop*. After which, they build a case and rationalize the product they will purchase after making comparions and evaluations of the short-listed items.

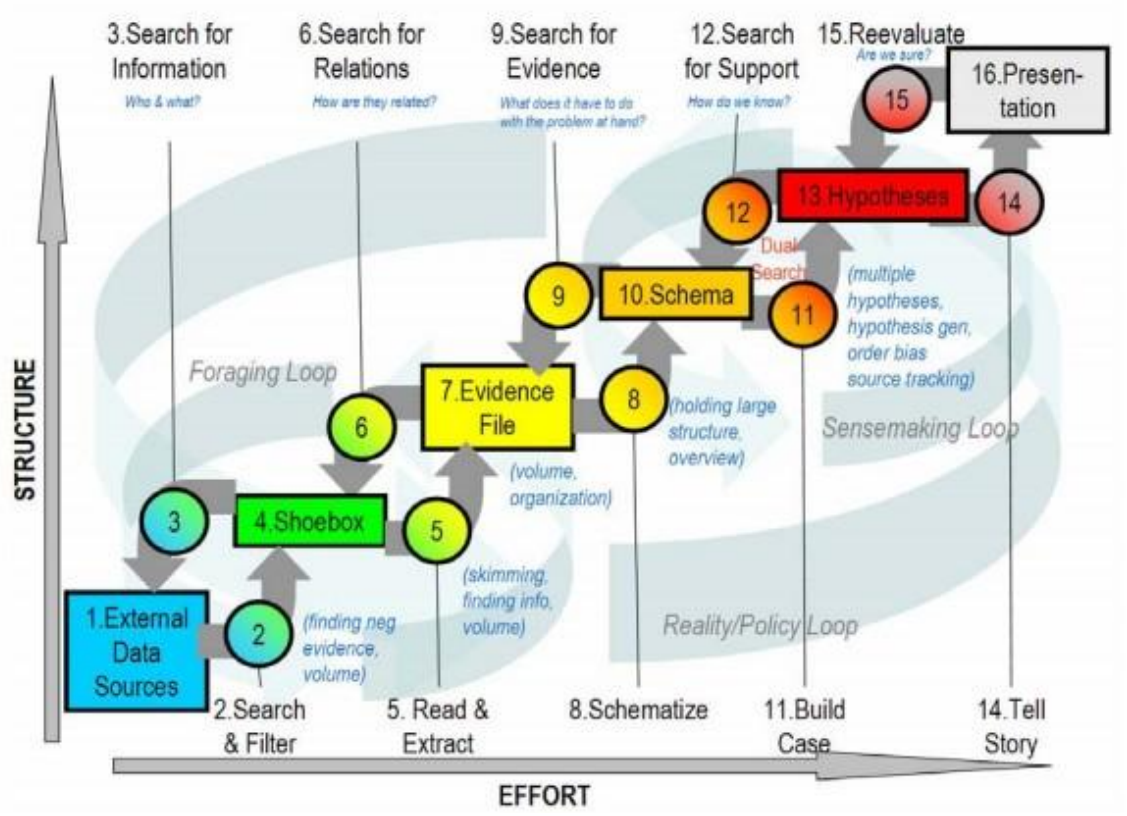


Figure 2.1 Notional model of sensemaking loop for intelligence analysis derived from Cognitive Task Analysis (Pirolli & Card, 2005)

To analyze users' interactions on web sites, usability metrics were also developed to measure and compare the efficiency and efficacy of human's foraging behavior. Metrics are derived from the common measures in the ISO 9241 specification. The specification defines usability as the "*effectiveness, efficiency and satisfaction* with which specified users achieve specified goals in particular environments". Usability practitioners and researchers adopt a myriad of metrics to measure each of these constructs. Research studies applying concepts of Information Foraging Theory in experimental setting also adopted similar measures of usability in their research (Krishen & Nakamoto, 2009; Moody & Galletta, 2008). Similarly in this thesis, I will also adapt such metrics to measure effectiveness, efficiency, and satisfaction of consumers' interactions on the design parameters that are under evaluation.

2.2.2 Consumer decision making process

Similar to the behavioral model developed in the Information Foraging Theory in the human computer interaction field, management scholars have developed a cognitive to analyze consumers' decision making process (Häubl & Trifts, 2000; Mackay, Barr, & Kletke, 1992). Adapted from (Simon, 1957), the decision-making model comprises of three distinct phases – *intelligence, design, and choice* (Kohli, Devaraj, & Mahmood, 2004). Applying it to analyze the purchase of a product by a *comparison buyer*, the shopper first recognizes the product to purchase and then gathers the relevant product information in the *intelligence* phase. The *design* phase is marked by structuring the product requirements, developing criteria to assess product attributes for suitability, and identifying a set of alternative products. Finally, in the *choice* phase, the shopper chooses the best product that meets the criteria, and makes the purchase decision.

Loosely mapping the different components of the behavioral models developed in the human computer interaction and management literatures, the *foraging loop* from Information Foraging Theory is akin to intelligence phase in the consumer decision-making model whereby consumers seek, filter, and extract high level information on products to shortlist relevant ones. The information seeking actions are repeated until the consumer identifies a consideration set that allows her to evaluate it in the *sense-making* loop. The *sense-making loop* is similar to the *design* and *choice* phases in the consumer decision making model whereby it entails having consumers learn more about the differences between alternative products. In this loop of activities, a shopper repeatedly compares each product attribute with the requirements they have in mind until an optimal product is identified. Finally, prior to making the purchase, she looks for support, or

attempt to reduce uncertainties on the identified product (e.g. issues other consumers faced after buying the product, whether she has to buy any complementary product or service for the main product to function etc.). This uncertainty reduction process is part of the general consumer buying process established in the marketing literature (Kotler & Armstrong, 2010), which will be discussed later in *Sub-section 4.1.1*.

2.3 Information scents that support consumers' information goals

Other than modeling the activities in a user's information seeking process, another key concept developed in the Information Foraging Theory is information scent. Information scent is defined as the "user's imperfect, subjective perception of the value of information obtained from proximal cues" (Ed H. Chi, Pirolli, Chen, & Pitkow, 2001). The concept explains how humans follow information scents – cues that humans make use of to decide whether to forage through a patch of information (Budiu, Royer, & Pirolli, 2007; Pirolli, 2009) - to navigate from one information source to another. *Figure 2.2(a)* illustrates examples of information cues in textual and graphical forms typically seen in results on search engines. Besides, information cues adopted in salient interface designs have also included previews of web pages (Ed H Chi, Hong, Gumbrecht, & Card, 2005; Genest et al., 2009); when a user places her cursor over a hyperlink, a preview of the distal page is shown (see *Figure 2.2(b)*). Such information scents provide cues that allow users to learn about the information they expect to see on the following page, without having to navigate to that page. Adoption of these information cues likely to reduce the time and effort needed to navigate on an online retail store and enhance consumers' shopping experience.

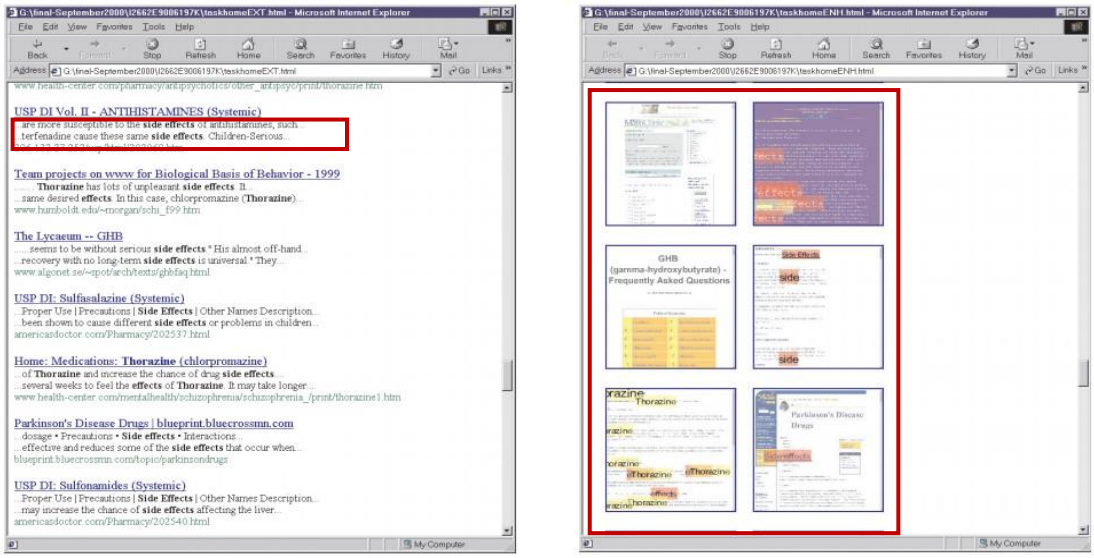


Figure 2.2(a) Information cues in textual and graphical forms (Pirolli, 2009)

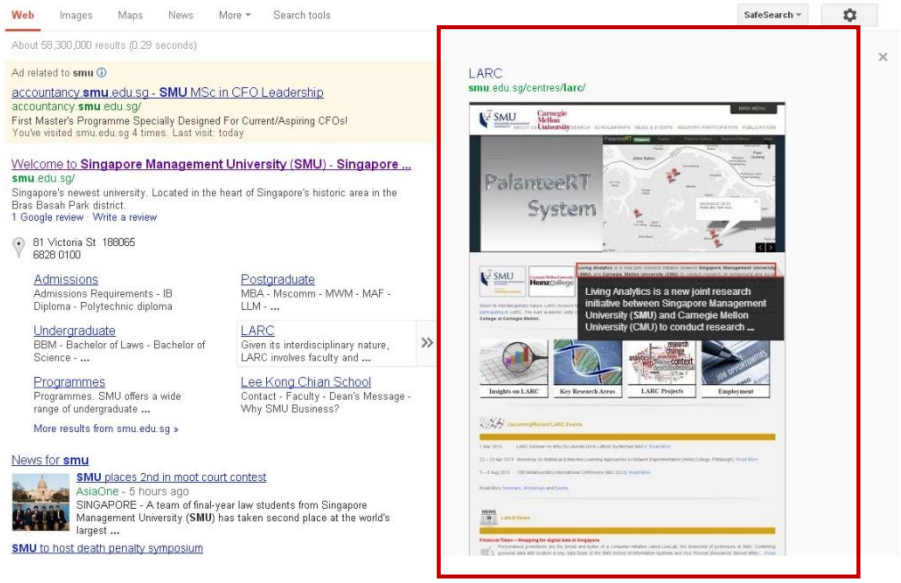


Figure 2.2(b) Information cues in on Google search engine.

Though information foraging theory and the information scent concept have been used several research to analyze users' behavior on the World Wide Web (Ed H. Chi et al., 2001; Huberman, Pirolli, Pitkow, & Lukose, 1998), they were based on users' interactions with web search engines or document

management systems. As all users of a search system have only one goal at all times while users of an online retail stores have multiple goals (Hahn, Kauffman, & Park, 2002), the results may not be representative in the electronic commerce setting.

And despite the positive motivations in providing convenience and satisfaction to consumers in seeking product information, processing information cues are expected to require greater cognitive effort. With more information to process for each of the products, consumers are induced to retain product attributes in their short term memory, compare them with the previously short-listed products, and filter products that do not satisfy their needs more than they are required in conventional store designs. Thus, it is one of my objectives in this thesis to understand the actual effect of information scent on consumers' effort and shopping experience

2.4 Decision-aiding features that support consumers' buying process

In the marketing literature, decision-aiding features have been studied to alleviate cognitive overload issues consumers face while making purchases online (Häubl & Trifts, 2000; Xiao & Benbasat, 2007). Instead of introducing mechanisms like information scents to reduce consumers' effect that facilitate activities in the *foraging loop*, research in this area have focused on the activities in the *sense-making loop* whereby consumers analyze differences between alternative products and consequently make a purchase. Two common decision-aiding features that have been widely investigated are: (1) recommendation agents for reducing the number of alternative products to evaluate, and (2) comparison

matrix for organizing product information in a structured manner for ease of evaluation (Häubl & Trifts, 2000).

Recommendation agents are "software agents that elicit the interests or preferences of individual consumers for products, either explicitly or implicitly, and make recommendations accordingly" (Xiao & Benbasat, 2007); they make use of consumers' self-reported preferences in their personal profiles or from their past purchases to recommend products that are highly likely to be of interest to them. It was found that recommendation agents reduce the amount of search consumers expend (measured by the number of pages accessed), and improves the quality of the products consumers place under consideration (Häubl & Trifts, 2000).

A comparison matrix is "conceptualized as an interactive tool that assists consumers in making in-depth comparisons among alternatives that appear most promising based on initial screening" (Häubl & Trifts, 2000). It was also found that the implementation of a comparison matrix improves the quality of products consumers place under consideration, and has a positive effect on purchase decision quality. Such matrixes are common on online retail stores and an example is shown in *Figure 2.2* below.

	Product A	**Product B**	**Product C**
Price	$20	$30	$40
Dimension	1" x 2" x 3"	2" x 3" x 4"	3" x 4" x 5"
Weight	80 grams	90 grams	100 grams
Warranty	1 year	1.5 year	2 year

Table 2.2 An example of a Comparison Matrix

Similar to the argument on information cues discussed in *Sub-section 2.3*, the addition of these decision-aiding features to online retail stores are expected to increase the time and effort that consumers expend in the shopping process. While I note that this argument conflicts with the findings from prior research, the discrepancy could be due the metric that was used to measure effort - the number of web pages accessed. By using the decision-aiding features in their shopping process, consumers are induced to use these features and thus have to navigate through lesser number of pages. Consumers who accessed lesser number of pages were taken to have expended lesser effort. However, consumers could have spent more time on each of the web pages they visit**.** Thus, my second objective in this thesis is to evaluate the effects of these features more holistically by taking into consideration time, cognitive effort, and physical effort in the assessment of overall effort.

2.5 Summary and broad questions

In sum, the concept of information cues proposed in the Information Foraging theory is primarily used to facilitate the efficient seeking of product information in the *foraging loop* (or *intelligence* phase), while decision-aiding features explored in the marketing field assist consumers in evaluating, analyzing, and making better purchase decisions in the *sense-making loop* (or *design and choice* phases). The effects of these mechanisms (i.e. information cues, decision-aiding features) on consumers' effort, quality of purchase decision, and satisfaction were investigated independently in the past. An interesting question to ask now: What will be the impact on consumer behavior, eventual purchases, and satisfaction if these two design parameters are introduced simultaneously?

Through this thesis, I aim to investigate the joint effects of the concurrent implementation of information cues and decision aids on consumer behavior in an electronic commerce environments.

	Literature Survey Summary
Information foraging theory	A model in analyzing users' information foraging behavior was proposed in the Information foraging theory. The entire information foraging process is organized into two loops of activities - a *foraging loop* and a *sense-making loop* (Pirolli, 2009; Pirolli & Card, 2005). The *foraging loop* involves processes aimed at seeking information, searching and filtering it, and reading and extracting information (Pirolli, 2009; Pirolli & Card, 1999), and the *sense-making loop* involves iterative development of a mental model (a conceptualization) that best fits the evidence (Pirolli, 2009; Russell et al., 1993).
Consumers decision-making process	Adapted from (Simon, 1957), the model comprises of three distinct phases – *intelligence, design, and choice* (Kohli et al., 2004). Applying it to electronic commerce setting, a shopper first recognizes the type of product to purchase and gathers the relevant product information in the *intelligence* phase. The *design* phase is marked by structuring the product requirements, developing criteria to assess product attributes for suitability, and identifying a list of alternatives products. Finally, in the *choice* phase, the shopper chooses the best alternative that meets the criteria, and makes the final purchase decision.
Foraging loop *(Information Scent)*	Humans seek information by foraging through patches of information, and switch from one patch to another when the cost exceeds the value of the task, at which point the seeker will reach a bounded, optimal solution based on the limited information that is available (Pirolli & Card, 1995). Information scent are cues that humans make use of to decide whether to forage through a patch of information (Budiu et al., 2007). In an online retail store with large assortment of products, information scents lead consumers to relevant products that fit their requirements, reducing their information foraging effort.
Sense-making loop *(Decision-aiding features)*	Humans make decisions through comparisons and analyses of information iteratively to develop a mental model (a conceptualization) that best fits the evidence (Russell et al., 1993). Interactive decision-aiding features enable such endeavor, and help consumers make the best choice with structured comparisons and recommendations (Häubl & Trifts, 2000). In an online retail store with large assortment of products, information foraging loop first reduces the number of choices to compare, and the decision-aiding features in the sense-making loop facilitate the selection of the optimal product.

