

## **Design Guidelines for Effective Recommender System Interfaces Based on a Usability Criteria Conceptual Model: Results from a College Student Population**

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### **Abstract**

With the retail electronic commerce being a major global shopping phenomenon, retailers need to develop additional tools to improve their sales. One such tool is a Recommender System through which the shopping page recommends products to the shoppers using their past Web shopping and product search behavior. While recommender systems are common, few studies exist regarding their usability and user preferences. In this study, a structured survey concerning what recommender systems should contain and how this content should be presented was administered on one hundred and thirty one college-aged online shoppers. Results indicate participants prefer specific recommender content. Price, image and names of products are identified as essential information while product promotions, customer ratings and feedback are identified as secondary types of information. Shoppers preferred short and relevant recommender information, with a maximum of three recommendations on one page. Future studies may explore differences in preference of recommender systems based on different product types.

**Keywords:** Electronic Commerce; Recommender Systems; Usability; User Preferences; Design Guidelines.

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## 1. Objective, Motivation and Significance

According to Turban et al. (2004), there will be 750 million internet users worldwide by 2008, and half of them will shop online. E-commerce transactions will have reached \$5 trillion worldwide by 2008 (Lucking-Reiley and Spulber, 2001). With the massive growth of e-commerce in the last decade, online retailers sought additional tools to determine the potential interests of shoppers in products other than those which they are currently shopping or searching for. If online sellers could develop a strategy for recommending additional products to shoppers, these recommendations would no doubt be a positive feature from the sellers' perspective as they could potentially result in higher sales. Resnick and Varian (1997) indicated that shoppers rely a lot on word of mouth, recommendations from other friends, and word of mouth. Hence online retailers imagined "Recommender Systems" (RS) as systems that would offer shoppers alternative products using different types of input such as users' search and/or shopping history, users' cultural preferences based on physical location and/or demographics (if available) and more. A large number of major e-commerce sites use a variation of recommender systems. Usually, recommendations are presented on the same Web page as the "main" product the customers are shopping or searching for, and contain statements such as "you might also like" and "customer who bought this item also bought following items." There are small differences between the terms "recommender system" and "collaborative filtering." While recommender systems aim at producing relevant product recommendations in e-commerce through analysis of both human and computer-related parts, collaborative filtering focuses on predicting what users/shoppers would like to be presented based on other users' or shoppers' behavior (Herlocker, Konstan and Riedl, 2000) for which a number of metrics have been developed ((Herlocker, Konstan and Riedl, 2004). The focus of the current study is on the presentation of

recommender systems. While it is likely that the design issues (both structural and content-related) covered in the current study concerning recommender systems may also apply to collaborative filtering, this applicability issue is not empirically tested due to the focus of the current study being on recommender systems.

From the shoppers' perspective, recommender systems in online stores can save effort and time (Karat et al., 2004). On the other hand, recommendations need to be presented to the shoppers in a non-intrusive, accurate, and convenient manner. The recommendations are presented to the shoppers in the form of images and text. It can be argued that if the interface of a recommender system is poorly designed, customers might ignore it, find it intrusive, annoying or distracting, and perceive it as a factor that negatively affects their shopping experience. In some cases, due to the interface design of recommender systems, customers may decide not to shop for the product they are seeking, or even leave the site with no intention of ever coming back. On the other hand, a well-designed interface can have a significant effect on the online store's sales (Callahan and Koenemann, 2000). This research therefore examines the fundamental question of what, if any, design issues should be taken into consideration for recommender systems to result in effective interfaces for such systems. It should be noted that although the design of the recommender system interfaces is part of the overall e-commerce site design, it is treated in this research as an independent design entity. Overall design issues of an e-commerce shopping site are not discussed.

It can be argued that recommender systems may be working fine to some extent in today's Web pages and whether there is a need for their improvement. However, the literature indicates that explicit usability studies specifically targeting e-commerce recommender systems are lacking. Additionally, a number of studies produced design guidelines for Web pages (Lazar,

2005; Ozok and Salvendy, 2004), but the applicability of these general Web design guidelines on the specific recommender system component has not been empirically tested. While an argument can be made that general Web page design guidelines can be applied on recommender systems, it should be noted that the recommender system is a component of the page that is heavily related to the product rather than anything else on the Web page. Therefore, it was concluded that recommender systems are independent enough entities worthy of deeper consideration, and they can be studied separately from the rest of the Web page concerning usability and user preference issues.

If an RS is used as a tool that is well integrated with the overall e-commerce Web page, it is not a major issue if they are not highly accurate from a content perspective (Svensson et al., 2005). The user interface of the recommender system can influence the perception of it from the users' perspective not only because people are influenced by what they see (Svensson et al., 2005), but also because interfaces that are "invisible" to users but do their function effectively can be perceived as highly successful (Myers et al., 1991). Therefore, in the current study, how well the recommendations are integrated to the Web page is seen as one of the criteria for their successful usability.

In recommender systems, interface issues such as page layout and navigation are the most important factors relating to the overall ease of use and perceived usefulness of system (Swearingen and Sinha, 2001), not much different from the general success factors in interface usability (Shneiderman, 1997). Additionally, a number of studies (Sinha and Swearingen, 2002; Höök, 2000; Miller et al., 2003; and Swearingen and Sinha, 2001) indicated that users are not just interested in recommendations from a system, but also would prefer knowing why exactly they are given certain recommendations. This is called the *transparency* of the recommender

systems (Sinha and Swearingen, 2002). In most cases, the transparency can be obtained by the visual presentation of the recommendation content, such as star ratings (Cosley et al., 2003), images of recommended products (Kim et al., 2004), as well as comments and feedback concerning the product from other shoppers. This information allows shoppers to determine the relevance between the products they are intentionally shopping for or viewing and the products they are recommended. Additionally, presentation techniques such as chat box (Åberg and Shahmehri, 2000) (chatting with online sales assistant regarding the product) and social texture (Svensson et al., 2005) (using graphics to indicate most visited recommendations) are also important factors strengthening transparency. The current Web and e-commerce design and usability literature discusses issues concerning recommender systems to a very limited extent. There is a similar lack of attention concerning the content of what recommender systems should present to the users. Therefore, this study aims at filling the gap concerning the assessment of the user interface usability and user preference issues concerning recommender systems.

The current study explores RS usability/user preferences from both the structural (how recommender systems should look) and content (what information recommender systems should contain) perspectives. From the structural perspective, previous studies such as the one by Markus and Soh (2002) indicated that the site structure directly affects shopping experience. Issues relating to site are also relevant to the e-shopper experience (Sing et al., 2005). The current study aims at expanding the investigation of these interface issues onto the recommender systems platform. The factors affecting user issues of recommender systems are aimed to be determined with the ultimate goal of producing design recommendations for e-commerce recommender systems.

The college student population was chosen as the target population in the study due to their frequent use of retail e-commerce. A number of previous studies strongly indicated that U.S. college students are primary customers of a high number of businesses (Lightner, Yenisey, Ozok and Salvendy, 2002; Yenisey, Ozok and Salvendy, 2005; Internet Demographics, 1998; Ozok and Komlodi, 2008). It can be argued that the results of the study may be applied to college-age student population only. However, based on previous literature and a common belief that college students' trends in shopping are to a great extent consistent with the majority of e-commerce population, the authors of the current study believe in the generalization of the results to the majority of e-commerce shoppers and therefore see the results representative.

The results from the study can be useful to both e-commerce consumers and vendors. From the consumers' perspective, recommender systems can offer them alternative or complementary products, which may result in a more improved, better shopping experience. From the vendors' perspective, offering additional products that may be of interest to customers and that are presented to them in a usable and satisfactory manner can result in higher sales and profitability. The current study looks at the usability of the recommender systems from the shoppers' perspective, but the metrics for the success of a recommender system should be considered from both vendors' and consumers' perspectives, which are surely inter-related. Therefore, the definition of a successful recommender system in the current study can apply to both customers' and vendors' views.

In the next sections, first a survey of the current literature and the developed conceptual model based on the literature are presented. This is followed by the explanation of the methodology used in an experiment. Next, results from this experiment are discussed, followed

by the recommender system design guidelines produced from these results. Finally, conclusions, limitations and suggestions for future research directions are presented.

## **2. Literature Review and Conceptual Model**

The current literature on usability and user preference issues concerning e-commerce recommender systems was surveyed and a conceptual model to determine the usability criteria of such systems was developed. This literature survey and the developed model are discussed in this section.

### **2.1 Literature Review**

Electronic commerce is defined as business transactions that take place over telecommunications networks where the process of buying and selling products, services and information over computer networks occurs (Turban et al., 2004). While e-commerce continued to be a global phenomenon (Chau et al., 2002), retailers started looking for new frontiers to reach customers (Kalakota and Whinston, 1996). Hence since late nineties, companies started to present recommendations of alternative products to customers on their Web pages.

#### *2.1.1 Comparative Studies on Recommender Systems*

Current literature on Web-based recommender systems is focused on techniques and computer algorithms to produce the actual content of the recommendations, rather than the usability and user-related issues. Herlocker, Konstan and Riedl (2000) indicated that current e-commerce recommendation systems resemble a “black box,” providing no transparency concerning why and how they should be implemented. In a study aimed at determining user preferences concerning recommender systems, Rashid et al. (2002) concluded that to get the relevant information from the user for recommender systems, the user experience dimensions such as shopping product type need to be determined. They also concluded that systems that

make accurate guesses on which shopping items people will rate will reduce user effort and produce acceptable recommendations.

### 2.1.2 Recommender Content Methods and Algorithms

According to research conducted in the e-commerce area, the main techniques that recommender systems use to come up with suitable products are the *non-personalized approach*, *attribute-based recommendations*, *item-to-item correlations*, and *people-to-people correlations* (Schafer et al., 1999). The *non-personalized approach* produces recommendations from other customers' feedback on similar products. *Attribute-based recommendations* are based on the description of the product properties and their relation to the customers' interests. *Item-to-item correlation* recommendations are based on customers' interest on similar products, and *people-to-people* correlation recommendations are based on the similarity in the buying histories of two or more customers. Schafer et al. also divided the recommender systems into automatic, semi-automatic, and manual categories based on the level of conscious customer input they need (where systems are more automatic with fewer conscious user decisions involved).

As part of a similar study, Burke (2002) put computer algorithms used in recommender systems into five categories in an algorithm survey he conducted. They include *collaborative*, *content-based*, *demographic*, *utility-based*, and *knowledge-based* algorithms. *Collaborative* algorithms are used to locate similar product interests between customers. *Content-based* algorithms are used to find similar product interests among customers based on descriptions of the products they shop or search for. *Demographic* algorithms focus on the customers' demographic information such as age and gender to produce appropriate product recommendations. *Utility* algorithms are concerned with the services offered as part of the recommendations, such as shipping, wrapping, and promotion. And finally, *knowledge-based*



algorithms use the comprehensive knowledge the system has about the specific customer and infers the product that might interest the same customer. Burke also surveyed existing hybrid algorithms, which combine the five algorithms. He confirmed that in a number of cases, hybrid algorithms perform better than using one algorithm. These articles indicate that researchers put significant efforts to improve the back-end algorithms of recommender systems to produce accurate and efficient recommendations for online shoppers (Cosley et al., 2003).

