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Master Thesis Proposal

多維瀏覽輔助：資訊處理階段之情境式介面

Multifaceted Browsing Aid: Contextual Interface for Process Stage

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摘要

以高彈性的瀏灠路徑爲特色的多維瀏灠介面近年來在許多研究中被廣泛地討論並採用。然而，這種型態的介面也因其高彈性而造成資訊過載的現象。因此，在使用此種介面時便需要一種能夠降低使用者負擔的輔助。此篇論文採用 Hill 所提出的架構，這個架構清楚地描述了使用者在資訊處理階段之行爲，並藉此來進一步改良 Wu, Chuang, & Joung 的情境式介面來改善系統效能。我們首先將比較介面與多維瀏覽介面作整合，而後將情境介面之概念整合進在資訊處理階段會使用到的介面元件—規格頁面與比較介面。其後，我們使用了五種指標來評估系統效能—有用性、易用性、定向力障礙、決策滿意度、與感受可控制度。實驗結果顯示使用者感受情境式介面較爲有用、易用、且可控制度顯著地較佳。總結而言，這篇研究爲使用者在使用多維瀏覽介面時的行爲提供了一個良好的見解，並且也提供設計準則以支援此種瀏覽行爲。

關鍵字：情境因子、情境介面、比較介面、介面設計、瀏覽

Abstract

Multifaceted browsing interfaces, which provide highly flexible browsing paths, have been widely discussed and adopted in recent years. However, such interfaces cause information overload due to their high flexibility. Therefore, aids that facilitate users' efforts are called for. This thesis adopts Hill's framework to depict how users behave in the process stage such as decision making. In addition, we further refine Wu, Chuang, & Joung's contextual interface for improving the system's effectiveness. We first integrate a comparison interface into the multifaceted browsing interfaces, and then contextualize the components of the interface used in Hill's process stage, specification page and comparison interface. Five measurements, namely perceived usefulness, perceived ease of use, disorientation, satisfaction with decision making, and perceived control, are used. Our empirical results show that users perceive the refined contextual interface as useful, easy to use, and control. To conclude, our objective is to provide a better understanding of users' behavior while using multifaceted browsing interface, as well as the design guidelines to support such behavior.

Keywords: Contextual factor, Contextual interface, Comparison interface, Interface design, Browsing

1. Introduction

1.1. Research problems

Multifaceted browsing[1] is an emerging browsing strategy, which describes an object by its attributes (facets) and allows users to acquire information by intersecting parts of the attributes(Wu, Chuang, & Joung, in press). Therefore, users can move freely from one predefined category (facet) to another based on their information needs without being restricted by fixed browsing paths. Because of the high degree of flexibility, this kind of browsing strategy has been widely discussed in recent years (Elliott, 2001; M. A. Hearst, 2002; Wu et al., in press), and some commercial web sites (e.g., eBay Express, Shopping.com) have implemented the interfaces that allow users to perform multifaceted browsing (M. Hearst, 2006).

However, the multifaceted browsing interface is not without flaws. The high degree of flexibility makes users confused and causes information overlord when users are browsing. To address this issue, Wu et al. proposed a novel concept of a contextual interface and integrated the concept with a multifaceted browsing interface. They contextualized the attribute list of the interface, where users form queries to retrieve product information, to assist users in browsing. Their results showed that users were not satisfied with multifaceted browsing interface, although they felt that

[1] The concept of a multifaceted browsing interface was firstly proposed by the Flamenco project, Berkeley (http://flamenco.berkeley.edu)

the contextual attribute list made the interface more easily accessible. Such dissatisfaction might influence users' acceptance of a particular system (Bechwati & Xia, 2003a; Bliemel & Hassanein, 2007; Garland, Reilly, & Westbrook, 1989). Wu et al.'s findings implied that the contextual interface is indeed an adoptable concept, but it is not sufficient to address the problems. Therefore, other aids that can enhance the effectiveness of the contextual interface are required.

1.2. Purpose

When considering the problems of multifaceted browsing, we should first consider how users behave while retrieving information. To address this issue, Hill(1999) provided a possible answer key. In Hill's conceptual framework, users seek information in two stages—navigation and process—while retrieving data via an information seeking system. In the navigation stage, users decide what to seek and create a query, so the major task of interfaces in this stage is to help users find out the correct direction. Then, in the process stage, users evaluate the results they have acquired and decide whether to terminate the information seeking session or engage in navigation stage again to seek more information. Thus, the major task of interface in this stage is to provide key information that is as sufficient as possible.