Table 2.3 Summary of literature review

2.5 Significance of this research

From an academic standpoint, firstly, researchers from both streams of literature could understand consumers' behavior in an end-to-end shopping process that commences with seeking of product information and ends with making a purchase. Secondly, this research evaluates consumers' effort, quality of decision, and satisfaction by combining the implementation of both information cues and decision-aiding features at the same time.

From a practical standpoint, the findings from this research enable online retailers to administer optimal amount of information cues and decision-aiding features to improve consumers' shopping experience; more information cues or decision aids may not necessarily be the best solution. Improved shopping enjoyment and perceived usefulness of the site lead to higher intention to return to the store (Koufaris, 2002). Ultimately, that generates more revenue for online retailers.

Chapter 3: Research Question & Hypotheses

3.1 Research questions

The objectives of this thesis are to learn the individual and joints effects of design parameters like information cues and decision aids on the effort that consumers expend in the shopping process, quality of their purchase decisions, and their satisfaction with the shopping experience.

To investigate these effects methodically, I will first examine whether adding decision-aiding features to an online retail store have an effect on users' information foraging and sense-making processes. While these features were found to benefit consumers, little has been investigated on whether an increase in the number of these features would be detrimental instead of being beneficial. In this study, I will examine if the addition of these tools induce greater effort from consumers in the shopping process, cause consumers to make less optimal purchase decisions, and consequently be less satisfied with their shopping experience.

Secondly, I will also investigate the joint effects of these decision-aiding features with high and low degree of information scents on the same set of metrics.

To summarize, the following are the research questions that I aim to answer:

Research Question 1:

What are the effects of more decision-aiding features on consumers' shopping processes, and consequently consumers' satisfaction?

a) **Effort:** Will the implementation of more decision-aiding features impede consumers' online shopping process?

b) **Quality of purchase decision, Satisfaction:** Does the implementation of more decision-aiding features enable consumers make better purchase decisions, and consequently be more satisfied with their shopping experience?

Research Question 2:

How important is incorporating information scents together with more decision-aiding features in facilitating consumers' shopping process?

a) **Effort, Quality of purchase decision, Satisfaction:** Will increasing information scent impede consumers' online shopping process, causing them to make less optimal purchase, and consequently be less satisfied?

b) **Effort, Quality of purchase decision, Satisfaction:** Is having a high level of information scent as important, if not more important, than more decision-aiding features that enable consumers to make optimal purchase decision using minimal effort, and consequently be more satisfied with their shopping experience?

3.2 Hypotheses

Research Question 1

With the addition of more decision-aiding features on an online retail store, consumers are exposed to more relevant products and are able to make structured comparisons with alternative products. While that better facilitates consumers' sense-making processes, these features induce greater effort from

consumers in their shopping processes. Even though consumers need to navigate through lesser number of pages with the introduction of these features (Häubl & Trifts, 2000), the time may be lengthened and cognitive effort increased with the need to analyze more products and the accompanying information in these features. Therefore, I argue that consumers' effort expended in the shopping process is expected to increase on a store with more decision-aiding features. I also hypothesize that consumers are able to make better purchase decisions with the presence of such features as it enable them to make structured comparisons over a larger pool of alternative products with ease.

In spite of expending more effort in the shopping process, consumers' attitudes towards the online retail store may not be affected as they remain motivated and be engrossed in identifying the best-matched product. The ability to make a better purchase decision outweighs the greater effort needed. With better purchase decisions made, consumers are more satisfied with their shopping experience.

H1: The addition of decision-aiding features to an online retail store induces greater effort from consumers in the shopping process.

H2: The addition of decision-aiding features to an online retail store improves the quality of the purchase decision.

H3: Consumers are more satisfied with their shopping experience on an online retail store with more decision-aiding features.

Research Question 2

Prior empirical studies in the context of web search discovered that higher degree of information scent enhances users' performance in terms of lesser time taken and lesser number of pages accessed (Olston & Chi, 2003; Woodruff, Rosenholtz, Morrison, Faulring, & Pirolli, 2002). It was conjectured with higher degree of information scents, users "use the summary page to fairly carefully identify a summary that is likely to lead to the correct answer", and "they will visit the corresponding page and search for the answer on this page, repeating the process if the answer, in fact, seems not to be available" (Woodruff et al., 2002). Relating to the taxonomy of online shoppers, this conjectured set of actions gels well with the information goals (i.e. directed search behavior) of *comparison buyers*. However, such capabilities of information scents found in the context of web search may not be applicable to electronic commerce environment. We will validate the effect in this thesis.

The application of information cues on a product listing page allow consumers to learn high level information of each individual product before deciding whether to click on the link to know more about a selected product in the product details page. With information cues introduced, it is expected to reduce the effort needed to traverse between pages, but the time spent on each page and effort (and time spent on each page) is expected to increase. Therefore, I hypothesize that a basic online retail store (one without any decision-aiding feature) with information scent induces more effort from consumers, while enabling them to short list a set of relevant products closely aligned with their needs. Subsequently, they could make a better purchase decisions, and as a result are more satisfied with their shopping experience.

H4a: A basic online retail store with high degree of information scent induces more effort from consumers in the shopping process, compared to one with low degree of information scent.

H4b: A basic online retail store with high degree of information scent improves the quality of the purchase decision made, compared to one with low degree of information scent.

H4c: Consumers are more satisfied with their shopping experience on a basic online retail store with high degree of information scent, compared to one with low degree of information scent.

Though I have argued that information cues could improve quality of product decision and ultimately consumers' satisfaction with their shopping experience in Hypothesis 4, it was solely focused on the *foraging process* (i.e. information seeking). Decision quality and consumers' satisfaction could be further enhanced with the addition of decision-aiding features that facilitate consumers' *sense-making process* (i.e. comparison and evaluating alternatives).

For example, on the product listing page, consumers often need to click into each of the product details page to enrich their knowledge about the products to make comparisons and evaluations. This comparison and evaluation process requires consumers to retain large amount of product information in their short-term memory and making comparisons in within. Having a decision-aiding feature like a comparison matrix to an online retail store could potentially alleviate consumers' heavy cognitive load by enabling them to learn and analyze product

attributes through a page that displays attributes of short-listed products in a structured manner.

However, arguing from another perspective, adding a decision-aiding feature could induce even greater effort from consumers. Firstly, a consumer needs to short-list a set from the product listing page to compare, before actually comparing them on the comparison matrix. And on the comparison matrix page, she needs to further compare and evaluate the set of alternative products. As such, effort induced from the feature is expected to be greater.

Regarding the quality of decisions with comparison matrixes, I hypothesize that by providing a structured approach that allows consumers to compare attributes among the alternative products improves the quality of decisions made as differences can be clearly and easily distinguished. And contrary to popular beliefs that reducing consumers' time and effort in identifying the best-matched product is key to keeping consumers satisfied, I argue that finding the best-matched product is more important, even if it requires consumers to expend more effort. Consequently with better purchase decisions made, consumers are more satisfied with their shopping experience.

H5a1: A store with product comparison feature with low degree of information scent induces more effort from consumers in the shopping process, compared to a basic store (both high and low degrees of information scent).

H5a2: A store with product comparison feature with low degree of information scent improves the quality of the purchase decision made, compared to a basic store (both high and low degrees of information scent).

H5a3: Consumers are more satisfied with their shopping experience on a store with product comparison feature accompanied by low degree of information scent, compared to a basic store (both high and low degrees of information scent).

When the store with comparison matrix is coupled with high degree of information scent, consumers then not only have to perform the two steps in creating a consideration set and making comparisons across product attributes, but also have to process the information cues on the product listing and comparison pages. I hypothesize that greater effort is induced from consumers and is counterproductive in helping them make good purchase decisions. With lower quality of purchase decisions, consumers are consequently less satisfied with their shopping experience.

H5b1: A store with product comparison feature coupled with high degree information scent induces more effort from consumers in the shopping process, compared to the same store with low degree of information scent.

H5b2: A store with product comparison feature coupled with high degree information scent reduces the quality of the purchase decision made, compared to the same store with low degree of information scent.

H5b3: Consumers are less satisfied with their shopping experience on a store with product comparison feature coupled with high degree information scent, compared to the same store with low degree information scent.

After having short-listed relevant products and evaluating them, the last phase of consumer decision-making process (i.e. the *choice* phase) is to make the purchase.

Well established in the marketing literature, the consumer buying process typically comprises of five stages in the following order: need recognition, information search, evaluation of alternatives, purchase decision, and post-purchase behavior (Kotler & Armstrong, 2010). In the purchase decision stage, a consumer is susceptible to disruptions from two factors – (1) attitudes of others, and (2) unexpected situational factors (Kotler & Armstrong, 2010). Mitigating risks from unexpected situational factors online are not the objective of this thesis. Here we will discuss on how attitudes of fellow consumers, expressed in contemporary online retail stores, could affect the purchase decisions of others. Attitudes of other consumers are often expressed explicitly through reviews, and implicitly through product recommendations (e.g. what others have bought in the past with a product currently in view). These reviews and recommendations could disrupt or promote consumers' purchasing decision.

Early research in the marketing literature found that word-of-mouth information plays an important role in consumers' decision making process. The decision maker obtains recommendations for the purpose of reducing the uncertainty and amount of information that must be processed to make a decision (Olshavsky & Granbois, 1979). Reduced uncertainty increases consumers' confidence (or quality) of their purchasing decision.

In this thesis, I will examine two recommendation features that reduce uncertainty: (1) reviews, and (2) recommended products. Reviews made by fellow consumers commonly seen on contemporary online retail stores play an important

role in assisting consumers make purchase decisions (Lightspeed, 2011) by explicitly informing prospective buyers on the after sales experience. Recommending complementary products bought by other customers implicitly informs prospective buyers whether there is a need to buy a complementary product with the one under consideration

Similar to Hypothesis 5a, I hypothesize that the addition of recommendation features like reviews and product recommendations enable consumers to make better purchase decisions and acquire greater satisfaction, even though it induces them to expend more effort (cognitive and physical) to process more information (i.e. reviews and recommended products). Again, in alignment with my previous argument that better decisions are associated with greater satisfaction, consumers equipped with both comparison and recommendation features are expected to be more satisfied with their shopping experience.

H6a1: A store with product comparison and recommendation features with low degree of information scent induces more effort from consumers in the shopping process, compared to a store with only product comparison feature (both high and low degree of information scent).

H6a2: A store with product comparison and recommendation features with low degree of information scent improves the quality of the purchase decision made, compared to a store with only product comparison feature (both high and low degree of information scent).

H6a3: Consumers are more satisfied with their shopping experience on a store with product comparison and recommendation features

accompanied by low degree of information scent, compared to a store with only product comparison feature (both high and low degree of information scent).

In the scenario with high degree of information scent, not only that consumers have to perform the two steps in comparing alternative products, they have to evaluate the reviews and recommendations in the product details page, and also to process the information cues on all the pages. I hypothesize that greater effort (cognitive and physical) is induced from consumers leading to lower quality of purchase decisions, and consequently, lower satisfaction with their shopping experience.

H6b1: A store with product comparison and recommendation features coupled with high degree of information scent induces more effort from consumers in the shopping process, compared to the same store with low degree of information scent.

H6b2: A store with product comparison and recommendation features coupled with high degree of information scent reduces the quality of the purchase decision, compared to the same store with low degree of information scent.

H6b3: Consumers are less satisfied with their shopping experience on a store with product comparison and recommendation features coupled with high degree of information scent, compared to the same store with low degree of information scent.

To summarize, I hypothesize that a low information scent store with both comparison and recommendation features is the optimal design configuration. This configuration enables consumers to make the best purchasing decision, and to have the greatest satisfaction with their shopping experience.

Chapter 4: Methodology & Measurement

To answer the research questions and prove the hypotheses outlined in *Chapter 3*, a controlled experiment was conducted on online retail stores created for this study. Only through stores created specifically for this purpose will allow me to manipulate the variations of decision-aiding features coupled with high and low degree of information scent. A live store's design may contain parameters (e.g. content layouts, menu structures etc.) that are not of interest in this research, but could influence the planned measures of effort, quality of purchase decision, and satisfaction with shopping experience.

4.1 Experimental Design

The experiment adopted a 2x3 between-subjects design. There were six conditions: two basic online retail stores, two online retail stores with comparison feature, and two online retail stores with both comparison and recommendation features; one condition in each pair of stores will be incorporated with high degree of information scent. The details of what was included in each of these conditions are documented in *ANNEX A*.

To ensure that the experiment is not confounded by factors that are not of interest in this study, the content and structure in all conditions will be identical. Prior studies on information foraging were very much focused on providing information scents to guide users' navigational paths (i.e. through menu structures, names and tags). In one of the studies, the breadth and depth of menu structure was found to have an influence on users' search or browse choice (Katz & Byrne, 2003). And by pursuing different navigational paths through a search (i.e. use of search bar to seek information) or browse (i.e. use of menu bar to seek

information) choice may influence the effort participants expend, the quality of their purchasing decision, and satisfaction with their shopping experience. One method to ensure all participants follow the same navigational path is to remove the search bar from the online stores. However, to mimic the real online retail stores as much as possible, I decided to retain the search functionality. In an attempt to control the effect of consumers' search or browse choice on the results of the study, I adopted a flat menu structure for the stores whereby the entire menu was displayed (i.e. no collapsible menu) and participants could directly access the sub-menu items as if it is a top-level menu item. As such, the depth of the menu is controlled to match that of a search. Nonetheless, I recorded participants' browse or search choice to allow me determine if the choice they made has any effect on the end results.

After making the choice to access product information through the search or menu bar, a list of relevant products will be displayed to the participants. The layout, fonts, color scheme, and number of products shown on each page of the list were kept constant. For ease of reference in this thesis, I shall refer to these lists of products as "product listing page". The page that contains the comparison matrix shall be referred to as the "comparison matrix page", and the one that contain all information pertaining to a particular product will be named the "product details page".

In the following sub-section, I describe in detail how high degree of information scent has been administered to each of these pages.

4.1.1 High degree of information scents on product listing page

On the product listing page, the condition with high degree of information scent included a tab which was displayed when the cursor was positioned over each of the individual product (see *Figure 4.1*). Product attributes and review summary for that particular product was shown within the tab. This mouse over effect allowed participants to preview parts of the information that would see if they click on the link to access the product details page. For the condition with low degree of information scent, the mouse over effect was not shown to the participants.

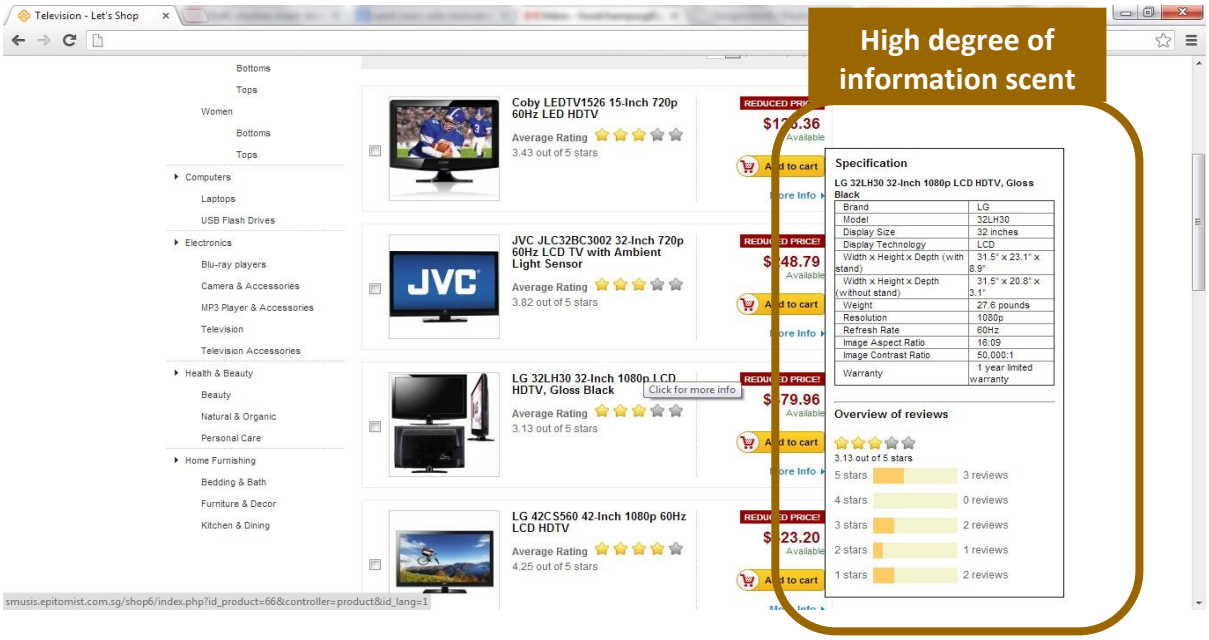


Figure 4.1 Basic shopping features

4.1.2 High degree of information scents on comparison matrix page

After short listing products close to their requirements in the product listing page, consumers typically compare the attributes of these products to identify the optimal one. To facilitate their comparison process, a matrix with high degree of information scent included the highlighting of dissimilar attribute values

(Olston & Chi, 2003). If the value for a product attribute differs from the value of an alternative product, the attribute row was highlighted. Similar to the mouse over effect in the product listing page, a tab containing product descriptions and review summary (only for the comparison and recommendation conditions) was shown when the cursor was position over each of the alternative product (see *Figure 4.2*). For condition with low degree of information scent, the highlighting of differing attribute values as well as the mouse over effects were not available.