### *2.1.3 Usability Studies on Recommender Systems*

The number of studies focusing on usability aspects of recommender systems are relatively low. There is currently one international conference on recommender systems which is in its second year in 2008. In one of the earlier studies examining the Human-Computer Interaction (HCI) aspects of such systems, Swearingen et al. (2001) found that some of the interface issues including graphics and color are not strongly correlated to the ease of use and perceived usefulness of recommender systems. In their innovative approach, Svensson et al. (2005) designed and evaluated a new kind of recommender system called “Kalas” which used social context to recommend food recipes. They concluded that the explicitness of the social texture in which the recommender systems are presented, such as comments and recommendations being presented in a formal versus informal language, appears to be more important than other information attached to recipes. However, their study did not discuss further issues concerning the applicability of their findings to general recommendation systems in e-commerce, specifically on whether the social elements such as customer comments and reviews concerning the product would affect the overall perceived usefulness and usability of such a system. In a similar study, Tintarev and Masthoff (2007) concluded that the features of a recommender system should be tailored to the needs and intentions of the user, they should be

tailored to the context, should be selected by the user from a relatively short list, and if product explanations are part of the features, they should also indicate their sources. In a related study, Tintarev (2007) developed a prototype for generating explanations for recommender systems in the movie business by integrating the flexibility of a natural language generation systems into recommenders. The results of this study are pending. Other studies examined trust issues involving recommender systems (O'Donovan and Smith, 2005; Leino and Raiha, 2007) where they explored the impact of human factors issues on ultimate customer decisions.

A few studies focused on user issues concerning e-commerce recommendations on a mobile device screen. These types of recommendations are different from regular Web based recommendations as there is not enough space on a mobile screen to display both the main and recommended product(s). Therefore, mobile recommendations consist of single recommended products that are sent to or accessed by the shoppers. In this context, Miller et al. (2003) studied recommender systems on a Personal Digital Assistant (PDA), and found that users like feedback when they are presented on an interactive interface. This is to some extent consistent with the findings by Svensson et al. (2005). They also found that users prefer a few lines of extra information concerning the product be displayed upon request. However, the authors did not explore the exact nature of this requested extra information.

Similarly, Kim et al. (2004) developed the Visual Content Recommender System (VISCORS) for Web-accessible mobile devices, which is initially designed as a recommender system that presented pictures of recommended products on cell phone screens. Not surprisingly, they indicated that showing images of recommended products is better than using plain text for descriptions of the products. However, there is no information in their study on the effectiveness and usefulness of combining image and text in mobile recommender systems .

Callahan and Koenemann (2000) argued that a well-organized interface with a carefully designed product list and additional product information such as product description and image could positively affect online sales. They concluded that easy navigation and a well-organized layout of the interface can improve accessibility of the product information to online shoppers. McNee, Riedl and Constan (2006) examined human factors issues concerning recommender systems from the perspective of an analytic process model, and concluded that the metrics for algorithms that are used in recommender systems should be built based on usability criteria involving user tasks. Similarly, Cramer (2007) indicated that adaptive recommender systems will allow higher transparency and better user interactions, and Sinha and Swearingen (2002) indicated that transparency in recommender systems is a boost factor for customer liking and confidence in e-commerce.

Matera et al. (2006) defined the usability principles of Web applications as Web application learnability, efficiency and memorability. Additionally, few errors and high user satisfaction are part of Nielsen's usability principles (Nielsen, 1993). Those criteria can to some extent be applied to evaluate the recommender systems as they are Web applications. The integration of diverse recommendations can improve the e-commerce user experience and lead to better sales (Schafer, Konstan and Riedl, 2002). The main reason e-commerce vendors allow recommender systems on their sites include helping customers in their purchasing activities, offering alternative or complementary products, improving the overall shopping experience, improving shoppers' satisfaction with the e-commerce site, and resulting in better sales (Callahan and Koenemann, 2000). The authors of the current study therefore view recommender systems as a popular sales tool and aimed at investigating it from usability and user preference perspectives. The literature search indicated that these user issues have not been adequately

covered in previous literature. Miller et al. (2003) indicated that a number of false interactions that have not yet been addressed as part of using recommender systems, while according to Sinha and Swearingen (2002), the design of recommender system user interfaces should be based on more specific criteria than those available today. The literature also appeared lacking in what usability criteria can be applied to recommender systems to improve usability and user preference issues. A conceptual model based on usability criteria for Web-based interfaces can be developed and tested for recommender systems in e-commerce to improve usability/user preferences of these e-commerce interfaces. The motivation of the current research was therefore to develop and test such a model specific to recommender interfaces to improve their design, thereby contributing to e-commerce and human-computer interaction literatures as well as help vendors in design of such systems. The development of this conceptual model is detailed in the next section.

## **2.2 Usability Criteria Model for Recommender System User Interfaces**

Based on the literature review, a usability criteria conceptual model was developed for e-commerce recommender systems. With this model, the goal was to determine and test usability criteria to evaluate the systems. Primarily, two levels of interface usability evaluation for the targeted recommender systems are identified and named: Micro- and macro-level interface evaluation.

The *micro-level* of the interface focuses on the information specific to the recommended product. Common information for recommended products includes the name, price and image of the product. These are named *basic attributes*. The additional information can include product description, product ratings, promotion information (if available), user comments and other user

input. These features are named *advanced attributes*. Both the basic and advanced attributes are only used for recommended products at the micro-level.

The *macro-level* of the interface treats the batch of recommended products as an entity. Therefore, it includes issues concerning when, where and how the recommended products should be displayed.

The conceptual model was constructed based on this main distinction and is presented in Figure 1. There is an additional section in the macro-level called *additional features*, which covered comparison, product evaluation and product quantity items.

Concerning the recommender system content, basic and advanced attributes as well as additional features belong to what content should be displayed. Where the content should be displayed corresponds to the *layout* of the recommendation, as the layout indicates the physical position of the recommendation on the Web page. At what point in time during the user's visit to the site, i.e., when the recommendations should be displayed, is part of the availability of the recommender system. Finally, how the recommendation should be delivered to the customer is part of the format of the recommender system interface (as part of the Web page content, or as multimedia, shopping robot, pop-up window, e-mail sent separately, etc.).

The micro-level and macro-level evaluations can be seen as the most relevant usability criteria for recommender systems as they directly deal with actual design. They can also be considered highly inter-related as most of their content is presented as a group on recommender Web pages. Their elements include name, price, image, description, rating, promotions, comments and other user input for micro-level, and user evaluations, comparisons, quantity, layout, availability and format for macro-level components. Most recommended products include a sub-set of these information elements, and the developed model covers them together in its first

layer. Consequently, results of this study (discussed in Section 5) are entirely based on these criteria.

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The usability criteria in the model are adapted from the elements of *sufficiency*, *transparency*, *flexibility* and *accessibility*, which are based on the usability studies by Matera et al. (2006), Nielsen (1993), and Sinha and Swearingen (2002). The four criteria used in the model are inter-related according to the literature, as they aim at constructing the optimal user experience. The usability concept is constructed with the primary objective that the recommender system user interface should ideally help the shopper in purchasing and/or exploring additional products in addition to their main product. While the content displayed should be relevant, the physical positioning of the recommendations should be intuitive, accessible and flexible, just as the other elements of the shopping Web page should be (Ozok and Salvendy, 2001).

*Sufficiency* indicates that the content of the recommendation should be sufficient for users to make confident buying decisions while saving time and effort. In the example of Amazon.com, customers need to visit one more page to put the recommended item in the shopping cart, while in Blockbuster.com, customers can add the recommended item directly into the cart without moving onto another Web page. The model uses sufficiency instead of efficiency as the usability criterion as it is focused on the customer's perspective on what would be an appropriate set of features to be presented in order to evoke customer interest.

*Transparency* of the recommender system determines what the recommendation decision by the system is based on (Sinha and Swearingen, 2002). Recommendations based on facts and

customer histories can be deemed more transparent. Some recommendations are based on the name and features of the product shopped for or sought by the customer. The recommendation can also be based on accessories or shopping histories of customers who shopped for the same product in the past. Additionally, customers may trust concrete statements such as “Customers who bought this item also bought:” more than vague statements such as “You may also like:” It can therefore be argued that transparency can improve the users’ satisfaction with the recommendation.

*Flexibility* of the recommender system refers to the system being able to be personalized and manipulated according to the shoppers’ needs and desires. Flexible systems can also be viewed as less intrusive as they can be more in line with what the shoppers would like to be presented. The personalization feature, however, is not very common in recommender systems today.

*Accessibility* of the recommender system means the recommendation should allow the shopper to easily navigate through. For example, the links in the recommendations can lead to more detailed information.

The constructed model on usability criteria has two layers. The first layer (to the left in Figure 1) consists of structural attributes of a Web page recommender system, such as name, price, image, description and location of the recommended product. More specifically, the elements of this layer represent the content and design of the recommender system interface (What information should be presented, where, and when). The second layer (to the right in Figure 2) presents the four general e-commerce interface criteria and how they relate to the elements of the first layer. The goal of the current study is to detail the elements of the *first layer* of the constructed model as they more closely relate to e-commerce user experience. For this

purpose, a structured survey tool was used that integrated these first layer elements to measure and rank their importance from the shoppers' perspective. The next section explains the methodology based on this survey.

### **3. Research Methodology**

To determine the user issues concerning e-commerce recommender systems based on the items covered in the conceptual model, a 32-question structured survey was designed to determine user preference and usability issues in e-commerce recommender systems, primarily among college-age U. S. shoppers.. The Survey on Usability of E-Commerce Recommender Systems (SUERS) is presented in the Appendix.

#### **3.1 The Survey on Usability of E-Commerce Recommender Systems (SUERS)**

The questions in the SUERS were developed based on the elements of the first layer of the conceptual model on usability evaluation of recommender systems. This model was in turn based on the literature review in the previous section. The attributes of usability as it relates to e-commerce and specifically to recommender systems taken from this conceptual model included *name, price, image, description, rating, promotions, comments, user input, evaluations, comparisons, quantity, layout, availability* and *format* of the recommended products.