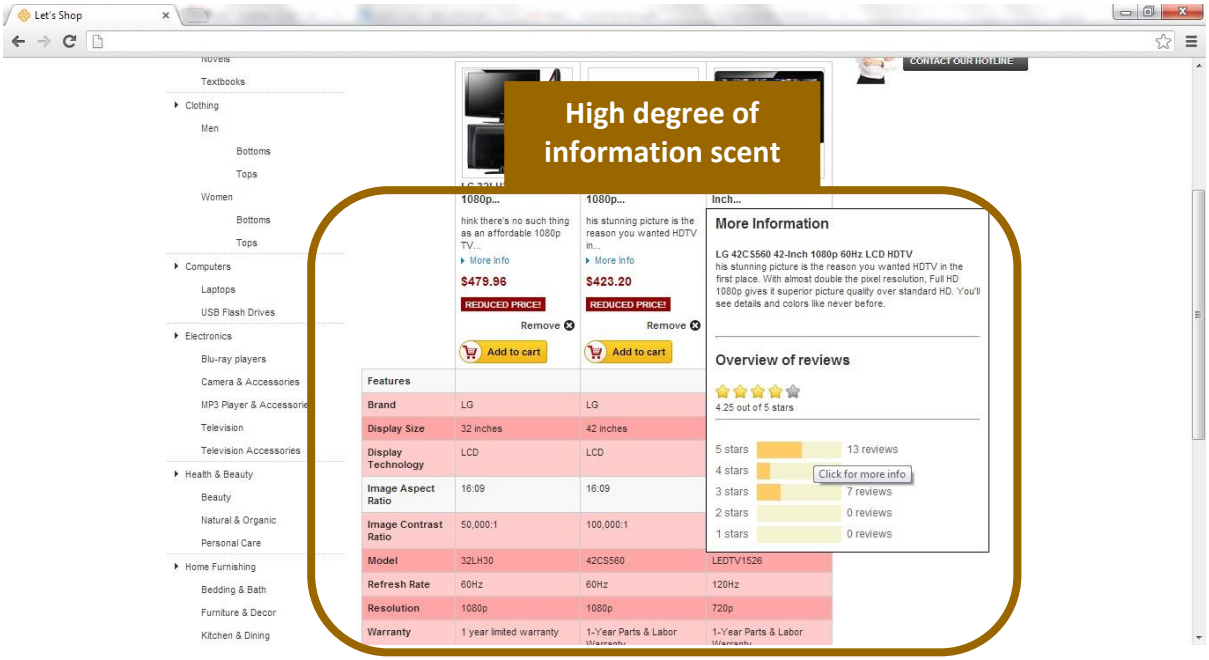


Figure 4.2 Comparison matrix with information scent

4.1.3 High degree of information scents on product details page

Product descriptions, specifications (i.e. product attribute and values shown in bullet form), reviews ratings with comments and recommendations are shown in the product details page. However, the core of the argument in this thesis is only on the reviews and recommendations. As such, the incorporation of high degree of information scent was only targeted at these two features.

Each review is rated between one to five stars on the three criteria: (1) price, (2) quality, and (3) features. The mean of the three criteria determine the overall rating given by each of the reviewer. A summary that counts the number of reviews from one to five star categories were presented in the review section of the product details page. For the condition with high degree of information scent, a mouse over tab appeared when the cursor is placed over each of the category in the review summary section (see *Figure 4.3(a)*). The tab contains the top review of the category, identified by the number of "thumbs up" given to that review.

Recommendations on products which previous customers bought with the product in view are placed at the bottom of the page (see *Figure 4.3(b)*). The condition with high degree of information scent incorporated the mouse over effect. Product specifications and review summary was displayed when the cursor was placed over each of the recommended product.

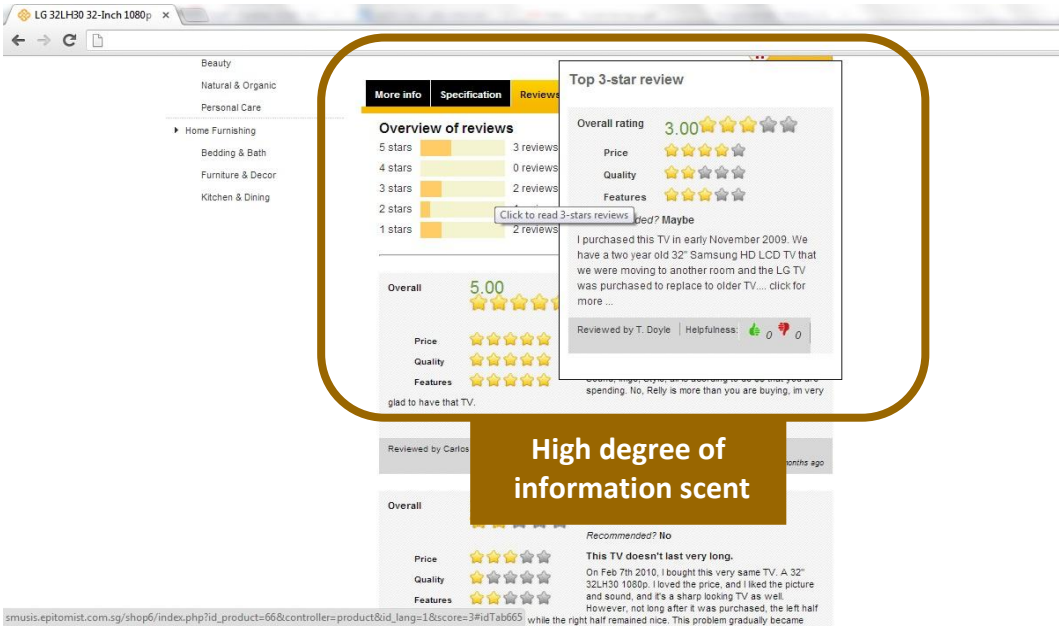


Figure 4.3(a) Reviews

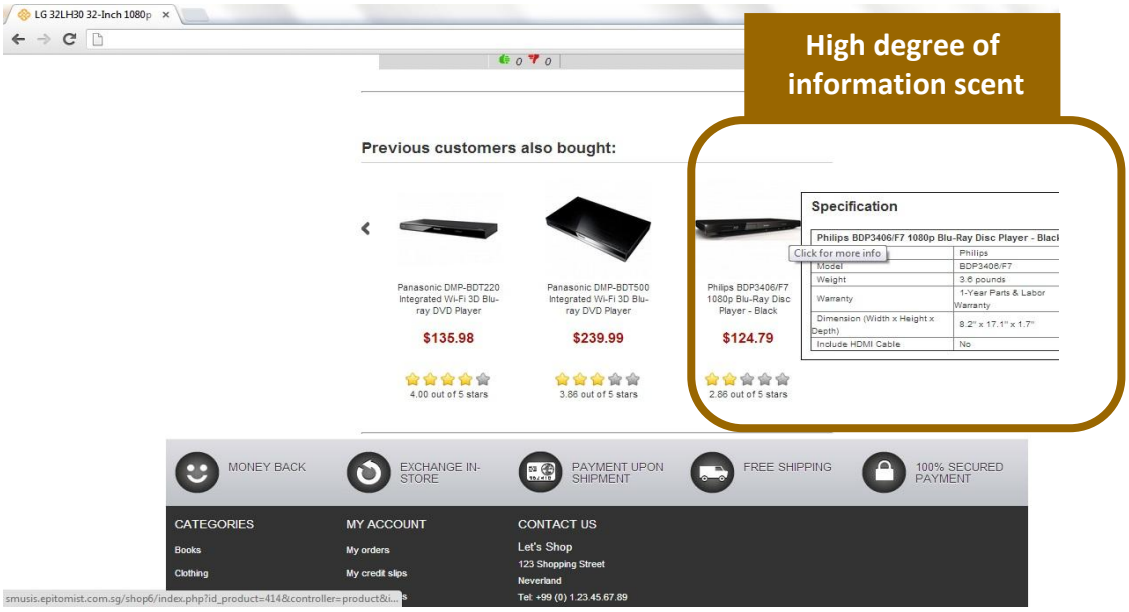


Figure 4.3(b) Recommendations

4.2. Data collection methods

4.2.1 Using Amazon Mechanical Turk as a subject pool

The experiment was conducted online via the use of Amazon Mechanical Turk (MTurk). MTurk is a crowd-sourcing platform where there are more than 400,000 workers (who shall be known as turkers from this point onwards) from all over the world, and 50,000 of them are available at any one time. The majority of the turkers are citizens of the United States (56%) and India (36%), of age between 18 and 34 (>65%), of almost even split between genders (52% female, 48% male), and with majority earning below US$10,000 per annum (32%) (Ross, Irani, Silberman, Zaldivar, & Tomlinson, 2010). Though the demographics may not be representative of all web surfers, it has been found to be more diverse than participants recruited online and American college student samples (Burhrmester, Kwang, & Gosling, 2011). Turkers are paid between US$0.01 and a few dollars for each task completed; employers have the option to reject work done and refuse

payment if it does not meet their expectations. On average, turkers earn about US$1.40 per hour (John Joseph Horton & Chilton, 2010).

This platform provides a convenient and low cost subject pool for online research studies. However, there have been concerns on the reliability of data gathered from this source. There were studies across disciplines such as economics (John J. Horton, Rand, & Zeckhauser, 2010), decision sciences (Paolacci, Chandler, & Iperirotis, 2010), human computer interaction (Heer & Bostock, 2010), and psychology (Burhrmester et al., 2011) that demonstrated results gathered from MTurk were not significantly different from laboratory studies. But there were also studies that found partial differences, especially on qualitative responses (i.e. those without a definite answer). In one study, qualitative ratings on a set of Wikipedia articles were only found to be moderately correlated between turkers and Wikipedia administrators. It was subsequently found that when turkers were tasked to complete quantifiable tasks before attempting qualitative assessment of the articles, the correlation between the two increased (Kittur, Chi, & Suh, 2008). Thus, gaming behavior to complete tasks to earn the most in the shortest time by doing qualitative rating frivolously was found to be prevalent among turkers if no controls are implemented.

To improve the quality of qualitative responses from turkers, it was found that by introducing financial incentives that is coupled with greater cognitive effort and financial punishment arising from disagreement of one's response with the majority of others' responses are associated with higher quality responses (Shaw, Horton, & Chen, 2011). In the context of this research, for the survey section to elicit participants' qualitative feedback on satisfaction with the shopping experience, having them to align their response to the majority is not

appropriate as they should be able to give their assessment of their interactions with the online store independently. The other recommendation on increasing participants' cognitive effort is suitable for this study and is already introduced in the shopping tasks that will be given to the participants – they will require quite a fair bit of cognitive effort in searching and identify product that matches the shopping requirements.

Deciding on an appropriate financial reward for the turkers is not a simple affair. It was found in prior research that with the increase in financial reward, the amount of responses (i.e. the amount of words that respondents type in an open ended question) increased but not the quality. Instead, quality was found to be the highest in the group that was not financially rewarded (Mason & Watts, 2009). Thus, intrinsic motivation of respondents is more crucial in getting quality responses than financial rewards. Researchers have suggested the explicit revelation to respondents that their input lead to social or research impact could increase respondents' intrinsic motivation (Krosnick, 1991).

With the background information on MTurk above, I decided to recruit as many participants as possible over a 5 day period. Each participant was paid US$0.50 for completing the experiment. The experiment was estimated to take around 30 minutes, but I explicitly gave no time limit to complete in the instructions. Though the financial reward offered is slightly lower than the US$1.40 per hour rate found in an earlier study, there is no reason to believe that it will compromise the end results as quality of responses come more from participants' intrinsic motivations.

Recruiting participants from MTurk improve the generalizability of the results as it is not confined to college participants or localities. Also, time-related

stress is inherent in turkers as they generally have the objective of completing a task quickly so they could move on to other tasks to earn more money on the platform. In real life online shopping scenario, time-related stress is also prevalent where consumers are motivated to purchase a product but is constrained by the time they have to complete the task (Moody & Galletta, 2008). Thus, recruiting turkers would very well simulate the time-related stress faced by real consumers on an online shopping task.

4.2.2 Experimental procedures

From the MTurk interface, participants clicked on a link to Qualtrics surveying platform[1] in which the entire study was delivered. Each participant was briefed on the research, the impact to the society the research brings about, the requirements for them to get paid, and was asked to consent to participating in the experiment. They were free to drop out of the experiment at any point in time without penalty, but they were not paid if they did so. Lastly, participants were reminded that they have to complete the task to the best of their ability and verifications will be made to ensure that they truly work towards that goal. The checks that I have made included the time they complete the experiment, the interactions they had on the shop (e.g. merely opening the home page of the stores, no interactions etc.), and an attention-checking question in the list of survey questions to determine if a participant is reading between the lines (e.g. "Please select Agree for this item").

Participants first worked on a trial task, and were randomly assigned to one of the six conditions described in *ANNEX A*. The purpose of the trial task is to

[1] Qualtrics software enables users to do any kind of online data collection and analysis including market research, customer satisfaction and loyalty, product and concept testing, employee evaluations and website feedback. (Wikipedia) – http://www.qualtrics.com

determine the amount of information foraging and sense-making effort each individual would generally expend when seeking information online. There are differences between individuals on the amount of effort that each would expend to seek information. Thus, the data collected from the trial task was used to determine one's intrinsic motivation and determination when seeking information. This data was used as one of the control variables when statistically testing the hypotheses whereby its effect was factored in analyzing effects of the conditions on the dependent variables.

Trial Task

> *Over dinner, your friend quipped "*I thought Crocs were quite popular shoes. But Time magazine lists it as one of 50 worst inventions ever.*"* You get very curious and decide to do a little research on this.

The following were the questions following the task:

a) Is Crocs actually listed as one of 50 worst inventions by Time Magazine?

b) Crocs is a/an _____ (country) company.

c) Do you think the methodology behind the Time Magazine list of 50 worst inventions is rigorous?

d) Please provide a list of websites / URLs that you found most useful for your research.

To be able to assess participants' information searching process, a web proxy was installed and its URL given to the participants through Qualtrics (see *Figure 4.4*). While searching for information through the web proxy, all

interactions made with other sites through the proxy was logged and visually recorded by Javascript provided by Mouseflow[2]. I used (1) number of pages viewed, (2) average total time spent on each page, (3) average active time spent (i.e. mouse movement) on each page to determine the individual differences in performing information foraging and sense-making activities. The three metrics summed up to an "intrinsic information foraging behavior" score with equal weights for each variable. The number of pages viewed represents the depth the participant would invest in the foraging process; the average total time spent represents the effort they would use in the sense-making process. Collectively, they measure the intrinsic information foraging behavior of the participants on searching and understanding information online.

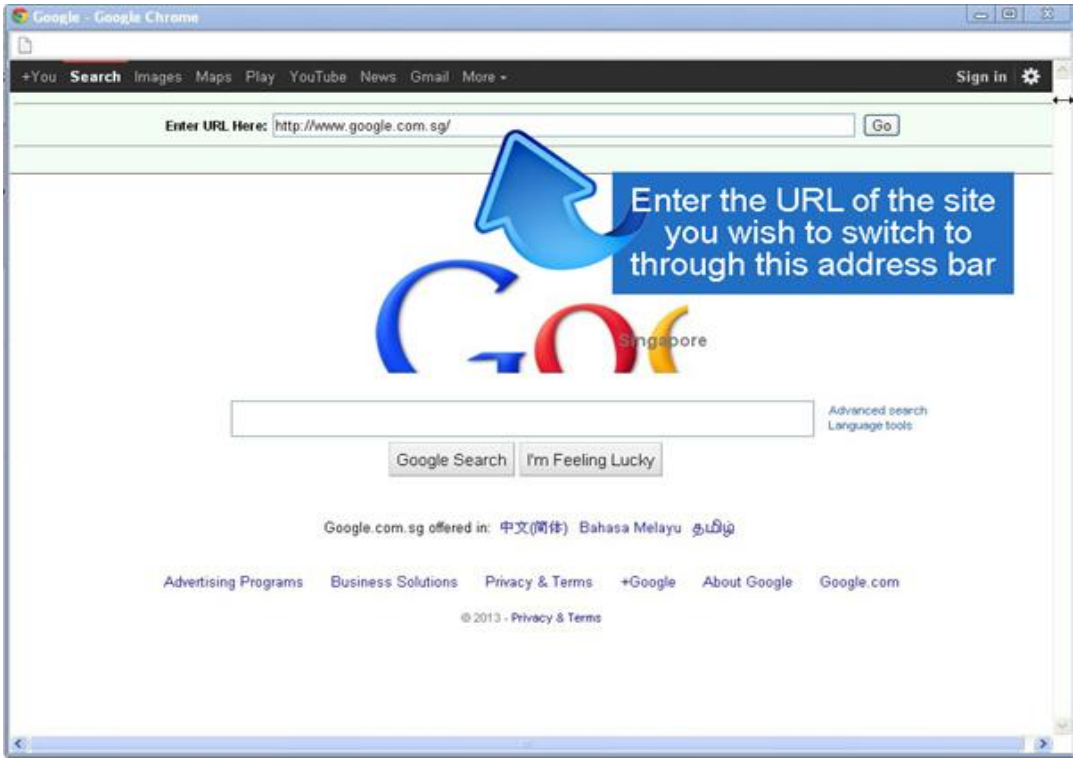


Figure 4.4 Trial task involving information search

[2] Mouseflow is a web service that records visitors' interaction data with web sites and presents it in various forms such as heat maps, play backs videos, and tables for web site owners to identify problems visitors face while surfing their sites. – http://www.mouseflow.com

Following on with the actual task (see *Figure 4.5*), each participant was randomly assigned to one of the six variants of the stores – each representing one of the conditions outlined in *ANNEX A*. The online retail stores were created using Prestashop™ – a popular open-source shopping cart script that has been downloaded more than 2 million times. The store included 21 product categories and an average of 20 items in each category. Descriptions photos, prices, and reviews of all items were extracted from Amazon.

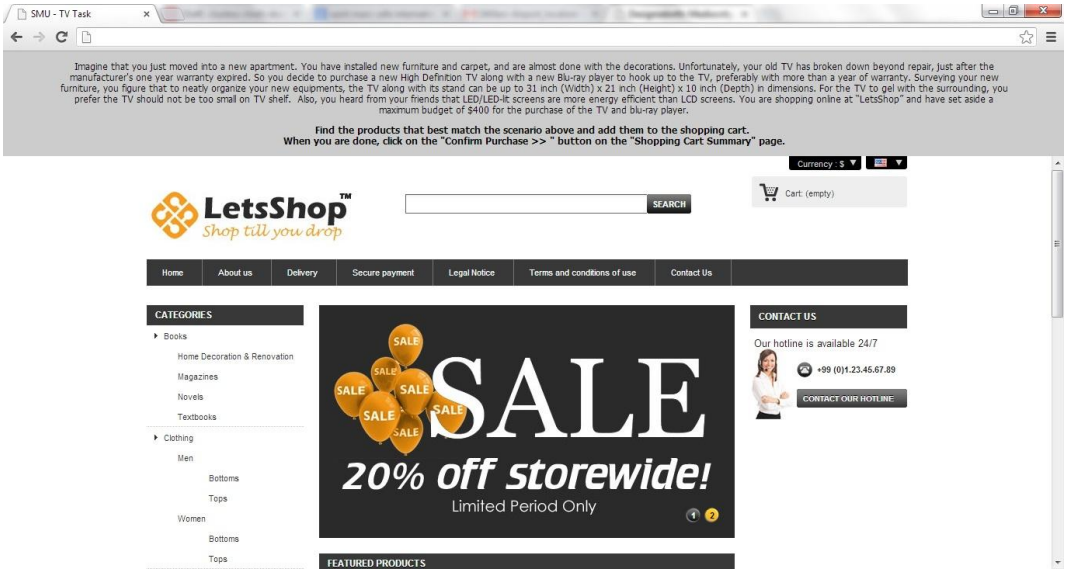


Figure 4.5 Shopping Task

Each participant worked on a shopping task to purchase a set of High Definition Television and Bluray player. The description of the task are as follow:

Shopping Task: HDTV & Bluray player

Imagine that you just moved into a new apartment. You have installed new furniture and carpet, and are almost done with the decorations. Unfortunately, your old TV has broken down beyond repair, just after the manufacturer's one year warranty expired. So you decide to purchase a new High Definition TV along with a new Blu-ray player to hook up to the TV, preferably with more than a year of warranty. Surveying your new furniture, you figure that to neatly organize your new equipments, the TV along with its stand can be up to 31 inch (Width) x 21 inch (Height) x 10 inch (Depth) in dimensions. For the TV to gel with the surrounding, you prefer the TV should not be too small on TV shelf. Also, you heard from your friends that LED/LED-lit screens are more energy efficient than LCD screens. You are shopping online at "LetsShop" and have set aside a maximum budget of $400 for the purchase of the TV and blu-ray player.

Find the products that best match the scenario above and add them to the shopping cart.

When you are done, click on the "Confirm Purchase >> " button on the "Shopping Cart Summary" page.

While they perform the shopping task, participants' interactions with the online retail stores as well as the final product that they purchase were recorded via Mouseflow and a self-created server-side script. After having completed the shopping process, each participant was requested to complete a survey that collect her feedback on why she made the purchase, her confidence level with making the purchase, her satisfaction with the shopping experience, and lastly provide her

demographical information. After which, each participant was thanked for their participation.

4.2.3 Metrics, data, and analyses

Measures	**Effort**	**Decision Quality**	**Satisfaction**
Metrics	1. Number of pages accessed 2. Average total time spent on each page 3. Average active time spent on each page	1. Objectively judged best matched product. 2. Subjectively judged best matched product.	1. Satisfaction with the shopping experience

Table 4.2 Summary of metrics for dependent variables

The three measures that we have discussed so far – *Effort*, *Decision Quality*, and *Satisfaction* with shopping experience – will be measured by via a series of metrics (see *Table 4.2*). The rationales for the use of the metrics for each of the constructs are as follows:

Effort

A number of metrics have been proposed to measure effort consumers expend on electronic commerce channels. It can be measured by the time (Benbasat & Dexter, 1985; Jarvenpaa, 1989), physical actions (Häubl & Trifts, 2000; Olston & Chi, 2003; Punj & Moore, 2009) and cognitive resources. For this research, I included all three metrics in my measure of *Effort*.

Firstly, time saving is one of the main reasons why consumers buy online (Lohse, Bellman, & Johnson, 2000). Using lesser time to complete a shopping task on an online store suggests better performance as shoppers are able to make

their purchase promptly. I took the average total time spent per page to complete the shopping task as part of the *Effort* measure.

Secondly, effort was also often measured by the physical actions consumers make (e.g. for example, the number of pages accessed). However, purely using physical actions to measure effort does not conform to a holistic approach. A consumer could have accessed few pages, but spent a long time on each page and processing the content of the pages in detail. They could have expended huge cognitive effort in that process, which the physical action metric does not capture. Cognitive effort refers to the psychological costs of performing the task of obtaining and processing the relevant information in order for one to arrive at a decision (Pereira, 2000). When a consumer stays actively on a web page (i.e. with active cursor movements), it is highly likely that they are reading the content presented on the page and are processing them cognitively. The average amount of time spent actively on a page for each participant would be a good measure of cognitive effort one expends in the shopping process. The higher the average amount of active time spent per page, the higher the cognitive effort a consumer expends.

In summary, the effort construct in this thesis will include the following metrics: (1) number of pages accessed, (2) average total time spent per page, and (3) average active time spent per page. Identical to the trial task, the three variables contribute equally to the *Effort* score.

Decision Quality

Quality of decisions measures the accuracy of consumers' buying optimal products that match their needs and constraints. In this research, I measured both objectively judged and subjectively judged decision quality.

For objectively judged decision quality, it was measured by the combination of: (1) deviation between the total price of a participant's purchases with the given budget, and (2) degree of match between product attributes and given requirements.

On the deviation of price with given budget, it is computed by deducting total purchased price from the budget. After which, I normalized the data by converting their values to a score within the range of 0 to 1. And on the degree of match between purchases and given requirements, I compared the attributes given in the task (4 product attributes for HDTV and 2 product attributes for Bluray player) with each of the products a participant purchased. For each product purchased, if a product attribute of a purchased product matches the corresponding attribute of the given requirement, a score of 1 was awarded. The scores were summed to represent the objective decision quality score. Like the variable earlier, the value for product match score was normalized to a score within the range of 0 to 1. Lastly, in order to be able to combine both scores into a one, the value for deviation with price was inversed (i.e. 1 minus the normalized value). The two scores were then summed for each participant.

In the shopping task given to participants, there were only 3 products in each of the Television and Bluray player categories where the product attributes match closely with the task requirements. Of these three products, I manipulated their *perceived quality* – assessed by a rating score given in the review section as

well as the review content (i.e. review ratings were kept constant, and content of reviews were kept similar except for their contexts) – so that they are almost equivalent. As reviews could influence the decisions made by participants, keeping review ratings and content constant control for effects of reviews on the purchases participants made.

Brand perception of a product has an effect on a consumer's choice (Cobb-Walgren, Ruble, & Donthu, 1995; Grewal & R. Baker, 1998). A product that is objectively optimal (e.g. match in product attributes with requirements) may not ultimately be optimal to them. Consumers may sacrifice a product with better specification for a preferred brand. As such, I included a subjectively judged decision quality metric, a self-reported measure on one's confidence of the products she bought (Häubl & Trifts, 2000). The participants were asked to answer the following question on a Likert scale of 5, between Strongly Disagree and Strongly Agree on their purchases: "I am confident that the products I have just purchased are the best choices for me". If a participant is confident, we could say that she perceived her purchase as a good decision made. The rating was again normalized to a score within the range of 0 and 1.

Finally, a composite *Decision Quality* score was computed that gives equal weighting to each of the two normalized (subjective and objective) variables.

Satisfaction

Consumers' satisfaction was measured using a modified scale developed by *(Devaraj, Fan, & Kohli, 2002)*. The following were the questions asked on a Likert scale of 5, between Strongly Agree and Strongly Disagree:

- "Overall, I was satisfied with this shopping experience."

- "The online store's content met my needs."
- "It was easy for me to choose and buy the product of my choices."

The three variables need to be validated for internally consistency before being made into a single score. The procedure and results are reported in the next chapter.

Demographics & Other information

Lastly, the following demographical variables were collected to control for individual differences on the three measures in this study.

1. Background
   - Age
   - Gender
   - Education
   - Nationality
   - Annual Income
2. Experience
   - Number of years online shopping experience
   - Number of online purchases per year
   - Previous experience with buying electronic products (e.g.TV, videos, refrigerators, air-conditioners etc.) online

Chapter 5: Finding and Analysis

5.1. Screening of participants

A total of 272 participants attempted the study posted on MTurk over a 5 day period. Of which, 117 completed the experiment. A series of screens were made on the participants. 8 of the participants were found to complete the study in less than 10 minutes (between 2 minutes to 9 minutes). On further investigation into these 10 participants, they took between 3 to 36 seconds to complete the shopping task. Also, the reasons these participants gave for making the purchase did not show any indication of the rationales behind the purchases. All the reasons were brief, general or irrelevant which did not demonstrate understanding the task. The following were the feedback: “no”, “very much”, “good and nice”, “grocery”, “nothing”, “dress and electronic equipment is available in a same web site”, “The product is quality”, and “yes”. As such, gaming behavior was deemed apparent in these cases and they were exclude from further analysis.

As mentioned in Chapter 4, an attention checking statement was included to determine if a participant carefully assesses each statement before giving her rating. Two participants, of which one was already excluded from the completion time verification conducted earlier, were found to fail this validation out of all 117 participants. Given that those who did not rate the survey carefully would create bias on the results (especially on the survey items) I excluded the case from the data set as well.

Following on, a participant who was found to take 2.6 seconds for the shopping task was also excluded. It is impossible for the participant to make any meaningful purchase if the time taken to make a purchase is in a couple of seconds. Also, another participant who bought magazines instead of television and

blu-ray player for the shopping task was also removed from the data set. 32 other participants were also found to not to have made any purchase or their interactions with the online stores were not present. This could be due to technical issues on our server or participants' browsers were not able to support the tools used in this experiment. To maintain the integrity and completeness of data for each participant, these records were also excluded from analysis.

The following table breaks down the number of participants that were excluded from each of the 6 conditions:

Condition	Total	< 10 mins	Attention Check	<40s shopping	No purchase / interaction	Bought irrelevant items	Final
Basic with low scent (B.L)	24	-4			-8		**12**
Basic with high scent (B.H)	18		-1		-5		**12**
Comparison Matrix with low scent (C.L)	18	-1			-3	-1	**13**
Comparison Matrix with high scent (C.H)	23			-1	-5		**17**
Comparison Matrix & Recommendation (CR.L)	18	-1			-7		**10**
Comparison Matrix & Recommendation with high scent (CR.H)	16	-2			-4		**10**
Total	**117**	**-8**	**-1**	**-1**	**-32**	**-1**	**74**

Table 5.1 Screen of participants

As an equal sample size in each condition is needed to perform a 2-way multivariate analysis of variance (MANOVA), I took the lowest denominator of participants in a group with valid data as the size that is required – that is, 10

participants from the final data set. For conditions with more than 10 participants, I drew 10 participants from each group in ascending order of the completion time of the entire study (i.e. the first ten participants from each group).

5.2. Statistical diagnostics

Composite scores were computed according to the formulae for the *Effort* and *Decision Quality,* and *Satisfaction* measures described in *Chapter 4*. And as proposed, for the *Satisfaction* score, I performed a reliability test among the three variables in the satisfaction scale before proceeding to convert them into a composite score. It was found to align with prior research that the three survey questions measure the same construct (Cronbach $\alpha = .804$), and thus they were combined into a single composite mean score. Thus, we now have three variables that act as the dependent variables in this research.

Prior to executing the MANOVA procedures to compare the effects between the six conditions on the dependent variables, diagnostics were first conducted on the data to ensure assumptions for such analysis are met (i.e. multivariate normality and homogeneity of variances). Firstly, Mahalanobis distance was computed for all the cases, and one case (MD=19.9) violated the cut-off based on 3 variables, $\chi^2(3)$ at $\alpha=.001$. On further investigation, the *Effort* measure was found to drive this case out of multivariate normality. The average time that the participant spent on each page was found to be 190 seconds, which was the highest among all the cases. The average time spent actively in proportion to the total time spent on each page for this case was between 30-34%, which was not out of the norm with the other cases. As such, I decided to keep the case in the data set for further analysis. However, to reduce the effect of large values on the

results that are prevalent for time-related variables, I performed a natural logarithmic transformation on the time values – both average total time per page and average active time per page (in seconds) for both the trial and shopping tasks. After which, another Mahalanobis distance was re-computed and there was a new case that violated the cut-off value (MD=18.79). It was found that the participant had navigated through the highest number of pages (i.e. 48 pages) for the entire shopping task. I did not see this as an anomaly as there could be cases in real life where people would surf more pages to make their purchasing decisions. Thus, I kept the case as it is and assumed multivariate normality.

5.3. Analysis of results

The three measures of *Effort*, *Decision Quality*, and *Satisfaction* were added as dependent variables to the 2 (information scent) x 3 (decision-aiding features) factorial design MANOVA procedures. The "intrinsic information foraging behavior" score (essentially the *Effort* score in the trial task) and choice of using the search bar or the menu bar to navigate the online store were used as covariates in the model. The homogeneity assumption of equal variance-covariance across groups was not violated at significance level of .01, Box's M=47.401, F(30,6589.96)=1.351, p=.096. Since both assumptions of normality and homogeneity of variances have been met, I proceeded on with the analysis of the effects between the conditions.