A survey tool was deemed appropriate to determine the user issues of recommender systems as surveys have been widely accepted as a valid tool in determining components of usability issues in a variety of different Web-based interfaces (Ozok and Salvendy, 2001). Throughout the survey, 5-point Likert scales were used to determine the opinions of the participants concerning recommender systems. These types of scales are a good measure for comparative studies on the Web (Dillman, 2000). Most frequency questions carried 5-point rating scales of Never, Seldom, Sometimes, Most of the Times, and Always. Similarly, questions



concerning participant opinions on the individual items as well as recommender systems in general were assigned scales consisting of the options Strongly Dislike, Somehow Dislike, Neither Like nor Dislike, Somehow Like, Strongly Like; and questions that included specific statements carried scales consisting of the options Strongly Disagree, Somehow Disagree, Neither Agree nor Disagree, Somehow Agree, Strongly Agree and I Don't Know.

A number of questions carried unique scales, for example questions on opinions concerning where the recommender systems should be located and what kind of information they should carry, or which recommender types participants favored (These questions are discussed in detail later in this chapter.). Finally, some open-ended questions allowed participants to freely state their opinions on general and specific recommender items. In a large number of questions, participants could also type in their response under the "Other (Please Specify)" option if their response was not included in one of the response options.

The survey consisted of four major sections. After reading and clicking through the text concerning the consent procedure, participants were presented a number of demographic questions on their age, gender, occupation, highest degree earned, number of times they shopped online in the past year, their average online shopping frequency, and the names of some sample online retailers they frequent. In this same section, they were also presented the following objective description of an online recommender system:

"A Recommender System is a system companies routinely use that uses stored shopper preferences to locate, choose and suggest items (recommend items) that may be of interest to e-commerce shoppers. For example, if you are shopping for a digital camera on Amazon, Amazon may recommend you some camera lenses that go with your camera, or some other cameras that may interest you." This statement concerning what the survey is about was followed by

questions specifically targeting recommender system use of the participant group. These questions included the frequency with which they examine the details of recommended products, the frequency with which they purchase the products, and how much they like recommender systems on e-commerce pages in general.

The second section of the survey consisted of specific design preferences of participants. For this purpose, six sample recommender system interfaces were presented to participants. These recommender systems were chosen based on a preliminary study of popular e-commerce retail sites with recommender systems. One hundred different sites were examined by two experts from the area with a doctoral degree from the fields of information systems and e-commerce, followed by a short brain-storming session. In the brainstorming session, the experts agreed that six sites contained representative popular recommender system interfaces. These were the recommender system interfaces from Amazon.com (Apparel Section), Blockbuster.com, Amazon.com (DVD Section), Levisstore.com, Overstock.com and Sheetmusicplus.com. The set of sample products was also deemed as representative, as movies, apparel and music can be identified as three of the most frequently shopped products in e-commerce. It should be noted that recommendations are product-specific. However, the current study limited itself to this limited number of frequently shopped product types. Recommendation differences among products were not made for the purposes of this study as the study is concentrated on user preference and usability issues concerning the design of recommender systems. While products for which recommendations are made differ, the goal of the current study is to determine the best design features of recommender systems regardless of the product type, in other words, producing universal design guidelines, whenever possible, that are independent of the product types, although obviously some limitations on product-specificity of

recommender systems would apply. Further issues concerning this potential product-specificity are discussed the section concerning Open-Ended Question Responses (Section 4.1.3) as well as Limitations and Future Directions section (Section 5.3).

The participants were asked which of the presented interfaces they preferred most, and they were also asked to indicate any other sites whose recommender systems they liked. These general preference questions were followed by questions concerning how, when and where the recommender systems should be presented. Regarding the “Where” question, a picture of a sample e-commerce Web page screen layout was presented with the page being divided into six distinct areas. Participants were asked where, if anywhere, the recommenders should be presented. This “floor plan” of an e-commerce page for the recommender system positioning is presented on Figure 2.

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The third section consisted of sixteen questions covering almost all of the remaining aspects of recommender systems. These aspects included:

- What specifications concerning the recommended product should be included in the recommender system,
- Whether product descriptions should be included in the recommender system, and if yes, how long these descriptions should be,
- Whether product ratings by the customers should be included in the recommender system,
- Whether product promotions should be included in the recommender system, and if yes, what information regarding the promotion should be presented,

- Whether product comments should be included in the recommender system, and if yes, how they should be presented,
- Which information regarding a recommended product is the most important,
- Whether detailed information concerning recommended products leads to a lighter shopping effort,
- How many product recommendations are optimal per page,
- Whether side-by-side comparisons of recommended products can be helpful,
- Whether and how customer feedback concerning recommended products should be displayed, and
- How automatic the recommended product display should be (i. e., whether they should automatically be created, whether customers should input information to generate recommended products, etc.).

In the final section, one open-ended question inquired about any other comments participants may have concerning recommender systems. The survey was structured to comprehensively cover both structural and content-related issues on recommender systems.

### **3. 2 Participants**

The survey was conducted online, as the participant group consisted of college students with significant online experience. This allowed the researchers to broadly distribute the survey and reach a representative sample. An initial power analysis based on Thiemann and Kraemer (1987) indicated that a sample size of about one hundred to one hundred and fifty participants would be adequate to measure the variables in the survey. The survey announcement was distributed via college e-mail groups and newsgroups, and data were collected on the online survey site [surveymonkey.com](http://www.surveymonkey.com). The online data collection method was appropriate for this study

because of practicality reasons, and also Internet-and Web-based tools are commonly used for survey research (Truell, 2003; Couper, 2000). For representativeness purposes, mostly full-time or part-time college students from a university were chosen, as this particular population largely consists of computer-savvy Internet users who are also frequent e-commerce shoppers. College students are routinely used for large-scale Internet surveys (Dillman, 2000). Additionally, a study by Internet Demographics (1998) indicated that 50% of Internet users had either an undergraduate (31%), Master's (15%) or a Ph.D. (4%) degree. Table 1 summarizes the participant demographics.

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One hundred and thirty one participants successfully completed the survey. The age mean was 31.0 (Std. Dev. = 10.0). Sixty-three participants were female (48%) and 68 were male (52%). Thirty-one participants (23.7%) had a high school degree, 45 participants (34.4%) had a Bachelor's degree, 49 participants (37.4%) had a Master's degree, and six of them (4.5%) had a Ph. D. degree. 43.5% of the participants were full-time college students. 35.1% were part-time college students working at an information-technology related job, and 24.4% worked at a college-level educational institution. All but two participants made a purchase at least once in the past from the Web, and all of them were familiar with shopping on the Web. 29.0% indicated that they shop more than once a year but less than once a month using the Web. 47.3% indicated that they shopped online more than once a month but less than once a week, and 22.1% indicated they shopped online about or more than once a week. Most favorite online shopping sites were Amazon.com (103 participants), eBay.com (45 participants), BestBuy.com (23 participants) and Newegg.com (14 participants). Amazon being the clear winner is consistent with the company's

good reputation and wide product variety. It should be noted, however, that this question was inserted at the beginning of the survey to determine whether possible bias concerning favorite recommender systems may be present, in other words, whether participants would favor Amazon.com's recommender systems because of their overall satisfaction with the site.

As a next step, the shopping habits and opinions of the participant students concerning recommended products were explored (The sums of the percentage values may not add up to 100% in some cases due to blank responses). 33.9% of the participants indicated they sometimes look at the details of the recommended product on a Web page. 14% indicated they always check out the recommended product details, and 10.5% indicated they never look at these details. 40.4% indicated they seldom buy products that are recommended to them. 27.5% indicated they sometimes do such purchase, and 24.6% indicated they never buy the recommended products. 36.3% of the participants indicated they somehow liked the recommender systems. 35.7% indicated they had neutral feelings about recommendations, and 11.1% indicated they somehow disliked them. 9.4% indicated they strongly liked recommender systems, and 7.6% indicated they strongly disliked them.

The descriptive statistics concerning the demographic and general opinion questions concerning recommender systems indicated that the participating college-age group consisted of avid e-commerce shoppers from a mostly college population and was therefore an appropriately representative sample for producing reliable results. Additionally, the sample was balanced between the genders and had acceptable age mean and variance. The participant students were also familiar with recommender systems and had generally neutral to positive opinions about them. They also occasionally used recommender systems for examining the recommended products and in some instances purchased them, although the purchases happened relatively

seldom. In the next chapter, results from the analysis on the remaining sections of the survey are discussed.

#### **4. Results and Discussion**

Both quantitative and qualitative analyses were conducted on the user data. In the following sections, first descriptive statistics are discussed, including the mean, standard deviation and frequency values. Next, correlation analyses to determine the most important interrelationships among the factors constituting to recommender systems as well as a stepwise regression to predict overall recommender usability and user preference success factors are discussed. Last, the open-ended questions participants responded to are discussed. While trustworthiness is a major issue concerning Web sites (Fogg et al., 2001), in this study, the trustworthiness of the recommender systems is not discussed. Instead, the assumption was made that they present accurate information and are trusted by the customers.

##### **4.1 Descriptive Statistics**

The descriptive statistics analysis aimed at broadly determining the general trends concerning user preferences and usability issues in e-commerce recommender systems for college-age shoppers, as determined by the first layer of the conceptual model and tested by the survey. The statistics in this section are presented in two formats: Some items are discussed in terms of frequencies of each response, and some are discussed with regard to their mean and standard deviation values. All descriptive statistics concerning the individual survey items are presented on Tables 2, 3 and 4.

###### **4.1.1 Recommender System Presentation Preferences**

To understand when, where and how the product recommendations should be, participant students first examined six representative recommender system interfaces (presented in the

Appendix) and were asked to choose their favorite recommenders among these sites. These six were *Amazon.com (Apparel Section)*, *Blockbuster.com*, *Amazon.com (DVD Section)*, *Levisstore.com*, *Overstock.com*, and *Sheetmusicplus.com*. The representativeness was based on content, layout and merchandise categories. Amazon was founded in 1994 and launched in 1995 as one of the first major e-commerce sites with rich product variety, features and Web services. Amazon sells almost all of the major consumer products, but uses different customer interfaces for some categories, and there are minor differences between most of the categories. Due to these inter-category differences, two categories from this massive site, Apparel and DVD sections, were chosen. Blockbuster specializes in selling and renting DVDs. Levi's Store is the online extension of the brand retail apparel store, which includes a wide variety of apparel products beyond their signature jeans. Overstock is an Amazon-like online warehouse whose product as well as recommender system interfaces are different than those of Amazon despite similarities in product categories. Additionally, as opposed to Amazon, Overstock uses a uniform interface for all product categories. Sheetmusicplus is an online music company that specializes in selling CDs. Its user interface is relatively different than the other retailers chosen for the study. The descriptive statistics results on user preferences concerning recommender systems are presented in Table 2. Among the recommender system screens presented, that of Amazon.com Apparel Section received the majority of confidence votes (45.8%), followed by Blockbuster.com (19.1%) and Levisstore.com (12.2%). Overstock.com (6.9%) and Sheetmusicplus.com (6.1%) recommender systems received the lowest preference rates. In the follow-up question concerning any more recommender systems not included in the survey, buy.com, iTunes music store site, and eBay were the most commonly mentioned sites. However, in this section, Amazon.com was re-emphasized as the most superior site by a number of participants. It appears that the simple



display of Amazon recommended products that includes the price, image, title and customer rating of usually three recommended products is liked by customers, followed by a similar presentation by Blockbuster.com. The lesser preferred Overstock.com and Sheetmusicplus.com contain larger images of the products, with the product name and price included.