The between-subjects effects were found not significant between groups on each of the two factors and their interaction:

- **Decision-aiding features (Wilk's λ=.228):** Effort, F(2,52)=1.528, p=.226; Decision Quality, F(2,52)=.034, p=.966; Satisfaction, F(2,52)=.432, p=.651.
- **Information Scent (Wilk's λ=.185):** Effort, F(1,52)=.712. p=.403; Decision Quality, F(1,52)=1.966, p=.167; Satisfaction, F(1,52)=1.145, p=.289.
- **Decision-aiding features x Information Scent interaction (Wilk's λ=.346):** Effort, F(2,52)=.544. p=.584; Decision Quality, F(2,52)=.345, p=.710; Satisfaction, F(2,52)=1.180, p=.316.

As the group differences were not significant, post-hoc tests comparing which condition is different from another are irrelevant. Though the results showed that there was no difference between the conditions, we could ascertain that there are indeed no differences due to the small sample size in this study.

As expected, the *Effort* expended in the trial task was found to be positively associated with *Effort* in the shopping task, F(1,52)=12.094. p=.001. That is, if the participant used more effort in the trial task, she was also found to use more effort in the actual shopping task.

Another covariate in the analysis was the choice of using search bar or the menu bar to access the list of products. An interesting finding was that participants who used the menu bar in their shopping process were more satisfied (N=40, μ =4.233, σ =.556) than those who used the search bar (N=20, μ =3.8, σ =.729), F(1,52)=5.582, p=.022. Participants who used the menu bar was also found to have better quality of decisions (N=40, μ =.636, σ =.105) than who had used the search bar (N=20, μ =.5479, σ =.092), F(1,52)=6.318, p=.015. This result is

counterintuitive as I expected search bar to be more suitable for the participants (who are conditioned to be *comparison buyers*) in seeking the most relevant products with minimal amount of effort, and consequently be more satisfied with the shopping experience.

As for other demographical variables, each of them was used to predict the three dependent variables in separate MANOVA procedures to preserve a conservative estimate (it is easier for results to be significant if they were predicted individually). None of these variables (i.e. age, gender, education level, income, country, years of online shopping experience, average number of online purchases per year, and past purchase of electronic products) were found to be associated with the dependent variables at. 05 level; Box's M Test was also not violated at .001 level, indicating that the homogeneity of variance assumption was met.

Despite the results were rather disappointing with regards to answering the research questions and proving the hypotheses outlined *Chapter 4*, this study provides a good starting point for similar experiments in future. To provide more insights and understand the causes of the not so encouraging results, I analyzed the choices and actions participants made in the shopping task, and the differences among the various conditions on the individual variables (instead of composite variables) used in this experiment. The following is a summary of the analyses:

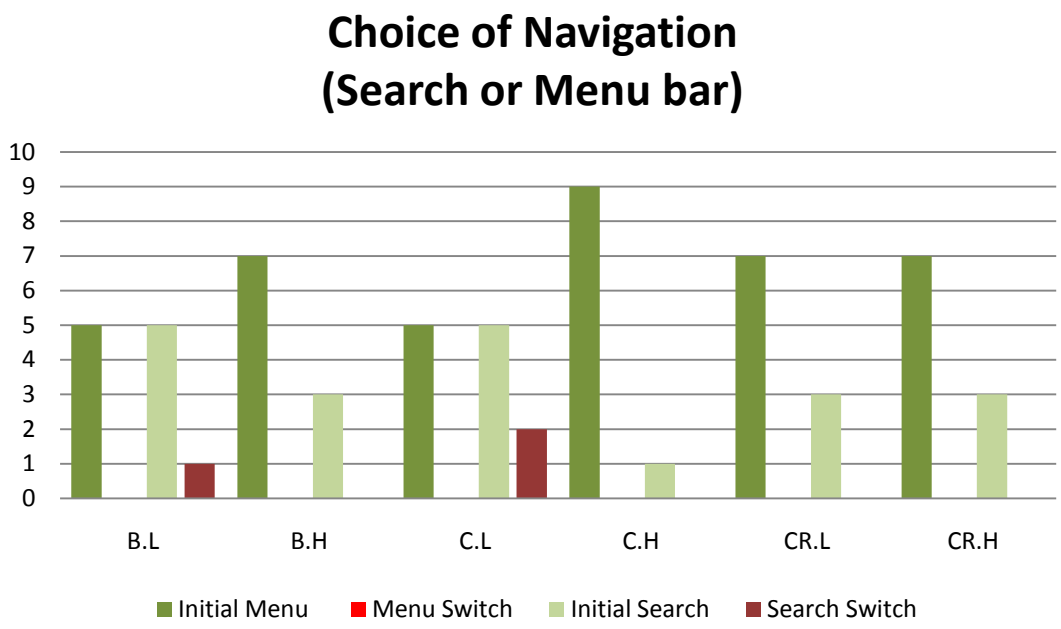


Figure 5.1 Participants' choice of navigation

Starting from the first action made on the shopping task, the majority of the participants were found to use the menu bar to access the list of products (see *Figure 5.1*). Other than basing on just the initial choice that participants made in the shopping task, I delve deeper to understand if they made any switch while performing the task. Only three participants – one in B.L and two in C.L conditions – were found to switch from using the search bar to the menu bar within the task.

Number of participants (10 in each condition)	B.L	B.H	C.L	C.H	CR.L	CR.H
Used comparison matrix	N/A	N/A	0	1	1	1
Browsed individual reviews	N/A	N/A	N/A	N/A	0	0

Table 5.2 Participants use of comparison matrix and reviews

The use of the comparison matrix and browsing of the individual reviews were low among participants (see *Table 5.2*). Only 3 participants out of 40 participants in C and CR conditions who were given the access to the comparison feature made use of the comparison matrix. As such, the participants in the Basic (B) and Comparison (C) conditions are almost indifferent even though there was one participant in C.H who used the comparison feature. The Recommendation feature was only available in the CR conditions. None of the 20 participants were found to have browsed the individual reviews in the product details page. A possible reason was that they were not conditioned sufficiently to treat the task as a real purchase. A real purchase requires serious deliberations on making comparisons between alternative products, but that was not seen in this experiment.

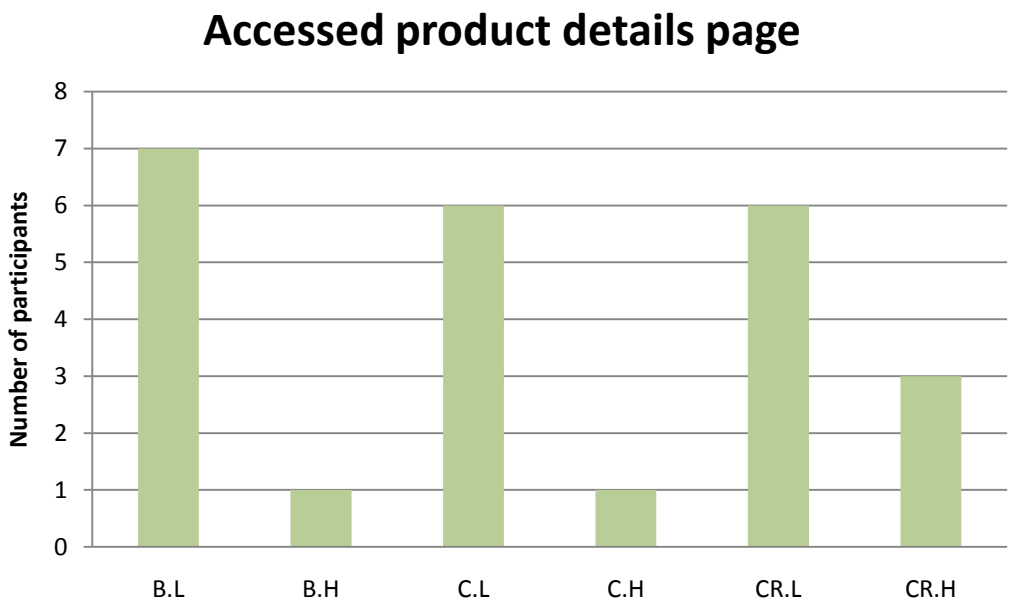


Figure 5.2 Number of participants who accessed the product details page

Significantly lesser number of participants in the high degree of information scent conditions (H) accessed the individual product page (see *Figure 5.2*). As participants in these conditions were able to access the product specifications and summary of review ratings through the mouse over tab in the product listing and comparison matrix pages, the reason for them not clicking into the product details page is probably that they have already gotten information they need to evaluate alternative products on those pages.

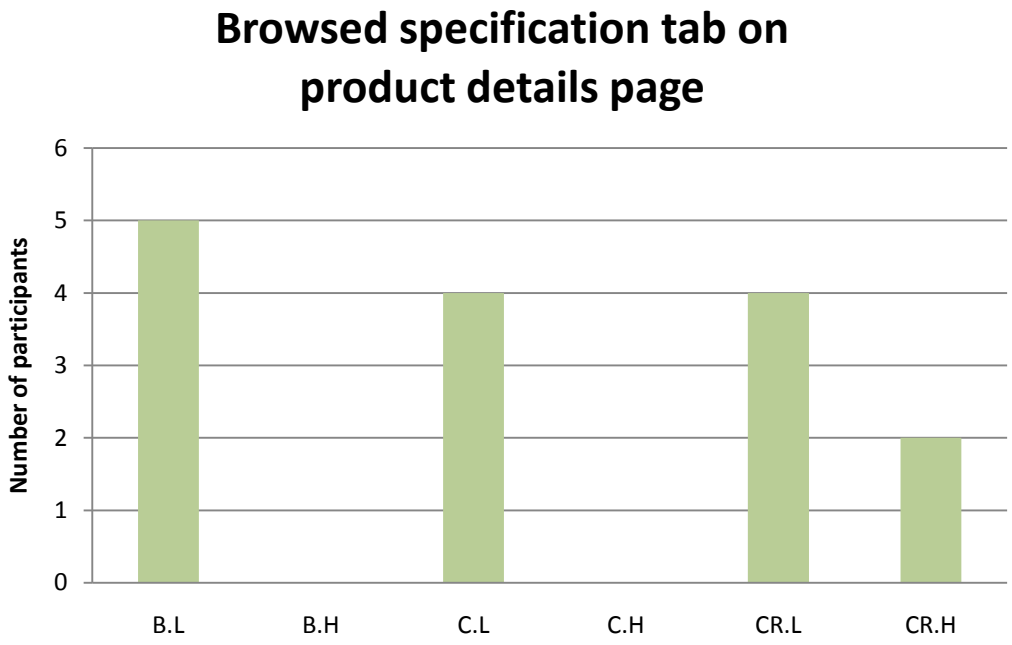


Figure 5.3 Number of participants who browsed the specification tab on product details page

Even lesser number of participants browsed the specifications tab in the product details page (see *Figure 5.3*). There were no participants in the B.H and C.H conditions who browsed such information. The reason is most likely to be similar to the reason for not accessing the product details page. Participants have

probably gotten information they need to evaluate alternative products on the product listing and comparison matrix pages.

Following on, I proceeded with analyzing the differences among the conditions among the individual variables that were made into composite variables in the MANOVA test earlier.

Mean (Standard Deviation)	B.L	B.H	C.L	C.H	CR.L	CR.H
Average number of pages accessed	13.500 (9.698)	10.700 (8.473)	16.000 (13.233)	12.300 (6.897)	10.200 (5.846)	10.400 (5.125)
Average amount of total time spent per page (secs)	35.321 (30.974)	28.015 (17.940)	28.298 (16.364)	25.513 (9.919)	29.252 (13.783)	73.795 (63.655)
Average amount of active time spent per page (secs)	20.014 (7.865)	20.215 (13.395)	16.656 (5.767)	18.495 (3.192)	22.140 (9.501)	35.889 (18.648)
Satisfaction with shopping experience	4.233 (0.446)	3.867 (0.849)	3.833 (0.527)	4.167 (0.478)	4.333 (0.544)	4.100 (0.890)
Degree of match with requirements of shopping task	1.050 (0.438)	1.100 (0.516)	0.925 (0.409)	1.350 (0.615)	1.125 (0.429)	1.250 (0.456)
Deviation of purchase price with budget	87.149 (78.605)	88.823 (80.028)	89.150 (55.692)	79.616 (87.543)	55.943 (55.137)	110.233 (86.582)

Table 5.3 Means and standard deviations of individual variables for all conditions

Effort Satisfaction Decision Quality

The means and standard deviations of the individual variables are presented in *Table 5.2*. T-tests based on the hypotheses were also conducted between conditions for each of these variables and analyses are given in the sub-sections below:

5.3.1 Effort – Number of pages accessed on shopping task

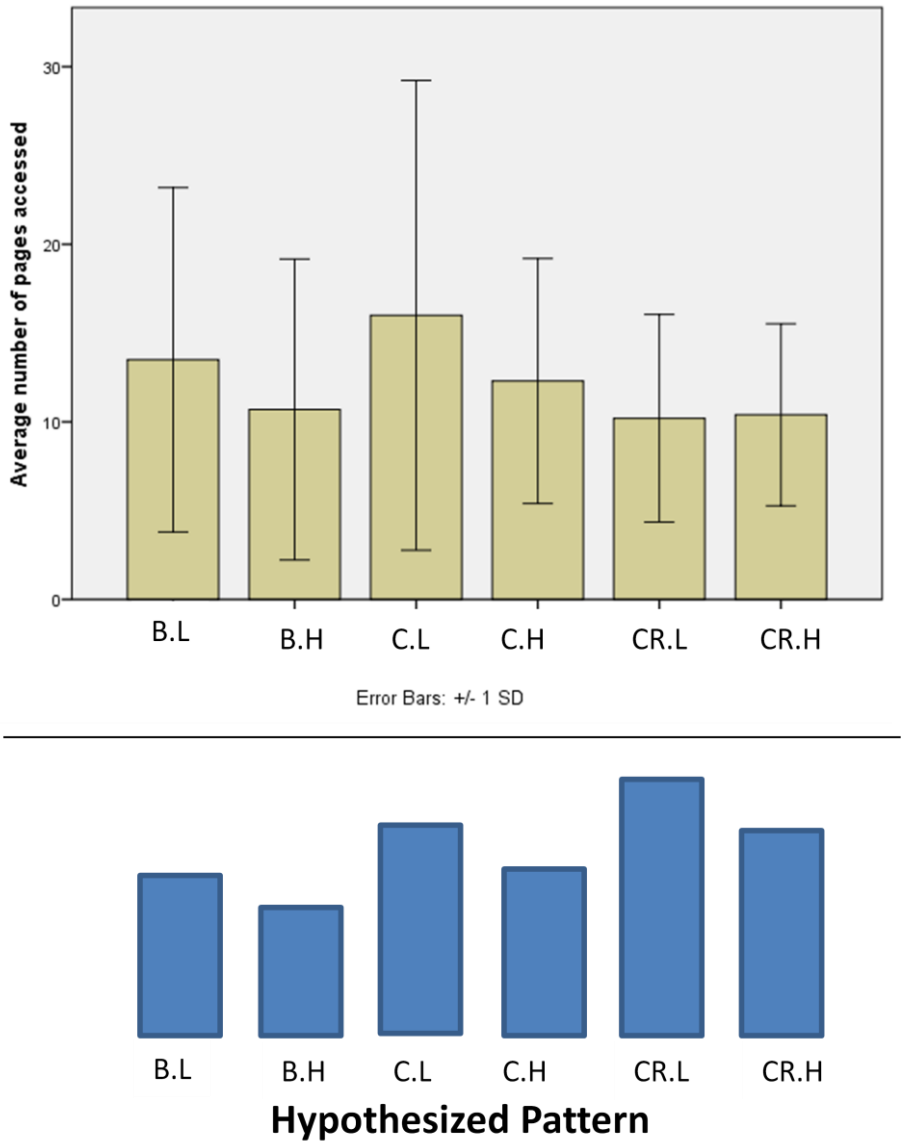


Figure 5.4 Actual and hypothesized graphs on average number of pages accessed

Low degree of information scent is generally associated with greater number of pages accessed. The participants in conditions with low degree of information scent (L) accessed more pages, with the exception of CR.L (see *Figure 5.4*). For the CR conditions, there was a case in which only 1 page was accessed. That is not possible to make a purchase as participants need at least 3 pages to traverse from the homepage to the check out page. A technical error might have occurred for the case. This case has escaped the filtering process to

remove cases that may bring bias to the results and future filtering procedures should include this criterion. Nevertheless, if we exclude that case from the analysis now, the new average for CR.L (μ=11.2) has no material impact on the result.

5.3.2 Effort – Average total time spent per page on shopping task

Participants in B.L to CR.L appeared to spent similar amount of total time per page, but with marginal differences (see *Figure 5.5*). The reason for the B and C conditions to yield similar result is probably due to the fact that only 1 participant out of 20 made use of the comparison feature in the C conditions (see *Table 5.2*). As such, the expected longer time spent in the C conditions was not seen in the result.