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Insert Table 2 about here  
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The findings concerning the recommender systems of real-life vendors are to some extent inconclusive, as participants who are familiar with and frequently shopped from particular companies indicated with strong likelihood the recommenders of those sites as their favorite. The student nature of the participant group should also be taken into consideration as this group may have a particular affinity to mostly shop from Amazon.com. It should be noted that, the recommender interface is quite similar to those of Sheetmusicplus.com and Overstock.com, while the average popularity scores of these companies were at the opposite end of the scale. Therefore, it appears difficult to judge recommender systems based on the brand name of the online vendors. Therefore, questions that were not specific to online vendor brand names needed to be directed at the participants. For the rest of the study, abbreviations for Questions and their corresponding sections are used in the form of “Qx.y” indicating the Question Number x in Section y.

Table 2 indicates that participants overwhelmingly (85.5%) wanted to see recommender systems as part of the regular Web page content, in the form of text and images. The majority of the participants (54.2%) also indicated that recommended products should be presented alongside the main product. Concerning the candidate locations on the main product page to present the recommendations (also see Figure 2), 44.3% of the participants preferred to see

recommendations on the lower right hand side (Area 3) and 33.6% wanted the recommendations to be located in the middle lower section of the Web page (Area 5). Amazon.com and a few other leading online retailers use these areas for recommendations, and the finding indicates that shoppers want recommended products in an easily reachable and visible, yet non-distracting location. This is also the likely reason behind the fact that only 12.2% wanted them located at the very bottom (Area 4).

The display preferences of college-age shoppers provided information on how, where and when the recommenders should be displayed. Questions on specific brands were concluded to be biased and not used further. While display preferences may be to some extent dependent on the individual products that are recommended, the current study covered a group of products that are widely used in retail e-commerce recommender systems. It is therefore believed that the recommender design findings are to a great extent applicable to a large category of products, including electronics, apparel, movies and music products. The display preferences are further detailed in the last section as part of the derivation of design guidelines.

#### **4.1.2 Recommender System Information Content Preferences**

Participants were asked what information should be presented as part of the displayed product recommendations as well as how it should be displayed. The summary of the descriptive statistics concerning these types of questions in the third section of the survey is presented in Table 3. Participants were allowed to mark as many answers as they wanted in some of the questions, and again, some questions were left blank by the participants. The results of Table 3 are discussed together with the results of Table 4 which consist of responses to opinion questions with 5-point Likert scales.

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Insert Table 3 about here  
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91.6% of the participant group indicated price, 84.0% indicated product name, and 85.5% indicated product image as possible items to be displayed within the recommendation (Q3.1). As part of additional items in the “Other” option, 9% indicated product description as a suggested part of recommendation display. These participants mostly wanted “short,” “concise,” “3-5 word” descriptions, with one participant indicating the product name should act as a link to the actual product description, and another indicating the description should be presented as a result of mouse roll-over. 11.5% indicated user reviews or ratings should be presented. Separately, two participants indicated the recommended product display should also contain an explanation on how the recommended product relates to the main product.

Relating to the recommended product presentation, participants were asked *how many recommendations* should be displayed on a screen (Q3.11). 44.3% wanted to see the top three products, and 18.3% wanted the top four products as recommendations. Only 2.3% were interested in seeing all recommended products related to the main product. Two participants also indicated that the number of possible products to be recommended depends on screen size and available screen space. The results in general indicated that presenting the top three recommended products on the display is what the majority of shoppers preferred for the particular product group the experiment was conducted on. Most participants did not indicate the need for a distinction among recommendations based on the product groups they belong to. Indications concerning this distinction are discussed in the next section.

More detailed questions with 5-point Likert scales were directed at the participants to understand their exact preferences concerning the content and display of recommender systems.

Logically, the survey score mean for each recommender system item constituted to the importance of this item. Furthermore, a certain element of the recommender system (such as price) being presented to the shopper can also be seen as a factor that can motivate the shopper to further examine the recommended product or possibly purchase it. Therefore, the survey scores of these recommender system elements can be seen as such factors that can be of benefit to the vendors for eventually improving their sales. The questions concerning these recommender elements were presented in a 5-point Likert scale, with a score of 1 corresponding to “Strongly Disagree” and 5 corresponding to “Strongly Agree.” In addition to these questions, the questions on general frequency and opinion on recommender systems were also presented. The mean and standard deviation results for the opinion questions on recommender system elements are presented in Table 4.

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Insert Table 4 about here  
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The students strongly indicated that if there is a *promotion* happening concerning the recommended product, this promotion should be highlighted (Q3.5, Mean = 4.28, Std. Dev. = 1.06). The concept of promotions is a major attraction to e-commerce customers (Allen and Fjermestad, 2001).

The result on promotions leads to the conclusion that presenting promotions of the recommended products can be seen as the most important element of the systems, although it should be noted that promotions, which are usually in the form of reduced prices (Inman et al., 1990), may not always be available for the recommended products. While the results of the survey can be seen as specific to the particular products in the experiment, it is highly likely that such results can be expected for other retail products.

When participant students were further asked about *how the promotions should be displayed* (Table 3, Q3.6), 82.4% indicated that the promotions *should be very precise* (such as “50% off,” “buy one-get one free,” etc.). 26.0% indicated that the promotion sign should be the link to the full description of the *promotion*, 16.8% indicated that the promotion sign should be the link to the full description of the *recommended product*, and 6.9% indicated they are not sure. The findings once again emphasize the importance the shoppers put on promotions and the expectation of precise information concerning the promotions, consistent with their overall expectation in finding best prices for the products they are shopping for. The finding is also consistent with the earlier finding of prices of recommended products being strongly favored by college-age shoppers.

The ability of shoppers to *compare* recommended products side by side (Q3.13) had the second highest score, with a mean of 4.02 and a standard deviation of 1.02. Comparison shopping is one of the major methods in retail today (Marmorstein et al., 1992). It is therefore only natural that this item is important for the purposes of shopping. Presenting product comparisons allows shoppers to choose from a number of options rather than being confined to one. The responses indicated that participants wanted to have product recommendations presented along with their comparisons to other, similar products. Although the question did not specify or ask what type of comparisons should be presented concerning the product, the main comparison item in retail products is price (Marmorstein et al., 1992). It is therefore assumed that price comparisons play a significant role in participant students’ interest in purchasing recommended products. However, recommended products’ maximum allowed area of screen occupation is limited and definitely smaller than the main product the shoppers are seeking or purchasing, and therefore, how much comparison information can be fitted to the recommended

product area remains to be further explored. Additionally, the desired degree of comparisons among products may also be dependent on the types of products. Comparisons in e-commerce may usually involve products from the same or similar categories, but the product-specific nature of comparisons can be further explored in future studies.

Display of *feedback* (Q3.15) from other shoppers concerning the recommended products received a mean of 3.81 (Std. Dev. = 1.12). It is not specified what kind of feedback is expected in the recommended products' display. However, the expected feedback on Web pages usually includes overall customer satisfaction with the product (Schafer et al., 1999). Prominent companies display both positive and negative feedback concerning their products, and the feedback is not censored unless it contains inappropriate or obscene statements. Hence, receiving objective feedback from other shoppers on recommended products plays an important role in customers' buying decision. Usually, feedback is displayed for almost all products in major e-commerce sites.

A similar form of feedback from fellow customers includes customer ratings which are condensed, symbolic forms of statements concerning the fellow shoppers' overall satisfaction with the recommended product. The *product ratings* (Q.34) are often in the form of star ratings, and the importance of displaying the ratings of the recommended products received an average score of 3.76 (Std. Dev. = 1.23). The placing of *product comments* (Q3.7) as part of recommended product information did not receive high scores from participants, with a mean score of 2.62 (Std. dev. = 1.30). Comments are a form of product feedback in text form. However, the main reason behind the comment mean being low is likely to be stemming from space issues. Text comments can occupy a large area and therefore are likely to be undesired. Participants favor the option to go to the recommended product's main page for more

information, and the finding is an indication that information presented as part of recommended product display is desired to be concise. Therefore, it can be concluded that comments concerning recommended products are generally not desired. As part of the open-ended question regarding *how*, if at all, recommended product *comments should be displayed* (Q3.38), some participants indicated that they should be displayed as a clickable link option, or in very concise format such as product ratings. Only 13% of the participants indicated that all comments regarding the product should be displayed, and 45.8% indicated that the most recent comments should be displayed. The finding again emphasized that the additional product information concerning recommendations should be informative but also concise.

The *product descriptions* as part of the recommended product (Q3.2) received an average score of 3.26 (Std. Dev. = 1.32). The finding again can be related to the finding concerning the recommended product information being desired to be short and concise, with additional information being reachable via the link to the product. Hence, the response mean being close to the middle value is not an unexpected finding. Regarding *what this description should contain* (Q3.3), 11.5% wanted to see the full product description, 22.9% wanted only the first sentence of the product description, 38.2% wanted only the first 50 characters of the full description followed by a full description link, 34.4% wanted the description to be a link, and 20.6% wanted to see some keywords such as “more” presented as a link to the product. Participants generally indicated a preference towards “brief” and “extremely short” descriptions. It can be concluded that the findings indicate product descriptions as not being a substantial factor to be included in recommender system displays. Participants value feedback highly from their peers, but ratings generally satisfactorily meet this need for feedback, rather than descriptions and user comments in text form.

Customer feedback concerning recommended products was further investigated in a question that inquired about *how the customer feedback should be displayed* (Q3.14). 51.1% wanted the feedback to be presented in star ratings. 29.0% indicated a numerical ratio rating would be useful (such as “3 out of 5 people purchased this recommended product”), 21.4% indicated it should be presented as a numerical score (such as 50%), 13.0% preferred the feedback in small icons other than star ratings (such as thumbs up-thumbs down), and 6.9% indicated they didn’t know. In summary, customer feedback concerning recommended products is expected by the consumer to be presented in a concise, easy to understand display format, and it is also deemed quite important in determining their purchasing decision concerning the recommended products.

Two relatively surprising results were obtained concerning the scores on the desire to receive detailed information and the help that product recommendations offer in the shopping effort. Student participants did not agree that *the more recommended products they were presented, the less effort they spent in online shopping* (Q3.12, Mean = 2.52, Std. Dev. = 1.09), and they were relatively indifferent concerning *more detailed information regarding recommended products lessening their shopping effort* (Q3.10, Mean = 3.07, Std. Dev. = 1.24). The findings indicate that product recommendations do not improve actual shopping performance of users. Therefore, it can be concluded that recommender systems increase the number of shopping choices presented to the shoppers without any additional effort, but do not improve the online shopping effort.

Finally, a few general issues concerning recommender systems were explored. These general items can be argued to be highly significant in how they should be designed. In this context, participants were asked about *how the site should decide what products to recommend*



to the users (Q3.16). 46.6% of the participants indicated a semi-automatic approach would be best where the site would come up with recommendations on its own, and shoppers can give feedback concerning the recommendation by indicating whether or not they liked the recommendation. To accomplish this, they can vote on whether they liked the recommendation by clicking on the Yes/No option provided with the question “Did you like this recommendation?” alongside the recommended product. One participant proposed a “...hybrid solution of content and collaborative filtering in order to deal with cold start problems as well as to find items that people like me like.” 32.8% indicated a preference towards a fully automatic system where the system decided on what recommendations to present to the shopper, and 14.5% preferred a manual approach where customers would specify their interests to the site for making decisions. It should be noted that most recommended products are presented based on the students’ shopping and browsing habits. The particular finding indicates that there is a desire on the shopper students’ part to play a bigger role in helping sites produce more precise recommendations.

#### **4.1.3 Open-Ended Question Responses**

There were two major questions where the participants were encouraged to type in any answer they wanted. Additionally, some scale questions contained an additional “Other” option to allow the participants to express any other comments and opinions they may have concerning the recommender system elements asked in the question. There was one open-ended question (Section 3, Question 9) concerning what should be displayed on a recommender system which was responded to by eighty-four participants (64.1%), a fairly high number. The goal behind asking this question was to allow participants to freely express their thoughts on what information, if any, they would like to learn from a product recommendation. *Name* and *price* of

the recommended products were the items most desired to be displayed, along with an *image of the product*, indicating a desire of the participants to see the product. A study by Lightner et al. (2002) indicated that American e-commerce shoppers desire their experience of shopping online to be as close as possible to the physical shopping in terms of examining the product (although obviously touching and feeling the product is not possible in the online environment), and the participants in this study indicated a similar desire for the recommended products. This is also an indication that participants view the recommended products with a serious intention of buying. The fact that images are deemed important is an indication that recommended product images are an additional significant part of their display (Sometimes referred to as “graphical representation” by the participants). Comparisons of product specifications and prices, “pros and cons” of the product, ratings and descriptions of the products, and links to the main page of the recommended product were other commonly indicated items. There were also some additional items that were indicated by one or a few (up to three) participants. These items included “explanations on how the product will be useful to me,” “how the product is superior to my main product,” “warranty” and “customer care information,” “Frequently Asked Questions” about the recommended product, a “thumbnail” product image, and a few more items that are indicated by one participant each. The commonly indicated items in this section are also mentioned by the participants in the rest of the survey, and are therefore established as significant display elements of recommender systems. They are further discussed in the Conclusion and Recommendations section as part of the design guidelines.

The college-age participants were also asked whether they had anything more to indicate concerning recommender systems (Q3.17). Thirty-four participants (26.0%) responded to this question. Responses generally indicated that they found recommender systems useful, and

Amazon.com's recommender system was commonly mentioned with high praise. Some participants indicated that "Amazon is the champ at the recommender system," "Amazon does it well. Every other one I've seen is VERY ANNOYING!" and "I find Amazon.com's recommender system for books extremely helpful when I am looking for books on similar topics or just books I might enjoy reading." One participant indicated both pros and cons of recommender systems objectively by saying "I like them and find them useful when they show me relevant products that match my interests. I find them annoying when they show me irrelevant products that I have no interest in." Concerning what information should be presented and how, results were again consistent with the majority of the responses given in the other parts of the survey in the expectation of concise, to-the-point product information as part of the recommendation. Participants indicated "I prefer minimalist systems to prevent disruptions to my purchasing experience," "They should be secondary within the page you are looking at, and relevant to the product," "Recommendation should not mislead customer in any manner. It must be as honest as possible," "Most important thing is relevancy. I like recommended products only if they are relevant to what I am trying to buy." A number of participants indicated that the need for recommender systems is product-specific and is therefore not a "one size fits all" concept. Their statements included "Recommenders are very helpful for electronics, appliances, and gadgets, but useless for personal items, apparel, books, music, etc.," "Unfortunately like many other systems, one size does not always fit all. What works for Books and CD/DVDs does not always work for clothing," and "Intelligent shopping agent can act as a platform for future consumer purchases based on their preference configuration." These statements are to some extent consistent with the literature, particularly by Im and Hars (2007) and the product-specific nature of recommender systems needs to be further explored. Besides product issues, the

findings represent the opinions of a college-age population and there may be some differences in preferences between different age demographics.

In general, responses to the open-ended questions were very helpful to the researchers to determine that college-age e-commerce shoppers have a high level of insight of understanding concerning recommender systems. Moreover, the qualitative responses complement the quantitative responses in a number of different topics, including what items should be displayed as part of recommended products (“price, ratings, images”), in what form information should be displayed (“System should be integrated and interactive,” “They must be carefully and wisely used in a site. Otherwise they bring confusion to the consumer,” “They should be timely,” “as transparent as possible.”), what should be avoided (“Do not make them overbearing or overly obvious,” “The items shouldn't dominate the page or otherwise disrupt from my experience,” They should be “unobtrusive,” and “not interfere with my searching.”) and a few minor items. Only one participant had strong feelings against recommender systems, indicating they are “very intrusive and obnoxious.”

#### **4.1.4 Main Results Summary of Descriptive Statistics and Qualitative Responses**

1. Overwhelmingly, college-age shoppers have a perception of Amazon.com’s recommender interfaces to be the most popular.
2. Shoppers prefer the content of the recommenders to be displayed as regular Web content (text and images) on the page.
3. Shoppers prefer recommended product information on the same page as their main product, in an easy-to-detect and compact form, consisting of a few words and one thumbnail-size image.

4. Most shoppers prefer the recommendation to be displayed under the main product description, while the second most popular display of product recommendations is the right hand side of the main product description.
5. Product price, name and image constitute to the basic set of desired information on the recommended product.
6. Promotion information concerning the recommended product is the foremost item to be displayed besides the basic information.
7. Shopper feedback in concise format such as star or percentage/points ratings are desired.
8. To keep the information short, generally no more than the information on Bullets 5., 6. and 7. is desired for display.
9. Shopper comments on the recommended product are generally not desired. If the comments are to be displayed, only the most recent three should be displayed.
10. A maximum of three products should be recommended.
11. The semi-automatic type of recommender system is the most desired type where customers can manipulate their recommendations if they want to, which can allow the system to produce more precise recommendations next time. The desired manipulations are both content- and format-related (such as the type and number of recommendations). A substantial group also would prefer fully automated recommendations.
12. There appears to be a general favoring of the recommender systems of Web pages that are popular and have high customer satisfaction ratings.
13. Recommender systems improve shopper choices by presenting them relevant product alternatives without any additional effort, but do not appear to affect shopping performance. It should be noted that shopping performance was not explicitly measured

in this study. While a future study can concentrate on the actual shopping performance in relation to recommender systems, the current study concluded that participants do not believe their shopping performance (time and number of errors) is affected by recommender systems

14. The majority of college-age online shoppers like recommender systems. However, there is a desire to control them. It can be concluded that online shoppers like a more interactive interface, as previously indicated by Miller et al. (2003) which can provide flexibility to them. The flexibility can be perceived as one of the usefulness criteria, and interactivity coupled with flexibility can give them control on when, where, how and what the recommenders will present them.

#### **4.2 Correlation Analysis of Recommender System Elements**

This section aimed at understanding the most significant interrelations among the elements that constitute to recommender system design, both from structural and content perspectives. To detect these relationships, a correlation matrix was set up for all of the questions that contained a 5-point Likert scale concerning user opinion and usage frequency. These questions were Questions on the **frequency of examining the recommended product details (1.8), frequency of purchasing the recommended products (1.9), overall opinion on recommender systems (1.10), opinions on whether there should be descriptions (2.2), ratings (2.4), promotion information (2.5), and customer comments (2.7) of the products, opinion on shopping effort easing with detail level of information (2.10) and with recommendations (2.12), opinion on side by side recommended product comparisons (3.13), and opinion on positive feedback of recommendations increasing likelihood of the purchase of recommended product (3.15)**. A correlation matrix with all of the correlations among the

scaled questions and the most significant correlations (the last three rows) are presented in Table 5.

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Insert Table 5 about here  
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The significant correlations at 0.05 alpha level included six correlations. The highest correlation (0.64) was detected between Questions 1.8 and 1.9, and is logically expected. The inspection of recommended product *details* was strongly correlated to the *purchase* of the recommended products, indicating to some extent a success of recommenders fulfilling their goal. The finding suggests that shoppers who inspected the products sometimes also bought them. Hence, presenting recommendations can be concluded to be a useful action to improve sales for B2C e-commerce vendors as shoppers can potentially give a buying decision regarding a product for which a high level of detail is presented. The “curiosity” factor may play a large role in this conclusion due to both the demographics and product factors. The participant group being college-age may be a factor in the product details being a welcome factor. Additionally, consumer products such as cameras are feature-heavy which may be of interest for this group of customers to learn. Similarly, details on clothing (size, fabric, etc.) and movies (genre, actors, director, etc.) are likely details of interest for recommended products.

The second highest correlation (0.54) was detected between Questions 1.9 and 1.10, indicating a strong relationship between *overall opinion* on recommenders and the *likelihood to purchase* a recommended product. The finding indicates that participants who have an acceptable opinion on recommenders trust it well enough to “listen to” the recommendations by purchasing the recommended products. Similarly, the fourth highest correlation was between

Questions 1.8 and 1.10 (0.44), indicating participants who in general enjoy recommendations end up buying the recommended products.

*Feedback from customers* was strongly correlated (0.48) to the *ratings* as part of two *customer feedback*-related display issues, confirming the earlier finding that participants who'd like to see customer feedback would like the feedback in the form of customer ratings. The two performance-related items were also highly correlated (0.43), indicating participants who thought of recommended product *details as useful information* also found a *high number of recommended products useful*. This finding indicates that a high number of details result in increased perceived usefulness of the product for the participant group, which is parallel to the previous finding concerning product details. Finally, *product ratings* and *product descriptions*, two items concerning the information on recommended products, also correlated highly (0.38). The findings indicate a strong interrelationship between the types of information provided concerning recommended products. In general, relevant information appears to improve the likelihood of the purchase of recommended product.