Those in the CR.H condition spent the highest total time on each page (μ=73.795 seconds). Two cases that spent the most time per page of all the cases were in this condition – 177.15 and 190 seconds respectively. Excluding these two cases, the new average for CR.H (μ=46.232 seconds) is not far from the rest of the conditions. The two participants causing the large difference could have left the page on, while working on something else. Nevertheless, even after excluding these cases from the analysis, participants in CR.H still spent the longest time on average. A t-test between CR.H (μ =73.795, σ =63.655) and CR.L (μ =29.252, σ =13.793) was found to be statistically different at .05 significance level, t(18)=-2.163, p=.044. Participants in the Comparison and Recommendation condition with high degree of information scent spent more time on each page as compared to its counterpart with low scent. This is in line with the *sense-making loop*

proposition whereby participants spent more time on each page as they digest the information shown in the mouse over tabs.

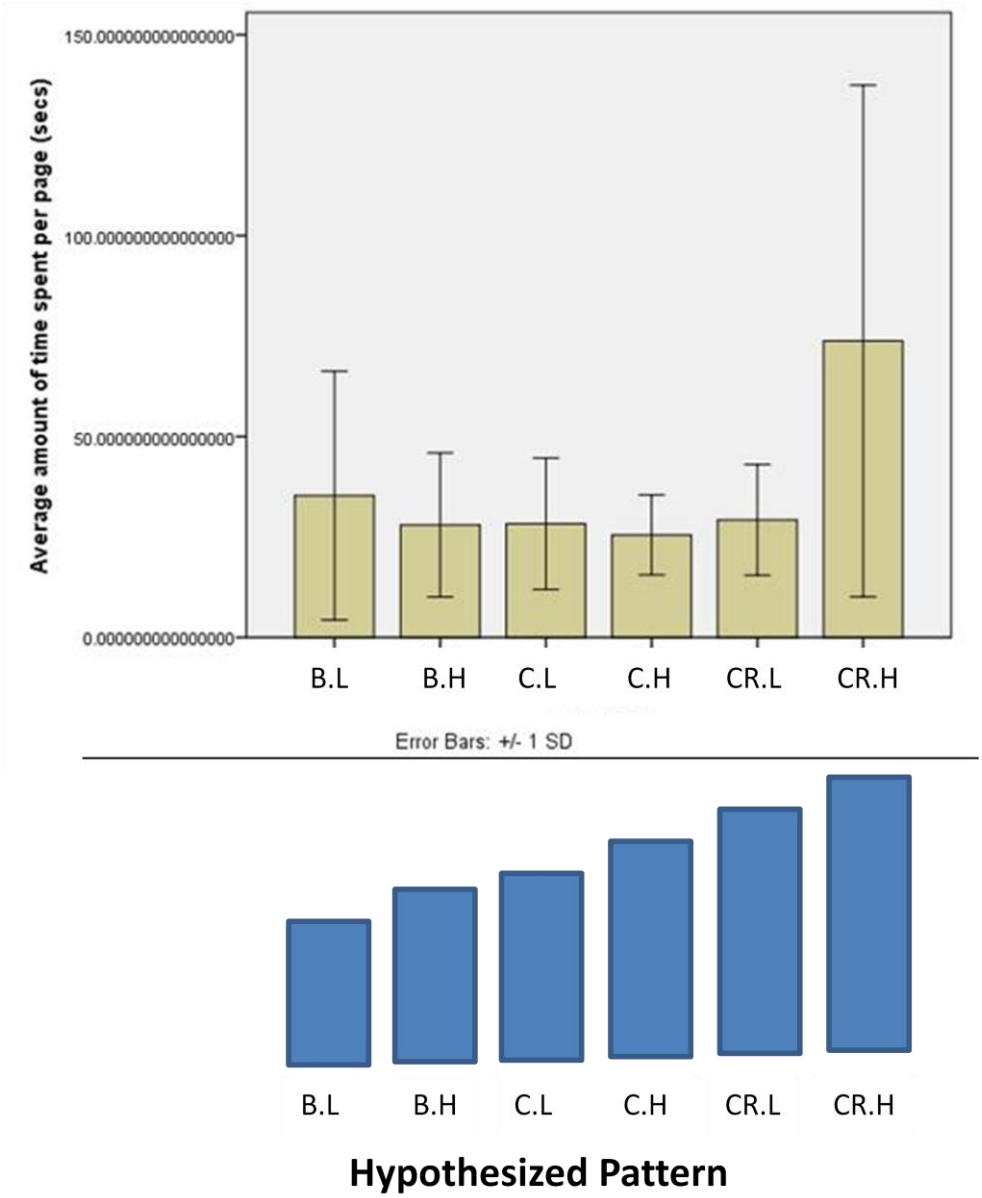


Figure 5.5 Actual and hypothesized graphs on average total time spent per page

5.3.3 Effort – Average active time spent per page on shopping task

The pattern for the average active time spent per page (see *Figure 5.6*) is similar to the average total time per page seen earlier (see *Figure 5.5*). The pattern we see here from B.L to C.H is probably be due to the same reason as the prior – there were no differences between B and C conditions in terms of the design parameters that the participants were subject to (i.e. not all participants in the C conditions used the comparison feature). With regards to the differences between CR.L (μ =22.140, σ =9.501) and CR.H (μ =35.889, σ =18.648), it was once again found to be moderately statistically different at .05 significance level, t(18)=-2.0773, p=.052.

Thus, not only the participants in CR.H spent more time in total on each page, they were actively looking through the pages compared to those in the CR.L condition. Though the other pairs on high (H) and low (L) degree of information scent conditions were not statistically different, the graph in *Figure 5.6* shows some signs that participants in high degree of information scent conditions (H) spent more active time compared to its counterpart with lower scent.

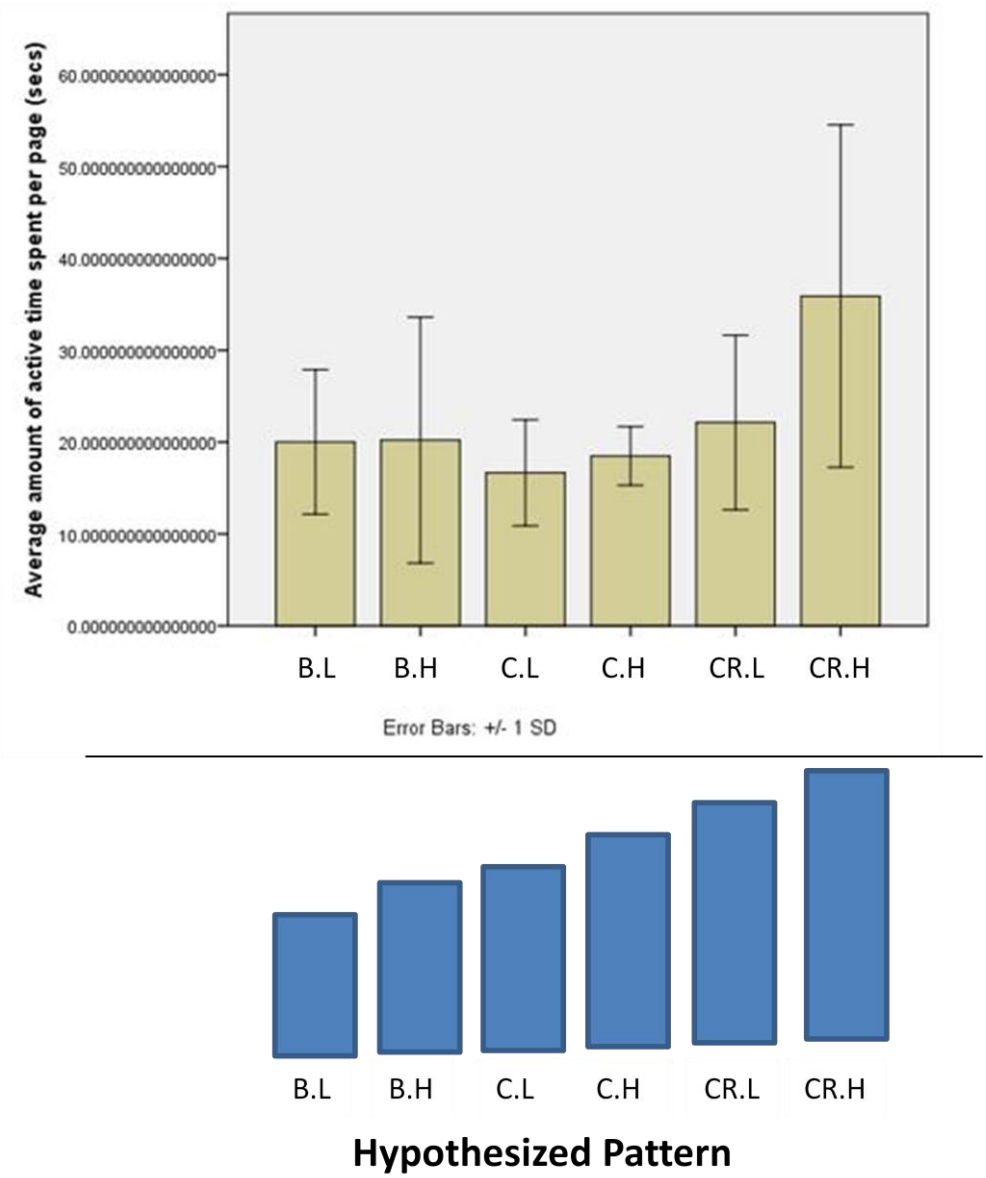


Figure 5.6 Actual and hypothesized graphs on average active time spent per page

5.3.4 Satisfaction with shopping experience

No prominent pattern of being more satisfied with more decision aids (B to C to CR), or with high degree of information scent (H) was found (see *Figure 5.7*).

However, a t-test conducted between CR.L (μ=4.333, σ =.544) and C.L (μ=3.833, σ=.527) was found to be almost statistically different at .05 significance level, t(18)=2.087, p=.051. Participants in CR.L had greater satisfaction with their

shopping experience compared to those in the C.L condition. This appears to be the effect of review ratings that were present in product listing page of the CR.L condition but not the C.L condition. There was only one participant in CR.L condition among 20 participants in these two conditions who had used the comparison matrix. If we exclude that case from analysis, it has no material impact on the average satisfaction score of the CR.L condition (μ=4.26). Thus, it is likely the effect of review ratings on the product listing page that had led participants to be more satisfied.

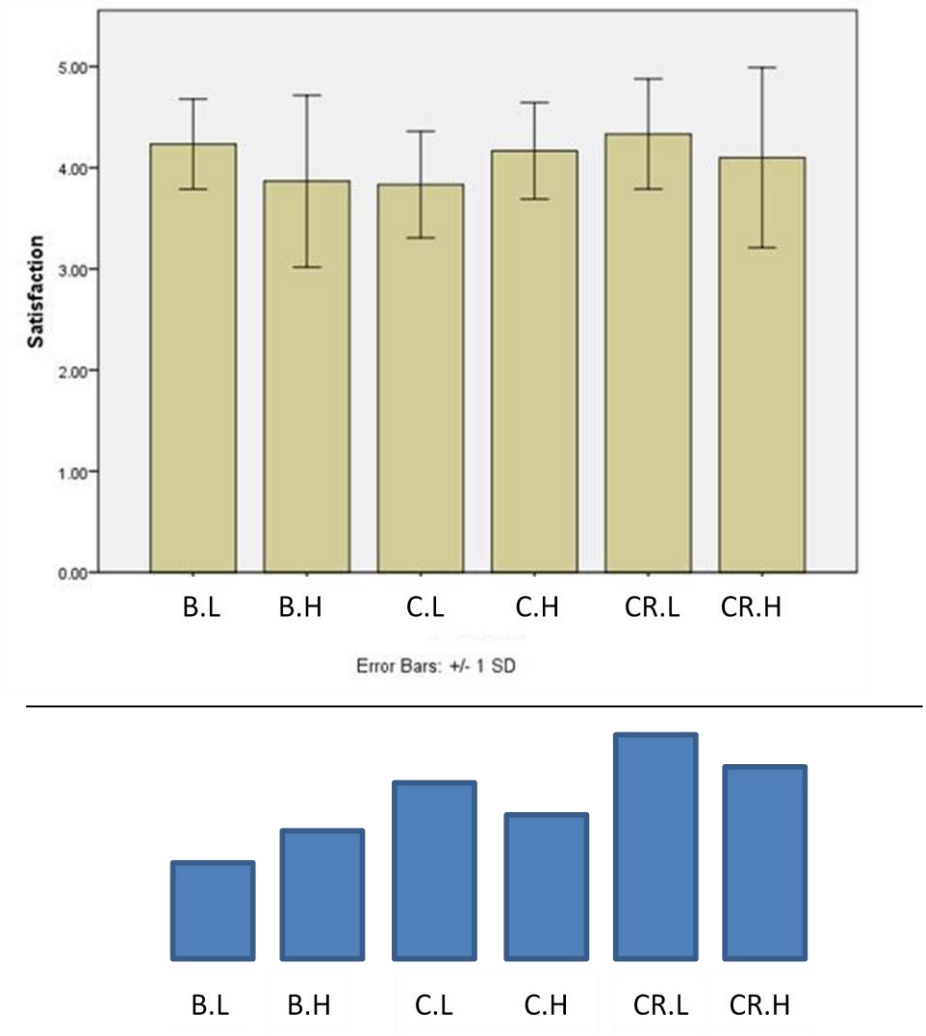


Figure 5.7 Actual and hypothesized graphs on satisfaction with shopping experience

5.3.5 Decision Quality - Match of purchased products with requirements

Contrary to the hypothesis that higher degree of information scent would lead to lower decision quality, the results here appear to show a marginal increase with high degree of information scent (H) as compared with each of a pairs low scent counterpart (see *Figure 5.8*). Information scent like the mouse over tab that we have administered probably helped participants to identify products that have a better match with the requirements.

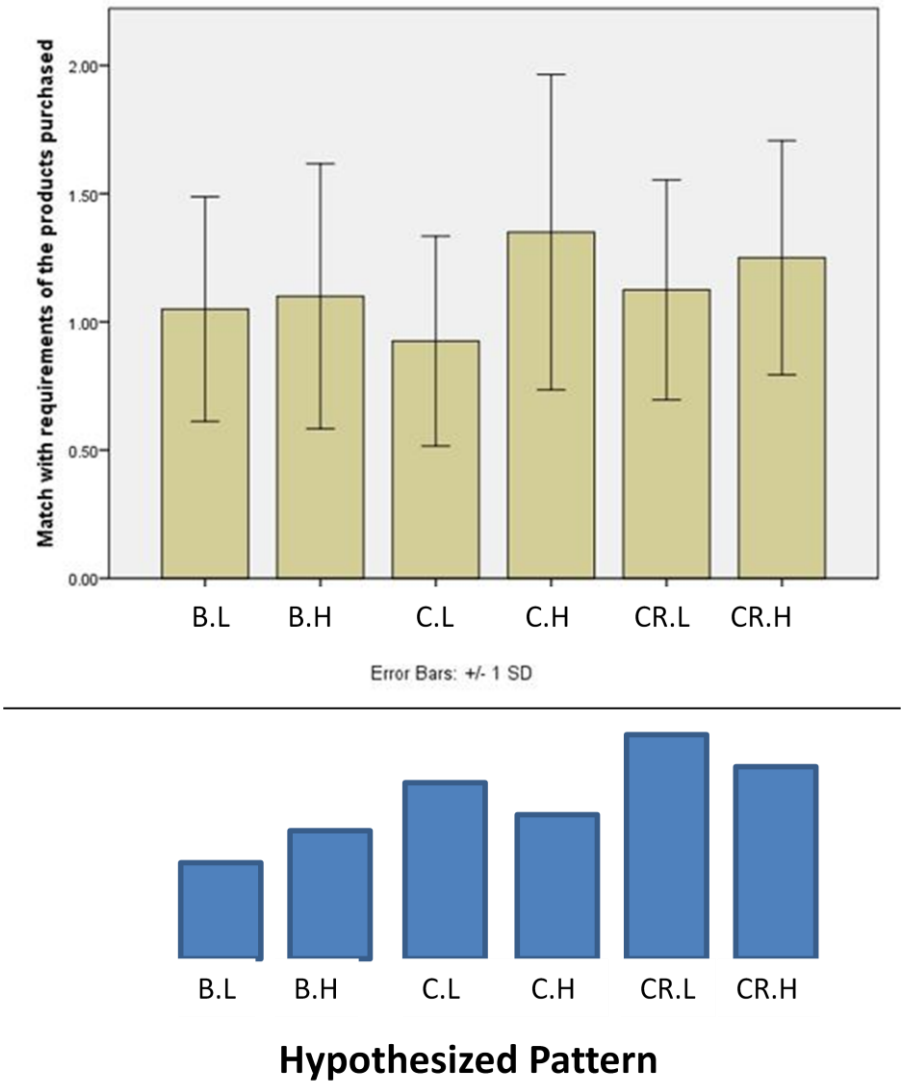


Figure 5.8 Actual and hypothesized graphs on match with product requirements

5.3.6 Decision Quality - Deviation of purchase price with budget

CR.L condition had the lowest deviation between the purchase price and budget among all conditions (see *Figure 5.9*). The reason for it being the condition with the best match with the budget was driven by three cases. There was a case with lowest deviation of $0.05, and 2 other cases below $10. While the condition was hypothesized to be the optimal configuration of decision-aiding features and information scent, but due to the small sample size, the 3 participants who led the deviation lower could be due to chance.