The correlations demonstrated some interesting results in the form of closely interrelated product recommendation items and also resulted in the conclusion that college-age shoppers have a clear understanding of what set of information they'd like to see in grouped form in recommender systems. As a final step, therefore, it was explored what items have the most significant predictive power for shoppers' overall opinion concerning recommender systems. For this purpose, a stepwise regression model was built among the same questions as in the correlation matrix, with Question 1.10 (**Overall Opinion on Recommender Systems**) as the dependent variable. The results of the stepwise regression analysis are presented in Table 6. Table 6 indicates that the four-step regression analysis identified four variables as predictors for



college-age shoppers' opinion on recommender systems. They include Questions **1.9**, **(Frequency of Purchasing the Recommended Products)**, **3.5 (Promotion Information)**, **3.7 (Recommended Product Comments)** and **3.15 (Recommended Product Feedback)**. The procedure identified that in order to produce recommender systems with high customer satisfaction, first and foremost, the shoppers need to be willing to purchase recommended products. Presentation of relevant information also plays an important role in buying decision concerning the recommended product.

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 Insert Table 6 about here  
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Additionally, product promotion information should be presented as part of the recommender system display, along with shopper feedback, as well as product comments, space permitting. While the absence of product ratings as a predictive variable is surprising, it can be concluded that the presence of the predictor items directly relates to how well participants like the recommenders, and its absence may be due to the fact that participants may have perceived the ratings issue as a part of feedback, meaning ratings may have been included within the feedback issue. Comments may be perceived by the shoppers as an additional item which can be inserted optionally. Overall, relevant product information and customer feedback were deemed as items with most predictive power for overall product opinion concerning recommender systems by the participant group.

### **Correlation and Stepwise Regression Analysis Results Summary**

The overall findings from the correlation and regression analyses include:

1. College-age shoppers who like recommender systems are willing to learn more information concerning recommended products.

2. Some shoppers perceive the recommendation as a product-specific application, with both positive and negative aspects.
3. Shoppers favor product comments and ratings by fellow shoppers as an essential part of recommender systems.
4. In some cases, users don't mind a high number of recommendations, space permitting.
5. None of the structural components made it as predictors of the overall satisfaction of shoppers with recommender systems in general. Therefore, content-related factors play a far more significant role than structural factors in determining overall shopper satisfaction with recommender systems.

The findings in general indicated a strong level of awareness, a desire to control the context and amount of information presented, and a demand for high relevance concerning recommender systems among e-commerce shoppers. Next, the larger-scale findings from the study are discussed and summarized along with recommendations for future studies and design guidelines.

## **5. Conclusions, Future Studies and Guidelines for the Design of Recommender Systems in Electronic Commerce**

In this section, overall findings concerning recommender systems' user preferences and usability issues are summarized. This is followed by future directions and design guidelines for effective, successful recommender systems.

### **5.1 Major Findings:**

1. College-age online shoppers generally demonstrate a high level of awareness concerning recommender systems. They ask for a high level of control in specifying what exactly they want, where and when they want it concerning the recommender system product displays.

2. College-age shoppers are generally fond of recommender systems for common retail products.
3. Shoppers would like to see very precise information concerning recommended products.
4. While shoppers want to have control on what recommendations they'd like to be presented, rather than choosing everything themselves, they like a semi-automatic approach of recommendation display where they can modify their preferences if they would like, but generally the system can decide on what product to present to them.
5. Shoppers who like recommender systems also pay attention to them and sometimes purchase the recommended products.
6. Recommender system design does not affect overall opinion of the shoppers concerning the e-commerce site they are presented in, meaning shopping sites with bad recommender systems are not consequently seen as bad shopping sites overall.
7. Recommender systems' content is a far more significant factor than the structural design in determining overall user opinion.
8. The essential recommended product information consists of product name, price and image.
9. Recommended product promotion information is the single most important thing to present as part of the recommendation besides the essential information.
10. Shoppers value peer feedback concerning recommended products highly.
11. The feedback is most generally preferred to be in the format of customer ratings.
12. Peer comments on recommended products are also highly valued, next to the ratings.
13. Additional items to be included, although secondary, are items that require more physical space on the screen. They are peer comments on recommended products and side-by side

comparison capabilities. They are also strongly correlated to the primary content preferences in the previous bulletin.

14. No more detail concerning the recommended products is generally desired beyond the above items.
15. Recommender systems neither disrupt nor improve the overall shopping performance of the shopper. Shoppers do not believe recommender systems result in their spending more time unnecessarily on the shopping sites, or committing more errors during shopping.
16. Shoppers see recommender displays as a secondary screen element. They'd like to see short and concise recommended product descriptions.
17. Amazon is the clear winner in shopper preference concerning recommender systems.
18. Participants do not want more than three recommended products per main product screen.
19. Recommendations should be placed on the lower-middle section of the screen on the main product interface.
20. In most cases, recommendation systems are not product-specific. Similar recommendation techniques can be used for most types of retail products in e-commerce, but future studies can further explore the product-specific nature of recommender systems.

Finally, based on the above findings, the following ten validated guidelines have been generated (They are subjectively rank-ordered according to priority):

1. Present the name, price and a thumbnail-size picture of the recommended product.
2. Do not present any more information than promotion, user rating, user comments and comparison information.
3. Present a maximum of three recommendations on the main screen.

4. Present short, concise and accurate recommended product information, no more than three lines in length.
5. Present recommendations on about the middle of the lower end of the screen.
6. Allow participants to modify and customize their automatically generated recommendation preferences.
7. Space permitting, present product promotions, if any, and average user ratings concerning the recommended products, besides the essential set of information, which consists of product name, price and image.
8. If your design allows for more screen space, present user comments and comparison of the recommended product with the main product or other products.
9. If you will display product comments, display the latest ones.
10. Do not present recommendations in pop-up windows or through any means other than as a section of the main product display.

## **5.2 Conclusions**

In this study, the essential elements for recommendation transparency and sufficiency were identified, including promotions, comments, ratings, comparison, feedback, etc. as well as basic recommender system elements at the micro level which include product name, image and price. Some additional elements of recommender systems are also identified. Normally, shoppers will look for promotions if there is one. This may also be the reason that online shopper prefer to primarily see the price as the essential information of recommended products. Consequently, promotions are concluded to be quite important to display.

From a social perspective, it is concluded that college-age e-commerce shoppers feel confident using the recommendations concerning common retail products (parallel to the

findings of Sinha and Swearingen, 2002), like the recommendations, and perceive them to be useful. Feedback can be in the form of ratings and/or comments concerning the product. Not surprisingly, online shoppers are more likely to buy the products with positive feedback. However, our results indicated that the transparency of the recommender system interface content played a highly important role in the success of the recommenders. Therefore, transparency is the criterion that primarily should be used to evaluate the usefulness of the interface of the recommender systems. Keeping transparency as the primary factor in design, the determined guidelines are believed to be applicable to almost any recommender system design for retail e-commerce companies in today's high-technology, high-competition environment. However, more research on how to provide transparency for recommender systems may be needed in future studies, exploring the transparency issue even further in both content and presentation context. Future directions are discussed in the next section.

### **5.3 Limitations and Future Directions**

The study measured the user preference issues concerning recommender systems as precisely and objectively as possible, with a college-age population as a target group.

However, future studies may consist of controlled experiments concerning recommender system use as it relates to the performance. One potential downside of the survey study is its focus on user opinions only. Another issue is the participant group consisting of college-age online shoppers. Therefore, the results to some extent need to be interpreted with regard to what student users of e-commerce sites may want. While the authors of the current study believe that the results are generalizable to broader e-commerce shoppers due to similar studies in the same vein as well as college-age students constituting to a large part of e-commerce shopper population, future studies may investigate recommender system preferences for different

population segments such as the elderly population as well as differences between different Internet demographics.

The product-based nature of recommenders was not explored in this study. People's preferences on how much information to present may depend on additional factors such as their experience with the system, product domain, shopping goals, etc. The current study focused on recommendations regarding a limited number of representative products, namely apparel, movies and music products. In this set, a low number of participants indicated that the "one size fits all approach" may not always work for different varieties of products. Im and Hars (2007) indicated that the effectiveness of collaborative filtering may be different among domains and search needs and modes of the customers. Further studies may therefore also explore product-based design differences that may be necessary for effective, tailor-made recommender system design. Additionally, cultural differences in design of e-commerce recommender systems can be explored in a future study, parallel to those discussed by Lightner et al. (2002), and also the applicability of the current study's results on collaborative filtering in e-commerce can be further explored. With the advent of technology, e-commerce Web design is a rapidly changing, fluid concept. With new designs, new requirements concerning recommenders will no doubt emerge. However, it can be concluded that this study is novel in its approach for determining and addressing a large set of user issues, concluding that recommender systems are a positive element of retail e-commerce.

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## Appendix. User Interface of Recommender Systems Usability Survey

### I. Demographic questions: (\* indicate required)

1. \*What is your age?
2. \*What is your gender? F, M
3. \*What is your Occupation/Job (e. g., student, database administrator, teacher, etc.):
4. \*What is your Highest Degree Earned:
5. \*How many times did you shop online in the past year?
6. \*On average, how often do you shop online? (You can type 'once a month', 'once a week', etc.)
7. If you have shopped online before, Please type some companies you shop at (for example, Amazon.com, walmart.com, bestbuy.com, etc.)

A Recommender System is a system online shopping companies routinely use that uses stored user preferences to locate, choose and suggest items (recommend items) that will be of interest to e-commerce shoppers. For example, if you are shopping for a digital camera, on Amazon, Amazon may recommend you some camera lenses that go with your camera, or some other cameras that may interest you. Please mark the response that best reflects your opinion in the questions below.

8. \*How often do you look into the details of the recommended products when you are browsing the online store (For example you look at the product page of the recommended product)? (pick only one)
  - a. Never
  - b. Few times
  - c. Sometimes
  - d. Most of the times
  - e. Always
9. \*How often do you buy the recommended products either online or offline because of the recommender system? (pick only one)
  - a. Never
  - b. Few times
  - c. Some times
  - d. Most of the times
  - e. Always

10. \*In general, do you like online recommendations? (pick only one)
- I strongly dislike them.
  - I somehow dislike them.
  - I neither like nor dislike them.
  - I somehow like them.
  - I strongly like them.

## II. An Overview of the Recommender systems in e-commerce.

In this section you will see some examples of Recommender Systems in e-commerce. Please note they are not the complete screen shorts but only the recommender system parts of the screen.