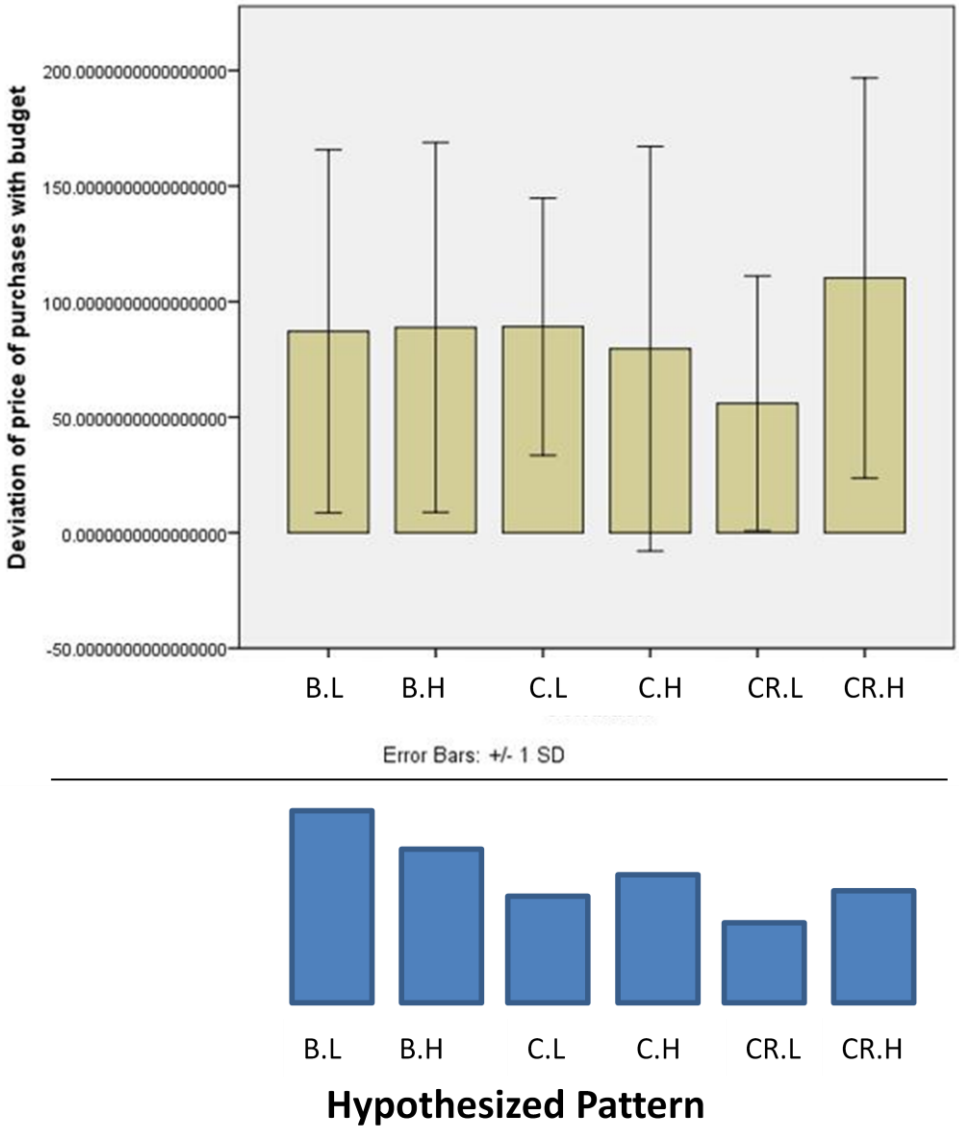


Figure 5.9 Actual and hypothesized graphs on deviation of purchase price with budget

The relatively higher deviation with budget seen in CR.H compared to the other conditions was probably due to the longer amount of time spent on the pages (see *Figure 5.5* and *Figure 5.6*). Information overload in the CR.H condition might have led to more time spent on processing information, and less attention given to keeping track of the budget. Again, such variations are normal in a study with small sample size. Future research with greater sample size could further prove any effect on these condition.

5.3.7 Other findings

Among the participants who have used the search bar to access the product lists, the search terms were all key terms given in the task. They include, but not limited to the following: "LED", "LED TV with Bluray", "high definition TV with stand", "high definition tv 24 inch" , "bluray player", "blu ray player HD TV", "TV LED", "blu-ray player", "LED TV 31 inch", "LED TV 30 inch". Some participants attempted to narrow the search by adjusting the values on specific product attribute. For example, a participant for LED TV but change the variant of its screen size (e.g. "LED TV 31", "LED TV 30 inch" etc.) to find the optimal product that matches with the requirements. The MANOVA test earlier found that those who used the search bar were less satisfied and made less optimal purchasing decisions. This could be due to the search method employed by the searchers. If a searcher narrows the search using screen size, they probably were too focus on that attribute and missed keeping tab on other attributes like price and warranty, which are also part of the given requirements.

An unplanned finding that was not part of the design of the experiment was that none of the participants bought a HDMI cable. The cable is needed for a Bluray player to work with the HDTV, and is usually excluded in the sale of the HDTV or Bluray player in real life. Even though the cables were in the recommendation list for the CR conditions, no one from those conditions actually purchased the item.

Chapter 6: Discussion and Conclusion

Though the research questions and hypotheses could not be fully addressed, several findings and support were identified. In this chapter, I discuss the issues faced, the findings, and the limitations of this experiment. Finally, I propose the agenda for future research in this area.

6.1. Findings from the experiment

6.1.1 Preference to use menu bar for access to list of products

Firstly, the menu bar was found to be the preferred choice for consumers with specific purchase requirements to access product list. 40 out of 60 (66.7%) participants started off the shopping task with the menu bar, and 3 searchers (5%) switched over to the menu bar during the task. Ultimately, the number of participants who used the menu bar to access the product list rose to 43 (71.7%). Also, those who used the menu bar to access the product list was found to be positively associated with decision quality and satisfaction. This outcome is unexpected and counterintuitive.

Logically, consumers with specific requirements on a product should prefer to seek products by using specific keywords that could assist them to lock in smaller number but highly relevant set of products for consideration. Consequently, they should be more satisfied with the shopping experience. However, we did not see this phenomenon in the experiment. An explanation could be that consumers knew that the search bar was not able to conduct very specific simultaneous filtering like screen technology, dimensions, price, and length of warranty at the same time. As such, they made use of the menu bar, which provides sorting functions like price to start off with their product selection and comparison process.

6.1.2 Effects of information scent

While there was no statistically significant effect of high degree of information scent on the dependent variables in the experiment, there was partial validity in the t-tests for *Effort* related variables discussed in *Chapter 5*. From the patterns in the charts and several group comparison tests, it was found that high degree of information scent is associated with lesser number of pages accessed and more time spent on each page (in total and with active movements on the pages). This aligns with my argument that high degree of information scent does not actually reduce the effort required but it is a shift of effort from traversing between many pages to processing information on lesser pages. In this thesis, my definition of *Effort* encompassed both the time and physical actions consumers expend in a shopping process. As we have discovered from the findings that these two factors vary in trend (i.e. one may use more time but access lesser number of pages), it may not be suitable to be combined into a composite score. Nevertheless, I have conducted the t-tests in its raw form and results were not found to be statistically significant. Thus, it was not a problem with the statistical procedure that caused the indifferent results.

With regards to the satisfaction with the shopping experience, there was no sign of high degree of information scent would lead to greater or lower satisfaction. However, a pattern emerged on the chart for the "degree of match with given requirements" variable. High degree of information scent appeared to elicit better match between the purchased products with the requirements over its counterpart with a lower scent. Participants are likely to have made product evaluations on the product listing page, instead of clicking into the product details page to learn about the specifications of products. In the process, information

pertaining to each product may be lost or distorted while being stored in participants' short term memory, resulting in lower quality of purchasing decision.

6.1.3 Effects of Decision-aiding features

When I set out the research question and hypothesis, I expected differences in the measures of *Effort*, *Decision Quality*, and *Satisfaction* with the addition of new decision-aiding features to the experimental store. However, an assumption behind this hypothesis was that all participants in the defined conditions will use all features that were provided. That was not the case encountered in the experiment. Only 4 participants out of 40 who were given the comparison feature made use of it, and none of 20 participants who had access to the list of individual reviews browsed through them.

With low usage of the decision-aiding features, any differences that are found between conditions are likely to be due to the information scent that was administered than on decision-aiding features. And indeed, in several of the group comparisons that were made in *Chapter 5* (i.e. total time spent per page, active time spent per page, deviation with budget etc.), participants in the *Basic* and *Comparison* groups had very close mean values. This issue could be an experimental design issue.

Nevertheless, some effects of decision-aiding features were discovered while conducting mean differences on participants' satisfaction with their shopping experience. Review ratings of each product that were on the product listing page and the comparison page might have led to greater satisfaction among the participants (see *Section 5.3.4*).

6.2. Limitations

There are four main limitations in this research: (1) sample size, (2) non-usage of decision-aiding features, (3) complications from multiple data sources, and (4) generalizability of results.

6.2.1 Small sample size

Group differences were not found to be statistically significant in the MANOVA procedure conducted in this study. One reason for not being to find any difference is likely due to the small sample size as the variance in each groups were large. An extension of this study could make use of the results gathered in this experiment to gauge the minimum size needed. With a larger sample size, we would be able to conclude if there are really no differences between groups.

6.2.2 Non-usage of decision-aiding features

The non-usage of the decision-aiding features was another limitation of this study. The priority of an extended study is to conduct test with more participants. With a more participant, we may then randomly select participants who have used the decision-aiding tools into each of the conditions and subsequently conduct statistical tests to determine the effect of participants who have used such features on the three dependent variables. However, this procedure will also require us to have a larger sample size than we need from statistical estimation. As we have seen in this experiment, cases were excluded due to a variety of reasons and there were low usage of the tools that were given to the participants. In order to have a concrete conclusion, we have to recruit a much larger pool of participants.

Also, with a larger pool of participants, we will be able to determine whether the usage rate of such features is low in practice. If the usage of such decision-aiding features is truly low in real life, the value of researching on these features is less impactful than when most of the consumers (at least for *comparison buyers*) perform comparisons and evaluations through them.

6.2.3 Complications in multiple data sources

A few operational issues with encountered in this study. Firstly, there was the time and effort needed to integrate data from multiple sources – Mouseflow, Qualtrics, and a self-created server-side script. And in each of these sources, there were issues pertinent to collecting and recording the data. Mouseflow collects data through the insertion of a Javascript on our experimental online retail store. If Javascript is not installed or enabled on a participant's browser, her interactions will not recorded even though she could still perform the shopping task. 32 out of 117 participants (27.35%) were filtered out in the screening process due to this reason in this experiment.

If such technical issues were not present, we could have a larger sample size in our experiment. Nonetheless, in cases where recordings were complete, the compiling process of the metrics was tedious. For example, to compute the average total time spent per page, I had to first compute the time spent on each page based on the timestamp, and subsequently average the time by considering all pages in the shopping task. Besides, the collection of data from Mouseflow has to be mapped to a participant that has responded to the self-reported survey items in Qualtrics and this process is labor intensive. As it already requires substantial effort for this experiment with only 117 participants who completed the entire

study, more time and effort is expected on the data compilation if an extension of this work attempts to collect data from a much larger sample size.

6.2.4 Generalizability of results

In this experiment, the majority of the participants were from India (48.333%), and United States (46.667%). While statistical tests did not show any difference between these two groups on the dependent variables, it may be useful to include other nationalities to determine if there are cultural differences out of these two nationalities.

Also, though we have learnt in *sub-section 4.2.1* that prior studies did not find results gathered from MTurk to be different from traditional laboratory studies, the experiment conducted in this study was confounded by factors that could have an influence on some of our metrics. One such example is the Internet connectivity of the participants. Some participants could have spent more time on their shopping task that was not a consequent of information scents or decision-aiding features, but due to the speed of their Internet connection. A test to be conducted in the laboratory that control for these external factors would also be useful to further validate that there are no differences between participants in the two subject pools.

6.3. Future Research

As I have discussed in *sub-section 6.1.1*, the search bar may not be effective in helping *comparison buyers* filter and shortlist products as they have a set of specific criteria that they may wish to filter simultaneously. Future research could also evaluate the effect of filtering tools that allow specification of simultaneous conditions (see *Figure 6.1*). Through this filtering feature, consumers are able to filter the list of products to compare by giving specific requirements (e.g. product has to be white color, less than $300, 30 inch at the same time). The adoption of this decision-aiding feature could also be compared with the comparison and recommendation features used in this study to determine which of them is more likely to be used by a *comparison buyer* in her shopping process. It will also be interesting to learn about the effects of three types of decision-aiding features on *Effort*, *Decision Quality*, and *Satisfaction*.

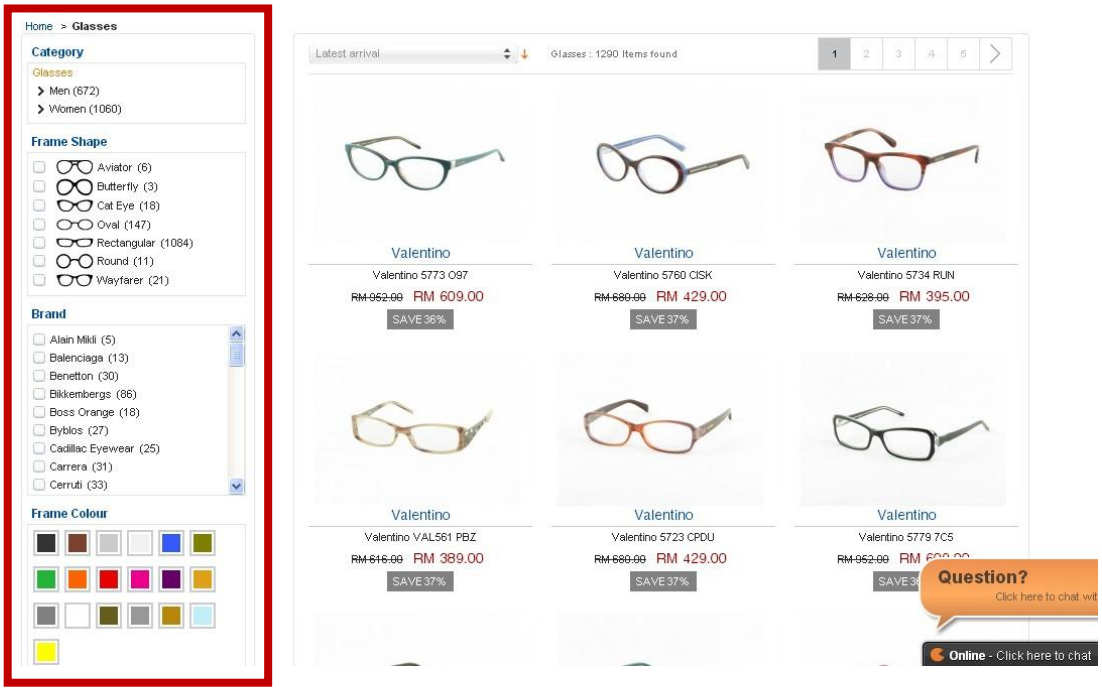


Figure 6.1 Product filtering based on simultaneous conditions

In this experiment, we have only gotten the participants to perform a shopping task to purchase electronic products – a HDTV and Blu-ray player. While decision-aiding features and information scent may have an effect on consumers shopping experience for such products, it may not be relevant for product categories in which people do not make purchases based on product attributes. For example, to make a purchase of a blouse, a consumer would typically look at the design and cutting of the apparel before searching for the right size and color that fits her. Decision-aiding tools discussed in this experiment may not be helpful for consumers seeking for such products on an online retail store. Nevertheless, high degree of information scent may still be useful to such consumers, provided that the content within the mouse over tab has to be in line with the information goals of such product (e.g. display different colors or variants of the design instead of product attributes).