Sample A -- Recommender system for apparel from amazon.com

### Customers who bought this item also bought



[C.B. Collections Moragne \(Bealls Florida\)](#)  
Average Customer Rating: ★★★★★  
[Buy new](#) : **\$29.99**



[C.B. Collections Awesome \(Bealls Florida\)](#)  
Average Customer Rating: ★★★☆☆  
[Buy new](#) : ~~\$24.99~~ **Sale: \$9.99**



[C.B. Collections Awesome Dot \(Bealls Florida\)](#)  
[Buy new](#) : ~~\$24.99~~ **Sale: \$9.99**



[Chinese Laundry Women's Jordan High Heel Strappy](#)  
Average Customer Rating: ★★★☆☆  
[Buy new](#) : **\$29.94**

Sample B -- Recommender system from blockbuster.com

**If You Like**    Reviews    More Details

**If You Like Just Friends...**

<a href="#">Meet the Parents</a> [Special Edition] [WS]	<a href="#">Shallow Hal</a> [WS]	<a href="#">Saving Silverman</a> [R Version]	<a href="#">Meet the Fockers</a> [WS]
			
<a href="#">Add to Queue</a>	<a href="#">Add to Queue</a>	<a href="#">Add to Queue</a>	<a href="#">Add to Queue</a>
Member Rating ⊗ ★★★★★	Member Rating ⊗ ★★★★★	Member Rating ⊗ ★★★★★	Member Rating ⊗ ★★★★★

Sample C -- Recommender system for DVD from amazon.com

**Customers who bought this DVD also bought**

- [Capote DVD](#) ~ Philip Seymour Hoffman
- [Crash \(Widescreen Edition\) DVD](#) ~ Sandra Bullock
- [Walk the Line \(Widescreen Edition\) DVD](#) ~ Joaquin Phoenix
- [Good Night, and Good Luck \(Widescreen Edition\) DVD](#) ~ George Clooney

Sample D -- Recommender system from levisstore.com

**YOU MIGHT ALSO LIKE...**



**Levi's® Pointelle Cardigan**

~~\$40.00~~ **Now \$19.98**

Lightweight pointelle in a zigzag pattern. Ribbed waistband and cuffs with overlock stitching at the armholes. Dressed-up goldtone buttons. 100% cotton. Machine wash. [...More details](#)

**Availability:** In Stock Leaves warehouse in ; 1 - 2 full bus. days

**COLOR:** Stream : 100% Cotton

Stream

Choose a Size

Qty:



**Levi's® Tab Twills Military Blazer**

~~\$58.00~~ **Now \$19.98**

Military-inspired blazer with a vintage two-button closure. Styled with contoured seams for a slim fit, two welt button-flap front pockets and a retro sized zip-front pocket near the collar. [...More details](#)

**Availability:** In Stock Leaves warehouse in ; 1 - 2 full bus. days

**COLOR:** Butternut Twill : 98% Cotton, 2% Spandex

Butternut Twill

Choose a Size

Qty:

Sample E -- Recommender system from overstock.com  
**Customers who bought this item often buy...**



Antique Design Umbrella Stand (16-in./2 colors)  
List Price: \$69.95  
**Our Price: \$39.99**  
Save: \$29.96 (42%)



9-ft. Market Umbrella  
List Price: \$99.00  
**Our Price: \$49.99**  
Save: \$49.01 (49%)

Sample F -- Recommender system from sheetmusicplus.com

Main product description was here.  
It is beeing removed for the survey purpose

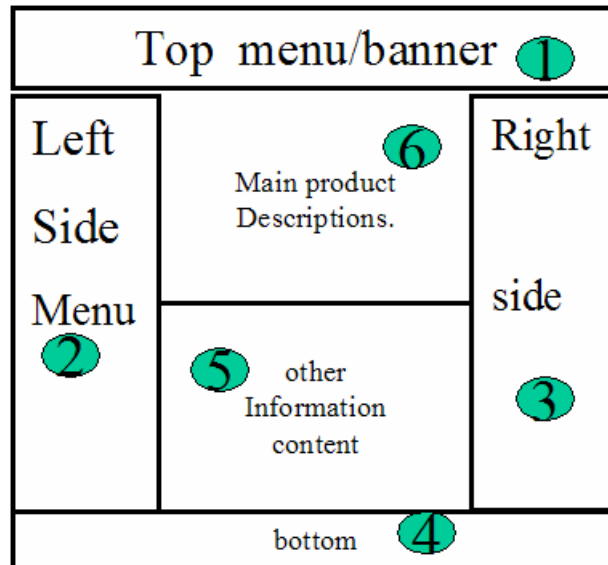
People who bought **Five for Fighting: 100 Years** also bought:

Five for Fighting: Superman For voice, piano and guitar chords...  
**\$3.95**

Evanescence: My Immortal For voice, piano



1. \*Please choose the recommender system you like most based on the above samples. Don't worry about the products or the sellers, this question is only about whether you like the presentation of the recommendation in general .(pick one)
  - a. Recommender system for apparel from amazon.com
  - b. Recommender system from blockbuster.com
  - c. Recommender system for DVD from amazon.com
  - d. Recommender system from levisstore.com
  - e. Recommender system from overstock.com
  - f. Recommender system from sheetmusicplus.com
2. If you have other favorite recommender systems you can remember, please tell us about it (textbox).
3. \*In terms of presenting the information concerning the recommended products, which of the following would you prefer most (Pick as many as you want)?
  - a. They should be displayed as regular Web content (text and images) on the Web page.
  - b. They should be displayed in a multimedia (video, audio, animation, etc.) format.
  - c. They should be sent as instant messages to the cell phones or mobile devices.
  - d. They should be presented in a pop-up window.
  - e. They should be sent to the customers via email.
  - f. Systems should never give recommendations.
  - g. Don't know.
  - h. Other (please specify)
4. \*When do you think is a best time to display the recommendations? (pick one)
  - a. When customers are reviewing the details of a specific item.
  - b. Right after customers put the item into the shopping cart
  - c. Anytime before the customer checks out
  - d. Anytime between the customer confirmed the payment and checked out
  - e. Right after the customer checked out
  - f. Any time during the customers' visit of the site
  - g. Only upon the request of the customers
  - h. Never
  - i. Other (please specify)
5. \*Normally, a web page in e-commerce can be divided into following 6 areas as shown in the figure below. Which area do you think is best for the recommendations.



- Any place in area 1
- Any place in area 2
- Any place in area 3
- Any place in area 4
- Any place in area 5
- No preference
- Other (please specify)

### III. Opinions on recommendation display

In the following questions, mark the responses that best reflect your opinions. There is no right answer.

- \*Suppose that you are doing online shopping, and you are looking at the description of a product. Meanwhile, there are some other recommended products. What do you think should be displayed as part of the recommendations (Pick as many as you want)?
  - Price
  - Name
  - Image
  - Other (please specify)
- \* There should be descriptions of the recommended product in the recommendation. (pick one)
  - Strongly disagree
  - Somehow disagree
  - Neither agree nor disagree
  - Somehow agree
  - Strongly agree
  - Don't know

3. What should be in the description of the recommended product if there is product description in recommendation? (Pick as many as you want)
  - a. The full description of the recommended product
  - b. Only the first sentence of the full description
  - c. Only the first 50 characters of the full description followed by something like '...Click for more.'
  - d. The description should be a link to the product
  - e. Only some keywords such as 'more', '...' presented as a link
  - f. Other (please specify)
  
4. \*Product rating is the rating that customers give to the products (such as 4 stars). Please choose the statement that best reflects your opinion on the following question: Ratings of the recommended product should be displayed in the recommendation. (pick one)
  - a. Strongly disagree
  - b. Somehow disagree
  - c. Neither agree nor disagree
  - d. Somehow agree
  - e. Strongly agree
  - f. Don't know
  
5. \*Please choose the statement that best reflects your opinion on the following question: When the recommended product has a promotion, the promotion information should be displayed in the recommendation. (pick one)
  - a. Strongly disagree
  - b. Somehow disagree
  - c. Neither agree nor disagree
  - d. Somehow agree
  - e. Strongly agree
  - f. Don't know
  
6. What should be in the promotion description if there is a current promotion for the recommended product? (pick as many as you want)
  - a. The promotion information should be in very precise phrase such as (50% off, buy one get one, etc).
  - b. The promotion sign should be the link to the full description of the promotion.
  - c. The promotion sign should be the link to the full description of the recommended product.
  - d. Don't know.

7. \*Product comments are comments that customers write concerning the product. Please choose the statement that best reflects your opinion on the following question. Product comments of the recommended product should be displayed in the recommendation. (pick one)
- Strongly disagree
  - Somehow disagree
  - Neither agree nor disagree
  - Somehow agree
  - Strongly agree
  - Don't know
8. How should the product comments be displayed if they are there? (pick one)
- All the comments of the recommended product should be displayed.
  - The most recent product comment of the recommended product should be displayed.
  - Other (please specify)
9. What is the information of a recommended product in your opinion that should definitely be displayed? (Textbox)
10. \*Please choose the statement that best reflects your opinion on the following statement. The more detailed information of the recommended product I get, the less effort I spend in shopping. (pick one)
- Strongly disagree
  - Somehow disagree
  - Neither agree nor disagree
  - Somehow agree
  - Strongly agree
  - Don't know
11. \*How many recommended products should be displayed along with your main product? (pick one)
- Top one
  - Top two
  - Top three
  - Top four
  - Top five
  - Top six
  - All the possible products I maybe interested.
  - Don't know
  - Other (please specify)

12. \*Please choose the statement that best reflects your opinion on the following statement:  
The more recommended products I get, the less effort I spend in shopping. (pick one)
- Strongly disagree
  - Somehow disagree
  - Neither agree nor disagree
  - Somehow agree
  - Strongly agree
  - Don't know
13. \*Please choose the statement that best reflects your opinion on the following statement: I should be able to compare the recommended products side by side if there is more than one. (Such as compare the recommended products' image, price, product ratings on one page, etc.) (pick one)
- Strongly disagree
  - Somehow disagree
  - Neither agree nor disagree
  - Somehow agree
  - Strongly agree
  - Don't know
14. \*Recommendation feedback is customers' feedback on how useful or helpful the recommendation is. What do you think will be a good way of displaying recommendation feedback? (pick multiple)
- It should be displayed in stars or similar format (such as number of hearts, etc.).
  - It should be displayed in numbers (such as 3 out of 5 people think the recommendation is useful).
  - It should be displayed in small icons (such as 'thumbs up' and 'thumbs down').
  - It should be presented as a numerical score (such as 50 out of 100).
  - Don't know.
  - Other (Please specify). (Textbox)
15. \*Please choose the statement that best reflects your opinion on the following question: I am more likely to buy the recommended product that receives positive feedback than the one that receives no feedback. (pick one)
- Strongly disagree
  - Somehow disagree
  - Neither agree nor disagree
  - Somehow agree
  - Agree
  - Don't know
16. \*Assume an e-commerce site is planning to use a recommender system. Which one of the following recommender systems would you recommend most? (pick one)
- Automatic -- Recommendations automatically displayed for the customer based on their shopping history without their input.

- b. Semi-automatic -- Customers can specify what they want if they are not satisfied the recommendation made automatically.
- c. Manual – Customers can specify their interests to the site first, then the site make recommendations for customer.
- d. Other (please specify)

17. Any other comments about the recommender systems?

Age	Mean = 31.0, Std. Dev. = 10.0
Gender	Female: 63 (48%); Male: 68 (52%)
Occupation	Student = 57 (43.5%); Part Time-IT Job = 46 (35.1%); Working in Education = 32 (24.4%)
Highest degree	Bachelor's = 45; Master's = 49; Ph. D = 6; High School = 31
Shop online in the past year	Mean = 24.8; Max = 365; Min = 0; Std. Dev. = 40.3
Online shopping frequency	More than Once a Week: 29 (22.1%); More than Once a Month: 62 (47.3%); More than Once a Year: 38 (29.0%); Never Buy Online: 2 (1.5%)
Favorite E-Commerce Site	Amazon.com = 103; Ebay.com = 45; bestbuy.com = 23; newegg.com = 14

Table 1. Summary of Participant Demographics (N = 131)

	a	b	c	d	e	f	g	h	i	Total
<b>Q2.1: Site Preference</b>	<b>Amazon Apparel: 60 (45.8%); Blockbuster: 25 (19.1%); Levi's Store: 16 (12.2%); Amazon DVD: 31 (9.9%); Overstock: 9 (6.9); Sheet Music Plus: 8 (6.1%)</b>									131
<b>Q2.3: General Placing and Form</b>	<b>112</b> <b>85.5%</b>	8 6.1%	1 0.8%	3 2.3%	7 5.3%	5 3.8%	7 5.3%	Other 11.5%		131
<b>Q2.4: When?</b>	<b>71</b> <b>54.2%</b>	26 19.8%	8 6.1%	1 0.8%	0 0	5 3.8%	14 10.7%	4 3.1%	Other 1.5%	131
<b>Q2.5 Where?</b>	0	3	<b>58</b>	16	44	5	Other			131
	0	2.3%	<b>44.3%</b>	12.2%	33.6%	3.8%	3.8%			

Table 2. Recommender System Presentation Preferences (Items in bold are the most popular responses.)



	1	2	3	4	5	6	7	8	9	10	Total
<b>Q3.1: Content</b>	<b>120</b>	110	112	32	Open						131
	<b>91.6%</b>	84.0%	85.5%	24.4%							
<b>Q3.3: Description</b>	15	30	<b>50</b>	45	27	13	Open				131
	11.5%	22.9%	<b>38.2%</b>	34.4%	20.6%	9.9%					
<b>Q3.6: Promotion</b>	<b>108</b>	34	22	9							131
	<b>82.4%</b>	26.0%	16.8%	6.9%							
<b>Q3.8: Comments</b>	17	<b>60</b>	37*	Open							131
	13.0%	<b>45.8%</b>	28.2%								
<b>Q3.11: Number</b>	3	10	<b>58</b>	24	16	3	3	7	7	Open	131
	2.3%	7.6%	<b>44.3%</b>	18.3%	12.2%	2.3%	2.3%	5.3%	5.3%		
<b>Q3.14: Feedback Type</b>	<b>67</b>	38	17	28	9	10	Open				131
	<b>51.1%</b>	29.0%	13.0%	21.4%	6.9%	7.6%					
<b>Q3.16: Automatic -Manual</b>	43	<b>61</b>	19	8	Open						131
	32.8%	<b>46.6%</b>	14.5%	6.1%							

\* 17 people did not answer this question, that is 17/131=13.0%

Table 3. RS Content Display Preferences (Items in bold are the most popular responses)

	<b>Mean</b>	<b>Std. Dev.</b>
<b>Q3.2: Description</b>	3.26	1.32
<b>Q3.4: Rating</b>	3.76	1.23
<b>Q3.5: Promotion</b>	4.28	1.06
<b>Q3.7: Comments</b>	2.62	1.3
<b>Q3.10: More Info-Less Detail</b>	3.07	1.24
<b>Q3.12: More Info-Less Effort</b>	2.52	1.09
<b>Q3.13: Side by Side Comparison</b>	4.02	1.02
<b>Q3.15: Feedback</b>	3.81	1.12

Table 4. Mean and Standard Deviation Values for Responses to Opinion Questions Concerning RS Elements on a Page (N = 131, 1: Strongly Disagree, 5: Strongly Agree)

	<b>Q1.8</b>	<b>Q1.9</b>	<b>Q1.10</b>	<b>Q3.2</b>	<b>Q3.4</b>	<b>Q3.5</b>	<b>Q3.7</b>	<b>Q3.10</b>	<b>Q3.12</b>	<b>Q3.13</b>	<b>Q3.15</b>
<b>Q1.8</b>	1.000										
<b>Q1.9</b>	0.645	1.000									
<b>Q1.10</b>	0.439	0.536	1.000								
<b>Q3.2</b>	0.019	0.076	0.078	1.000							
<b>Q3.4</b>	0.155	0.067	0.140	0.381	1.000						
<b>Q3.5</b>	0.154	-0.029	0.164	0.252	0.294	1.000					
<b>Q3.7</b>	-0.011	0.127	-0.072	0.196	0.252	0.018	1.000				
<b>Q3.10</b>	0.042	0.044	0.102	0.023	0.228	0.044	0.139	1.000			
<b>Q3.12</b>	0.202	0.201	0.079	0.211	0.231	-0.081	0.222	0.434	1.000		
<b>Q3.13</b>	-0.059	0.014	-0.053	0.067	0.076	0.013	0.019	-0.004	0.030	1.000	
<b>Q3.15</b>	0.225	0.155	0.266	0.149	0.485	0.220	0.177	0.220	0.257	0.163	1.000

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<i><b>Q1.8, Q1.9</b></i>	<i><b>Q1.9, Q1.10</b></i>	<i><b>Q3.4, Q.315</b></i>	<i><b>Q1.8, Q1.10</b></i>	<i><b>Q3.10, Q3.12</b></i>	<i><b>Q3.2, Q3.4</b></i>
0.64	0.54	0.48	0.44	0.43	0.38

Table 5. Correlation Matrix and Most Significant Correlations among RS Elements

Step	Variable Entered	Variable Removed	Number of Vars In	Partial R_Square	Model R_Square	C (p)	F Value	Pr>F
1	Q1.9		1	0.3608	0.3608	19.1238	62.64	< .0001
2	Q3.5		2	0.0591	0.4198	9.2841	11.20	0.0011
3	Q3.7		3	0.0279	0.4477	5.6935	5.51	0.0208
4	Q3.15		4	0.0325	0.4802	1.1887	6.74	0.0107

Table 6. Summary of the Stepwise Regression Procedure (Dependent Variable: Q1.10—Overall Opinion on Recommender Systems)

Figure 1. Usability Criteria Model for Recommender System User Interfaces in E-Commerce

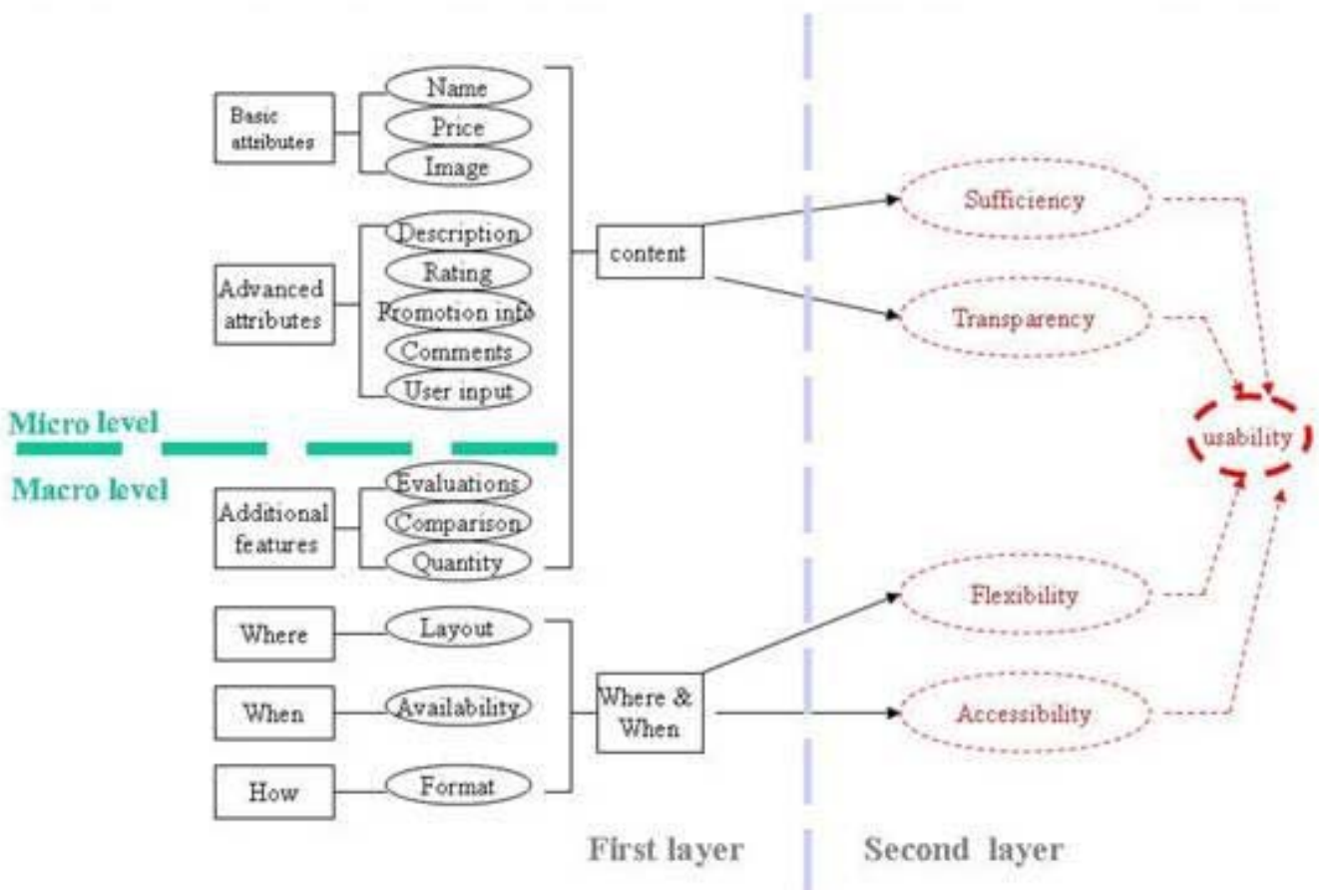


Figure 2. The “Floor Plan” presented to the Participants for Possible Locations of Product Recommendations