6.4. Conclusion

While the results in this research have been modest, there are several findings that were interesting and could be followed up in a separate study. Also, issues faced with the experiment could also be better managed in an extended study given the experience documented in this thesis. Lastly, as more salient tools like the one that allow specification of simultaneous conditions are being introduced in the market, future research in this area is expected to be more complex.

References

Babin, Barry J, Darden, William R, & Griffin, Mitch. (1994). Work and/or fun: measuring hedonic and utilitarian shopping value. *Journal of consumer research*, 644-656.

Benbasat, Izak, & Dexter, Albert S. (1985). An experimental evaluation of graphical and color-enhanced information presentation. *Management science, 31*(11), 1348-1364.

Brynjolfsson, Erik, Yu, Hu, & Smith, Michael D. (2003). Consumer Surplus in the Digital Economy: Estimating the Value of Increased Product Variety at Online Booksellers. *Management Science, 49*(11), 1580-1596.

Bucklin, Randolph E, Lattin, James M, Ansari, Asim, Gupta, Sunil, Bell, David, Coupey, Eloise, . . . Steckel, Joel. (2002). Choice and the Internet: From clickstream to research stream. *Marketing Letters, 13*(3), 245-258.

Budiu, Raluca, Royer, Christiaan, & Pirolli, Peter. (2007). *Modeling information scent: a comparison of LSA, PMI and GLSA similarity measures on common tests and corpora*. Paper presented at the Large Scale Semantic Access to Content (Text, Image, Video, and Sound), Pittsburgh, Pennsylvania.

Burhrmester, Michael, Kwang, Tracy, & Gosling, Samuel D. (2011). Amazon's Mechanical Turk: A New Source of Inexpensive, Yet High-Quality Data? *Perspectives on Psychological Science, 6*(3), 3-5.

Chernev, Alexander. (2003). Product assortment and individual decision processes. *Journal of Personality and Social Psychology, 85*(1), 151-162. doi: 10.1037/0022-3514.85.1.151

Chi, Ed H, Hong, Lichan, Gumbrecht, Michelle, & Card, Stuart K. (2005). *ScentHighlights: highlighting conceptually-related sentences during reading.* Paper presented at the Proceedings of the 10th international conference on Intelligent user interfaces.

Chi, Ed H., Pirolli, Peter, Chen, Kim, & Pitkow, James. (2001). *Using information scent to model user information needs and actions and the Web*. Paper presented at the Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, Seattle, Washington, USA.

Cobb-Walgren, Cathy J., Ruble, Cynthia A., & Donthu, Naveen. (1995). Brand Equity, Brand Preference, and Purchase Intent. *Journal of Advertising, 24*(3), 25-40.

Devaraj, Sarv, Fan, Ming, & Kohli, Rajiv. (2002). Antecedents of B2C channel satisfaction and preference: validating e-commerce metrics. *Information Systems Research, 13*(3), 316-333.

Genest, Aaron, Gutwin, Carl, Reetz, Adrian, Mandryk, Regan, Pinelle, David, & Doucette, Andre. (2009). Looking Ahead: A Comparison of Page Preview Techniques for Goal-Directed Web Navigation *Human-Computer Interaction–INTERACT 2009* (pp. 378-391): Springer.

Gill, Martin, Evans, Patti Freeman, Sehgal, Vikram, & Da Costa, Myriam. (2012). European Online Retail Forecast: 2011 To 2016: Forrester Research.

Grewal, D. Krishnan, & R. Baker, J. Borin, N. . (1998). The Effect of Store Name, Brand Name and Price Discounts on Consumers' Evaluations and Purchase Intentions. *Journal of Retailing, 74*(3), 331-352.

Hahn, Jungpil, Kauffman, Robert J, & Park, Jinsoo. (2002). *Designing for ROI: toward a value-driven discipline for e-commerce systems design.* Paper

presented at the System Sciences, 2002. HICSS. Proceedings of the 35th Annual Hawaii International Conference on.

Häubl, Gerald, & Trifts, Valerie. (2000). Consumer Decision Making in Online Shopping Environments: The Effects of Interactive Decision Aids. *Marketing Science, 19*(1), 4-21. doi: 10.1287/mksc.19.1.4.15178

Heer, Jeffrey, & Bostock, Michael. (2010). *Crowdsourcing Graphical Perception: Using Mechanical Turk to Assess Visualization Design.* Paper presented at the CHI 2010, Atlanta, Georgia, USA.

Hirschman, Elizabeth C. (1984). Experience seeking: a subjectivist perspective of consumption. *Journal of Business research, 12*(1), 115-136.

Hoffman, Donna L., & Novak, Thomas P. (1996). Marketing in Hypermedia Computer-Mediated Environments: Conceptual Foundations. *Journal of Marketing, 60*(July), 50-68

Horton, John J., Rand, David G., & Zeckhauser, Richard J. (2010). The Online Laboratory: Conducting Experiments in a Real Labor Market. *SSRN eLibrary*.

Horton, John Joseph, & Chilton, Lydia B. (2010). *The labor economics of paid crowdsourcing.* Paper presented at the Proceedings of the 11th ACM conference on Electronic commerce.

Huberman, Bernardo A, Pirolli, Peter LT, Pitkow, James E, & Lukose, Rajan M. (1998). Strong regularities in world wide web surfing. *Science, 280*(5360), 95-97.

Jarvenpaa, Sirkka L. (1989). The effect of task demands and graphical format on information processing strategies. *Management Science, 35*(3), 285-303.

Jiang, Zhenhui Jack, & Benbasat, Izak. (2007). The effects of presentation formats and task complexity on online consumers' product understanding. *MIS Quarterly, 31*(3), 475-475.

Katz, Michael A., & Byrne, Michael D. (2003). Effects of scent and breadth on use of site-specific search on e-commerce Web sites. *ACM Trans. Comput.-Hum. Interact., 10*(3), 198-220. doi: 10.1145/937549.937551

Kittur, Aniket, Chi, Ed H., & Suh, Bongwon. (2008). *Crowdsourcing User Studies with Mechanical Turk*. Paper presented at the CHI 2008, Florence, Italy.

Kohli, Rajiv, Devaraj, Sarv, & Mahmood, M Adam. (2004). Understanding determinants of online consumer satisfaction: A decision process perspective. *Journal of Management Information Systems, 21*(1), 115-136.

Kotler, Philip, & Armstrong, Gary. (2010). *Principles of Marketing* (13th International Edition edition (2010) ed.): Pearson.

Koufaris, M. (2002). Applying the Technology Acceptance Model and Flow Theory to Online Consumer Behavior. *INFORMATION SYSTEMS RESEARCH, 13*, 205-223.

Krishen, Anjala S, & Nakamoto, Kent. (2009). Improving consumer quality-efficiency by using simple adaptive feedback in a choice setting. *International Journal of Computer Applications in Technology, 34*(3), 155-164.

Krosnick, Jon A. (1991). Response Strategies for Coping with Cognitive Demands of Attitude Measures in Surveys. *Applied Cognitive Psychology, 5*, 213-236.

Lightspeed. (2011). Consumers Rely on Online Reviews and Price Comparisons to Make Purchase Decisions. Retrieved 30 January 2013, 2013, from

http://www.lightspeedresearch.com/press-releases/consumers-rely-on-online-reviews-and-price-comparisons-to-make-purchase-decisions/

Lohse, Gerald, Bellman, Steven, & Johnson, Eric. (2000). Consumer buying behavior on the Internet: Findings from panel data. *Journal of interactive Marketing*, *14*(1), 15-29.

Mackay, Jane M, Barr, Steve H, & Kletke, Marilyn G. (1992). An Empirical Investigation of the Effects of Decision Aids on Problem-Solving Processes*. *Decision Sciences*, *23*(3), 648-672.

Mason, Winder, & Watts, Duncan J. (2009). *Financial Incentives and "Performance of Crowds"*. Paper presented at the KDD-HCOMP 2009, Paris, France.

Moe, Wendy W. (2003). Buying, searching, or browsing: Differentiating between online shoppers using in-store navigational clickstream. *Journal of Consumer Psychology*, *13*(1), 29-39.

Moody, Greg , & Galletta, Dennis. (2008). *I'm Losing Patience with your Site: The Impact of Information Scent and Time Constraints on Effort, Performance, and Attitudes.* Paper presented at the Twenty Ninth International Conference on Information Systems, Paris, France.

Mulpuru, Sucharita, Sehgal, Vikram, Evans, Patti Freeman, Hoar, Andy, & Roberge, Douglas. (2012). US Online Retail Forecast, 2011 To 2016: Forrester Research.

Olshavsky, Richard W. , & Granbois, Donald H. . (1979). Consumer Decision Making-Fact or Fiction? *Journal of Consumer Research*, *6*(2), 93-100.

Olston, Christopher, & Chi, Ed H. (2003). ScentTrails: Integrating browsing and searching on the Web. *ACM Transactions on Computer-Human Interaction (TOCHI), 10*(3), 177-197.

Paolacci, Gabriele, Chandler, Jesse, & Iperirotis, Panagiotis G. (2010). Running experiments on Amazon Mechanical Turks. *Judgment and Decision Making, 5*(5), 411-419.

Pereira, Rex Eugene. (2000). Optimizing human-computer interaction for the electronic commerce environment. *Journal of Electronic Commerce Research, 1*(1), 23-44.

Pirolli, Peter. (2009). *Information Foraging Theory*. New York, NY: Oxford University Press.

Pirolli, Peter, & Card, Stuart. (1995). *Information foraging in information access environments*. Paper presented at the Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, Denver, Colorado, USA.

Pirolli, Peter, & Card, Stuart. (1999). Information foraging. *Psychological Review, 106*(4), 643-675.

Pirolli, Peter, & Card, Stuart. (2005). *The sensemaking process and leverage points for analyst technology as identified through cognitive task analysis.* Paper presented at the Proceedings of International Conference on Intelligence Analysis.

Professional Publishing Report. (1999). University Presses Credit Internet for Increased Sales (Vol. 3).

Punj, Girish, & Moore, Robert. (2009). Information search and consideration set formation in a web-based store environment. *Journal of Business Research, 62*(6), 644-650.

Rohm, Andrew J, & Swaminathan, Vanitha. (2004). A typology of online shoppers based on shopping motivations. *Journal of business research, 57*(7), 748-757.

Rook, Dennis W. (1987). The buying impulse. *Journal of consumer research*, 189-199.

Ross, Joel, Irani, Lilly, Silberman, M. Six, Zaldivar, Andrew, & Tomlinson, Bill. (2010). *Who are the Crowdworkers? Shifting Demographics in Mechanical Turk*. Paper presented at the CHI 2010, Atlanta, Georgia, USA.

Russell, Daniel M., Stefik, Mark J., Pirolli, Peter, & Card, Stuart K. (1993). *The cost structure of sensemaking*. Paper presented at the Proceedings of the INTERACT '93 and CHI '93 Conference on Human Factors in Computing Systems, Amsterdam, The Netherlands.

Schlosser, Ann E. (2003). Experiencing Products in the Virtual World: The Role of Goal and Imagery in Influencing Attitudes versus Purchasing Intentions. *Journal of Consumer Research, 30*(September), 184-198.

Schlosser, Ann E. (2006). Learning through Virtual Product Experience: The Role of Imagery on True versus False Memories. *Journal of Consumer Research, 33*(December), 377-383.

Shaw, Aaron D., Horton, John J., & Chen, Daniel L. (2011). *Designing incentives for inexpert human raters*. Paper presented at the Proceedings of the ACM

2011 conference on Computer supported cooperative work, Hangzhou, China.

Sherry, John F, McGrath, Mary Ann, & Levy, Sidney J. (1993). The dark side of the gift. *Journal of Business Research, 28*(3), 225-244.

Simon, Herbert Alexander. (1957). *Administrative behavior* (Vol. 4): Cambridge Univ Press.

Stephen, D. W., & Krebs, J. R. (1986). *Foraging Theory*. Priceton, NJ: Princeton University Press.

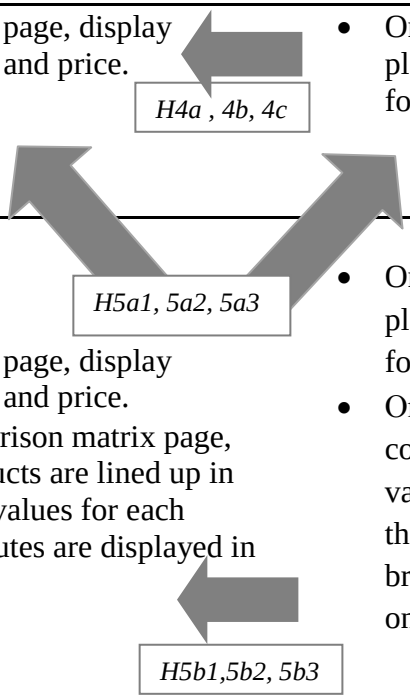
Wigder, Zia Daniell, Noble, Steven, Sehgal, Vikram, & Varon, Lily. (2012). Asia Pacific Online Retail Forecast, 2011 To 2016: Forrester Research.

Woodruff, Allison, Rosenholtz, Ruth, Morrison, Julie B, Faulring, Andrew, & Pirolli, Peter. (2002). A comparison of the use of text summaries, plain thumbnails, and enhanced thumbnails for Web search tasks. *Journal of the American Society for Information Science and Technology, 53*(2), 172-185.

Xiao, Bo, & Benbasat, Izak. (2007). E-commerce product recommendation agents: Use, characteristics, and impact. *Mis Quarterly*, *31*(1), 137-209.

Annex A

	No Information Scent	With Information Scent
Basic store	• On the listing page, display product name and price.	• On the listing page, display product name and price. Besides, when cursor is placed over the product, brief product information that will be seen in the following page (upon clicking link) is displayed through a pop-up.
Basic store with comparison matrix feature	• On the listing page, display product name and price. • On the comparison matrix page, selected products are lined up in columns and values for each product attributes are displayed in rows.	• On the listing page, display product name and price. Besides, when cursor is placed over the product, brief product information that will be seen in the following page (upon clicking product) is displayed in a pop-up. • On the comparison matrix page, users' selected products are lined up in columns and values for each product attributes are displayed in rows. For values of product attributes that are different between the alternative products, the row is highlighted. Besides, when cursor is placed over the product column, brief product information that will be seen in the following page (upon clicking on the column) is displayed through a pop-up.



Annex A

Basic store with product comparison and recommendation features	• On the listing page, display product name, price, and review rating. • On the comparison matrix page, selected products are lined up in columns and values for each product attributes are displayed in rows. Review rating for each product is also displayed. • On the product details page, under the review section, display rating, description, helpfulness score (i.e. like/dislike given by other users other than the one who posted) for each review, on top of a rating summary bar chart. • On the product details page, under the product recommendation section, show complementary products in the past have bought together with the product in view. For each product, the product name, price, and rating are displayed.	• On the listing page, display product name and price. Besides, when cursor is placed over the product, brief product information that will be seen in the following page (upon clicking product) is displayed in a pop-up.When the cursor is placed over the rating area, the review rating summary bar chart for that product is displayed through a pop-up. • On the comparison matrix page, users' selected products are lined up in columns and values for each product attributes are displayed in rows. For values of product attributes that are different between the alternative products, the row is highlighted. Besides, when cursor is placed over the product column, brief product information that will be seen in the following page (upon clicking on the column) is displayed in a pop-up. When the cursor is placed over the rating cell, the review rating summary bar chart for that product is displayed through a pop-up. • On the product details page, under the review section, display rating, description, and helpfulness score (i.e. like/dislike given by other users other than the one who posted) for each review, on top of a rating summary bar chart. Besides, when cursor is placed over the review rating summary bar chart (one bar for each; for 1-5 star rating), the top review of the category is displayed with a truncated text of 300 characters through a pop-up. • On the product details page, under the product recommendation section, show complementary products in the past have bought together with the product in view. For each product, the product name, price, and rating are displayed. Besides, when cursor is placed over the product, brief product information that will be seen in the following page (upon clicking product) is displayed in a pop-up. When the cursor is placed over the rating of a particular product, the review rating summary bar chart for that product is displayed through a pop-up.

H6a1,6a2, 6a3

H6b1,6b2, 6b3