Moreover, Hill indicated that it is not easy for non-expert users to transport to process stage from navigation stage due to the lack of prior knowledge. In other

words, the users' performance in the process stage is determined by their prior knowledge and how better they can integrate the information with that knowledge. Therefore, interfaces should provide aids that alleviate the effort of understanding the information and integrating it with the users' prior knowledge. A feasible way to address this issue might be to use the comparison interface in the process stage that summarizes individual information at once and thus alleviates the users' effort of making decisions. Previous research has proven that such interface can improve users' decision quality and make the information retrieval session go smooth.

Based on Hill's framework, the contextual interface for multifaceted browsing, proposed by Wu et al, has two shortcomings. First, the interface doesn't provide a comparison interface for users engaged in process stage. Second, the attribute list is the only component that is contextualized. In other words, their contextual interface only supports users engaged in the navigation stage rather than both. Therefore, the major goal of this thesis is to refining the contextual multifaceted browsing interface by providing aids for the process stage. In the literature, several customized aids for the navigation stage are discussed, for example recommendation agent(Swaminathan, 2003; van der Heijden & Sorensen, 2002) and multiple search mode (Xie, 2003). However, there has been dearth of research on the possibility of using contextual aids during the process stage. Consequently, we investigate whether or not providing

contextual aids for users engaged in process stage will significantly improve the effectiveness of multifaceted browsing interfaces.

2. Literature review

2.1 Contextual interface

One of the most intriguing issues prevailing throughout the recent years of information retrieval research is how contextual factors influence user's information behavior (Anick & Vaithyanathan, 1997; Barsalou, 1982; Carlson & Bond, 2006; Mandel & Johnson, 2002; Nosofsky, 1984; Taylor, Cool, Belkin, & Amadio, 2007). Contextual factors are the characteristics of the environment that are related to the effectiveness of a task(Carlson & Bond, 2006; Taylor et al., 2007). Several studies have considered the benefits of helping users retrieve information from a large volume of data by integrating the contextual factors with the interface of information retrieval system (Hirashima, Matsuda, & Nomoto, 1997; Park & Kim, 2000a, 2000b; Puntambekar & Stylianou, 2005; Wu et al., in press). Additionally, empirical studies have proven the contextual factors consistently affect users' online information behavior, such as gathering information and making decisions on the Internet (Hirashima et al., 1997; Mandel & Johnson, 2002; Park & Kim, 2000b; Wu et al., in press).

According to Mandel & Johnson (2002), contextual factors could influence users' preferences for specific attributes of products and affect the purchase decisions as a consequence. In their study, they provided an array of web pages that showed

several attributes of specific products. The web pages were manipulated by priming some attributes to match the contexts and to meet the needs of the participants in the study. The participants, no matter experts or novices, were affected by the contextual priming on the web pages. Moreover, Wu et al. argued that the contextual interface significantly influences users' perception of performance in a positive way while using multifaceted browsing interface. In their study, they integrated the contextual factor with the attribute list by adjusting the order of attributes. Their findings indicate that participants perceive the contextual multifaceted browsing interface as more accessible than the non-contextual one. However, user satisfaction was not significant improved by the contextual interface.

To summarize, we believe the contextual interface would be beneficial for users while using multifaceted browsing interfaces. In this thesis, therefore, we aimed to design a contextual interface by enhancing Wu et al's concept. Moreover, to address the drawback identified by Wu et al, the question about how users behave while retrieving information should be investigated in order to refined the contextual interface.

2.2. Users information retrieval behavior

Information retrieval can be viewed as continuous interaction between users and information retrieval interfaces. During the interaction, users translate their

information needs into queries and send the queries out, and then interfaces receive the quires and return the specific information that meets users' needs (Benoit, 2004; Hill, 1999; Xie, 2003). However, the interaction becomes complex and makes users confused as the amount of information increases(Hill, 1999; Wu et al., in press). For avoid being overloaded, users have to make a trade-off between the information accuracy and their effort for acquiring desired information (Haubl & Murray, 2003; Haubl & Trifts, 2000; Hill, 1999; Xie, 2003).

Hill proposed a conceptual framework to explain how users make this trade-off while facing the challenge of information overload. This framework separates the whole information retrieval process into two sub-processes, navigation stage and process stage. Users first engage in the navigation stage to retrieve a set of results from information retrieval interface, and then, they engage in the process stage to evaluate and integrate these results. If the results do not meet their needs, they will engage in the navigation stage and process stage again and again, and finally, they will end the information retrieval process when they acquire what they really want.

Users engaged in navigation stage have to address three problems: (1) what to seek, (2) how to seek, and (3) what is available in the system (Hill, 1999). For users in navigation stage, the key task is finding a correct direction towards the target information. The key mission of interfaces in this stage, thus, is to help them do so

and facilitate their effort. As to the process stage, users engaged in this stage first evaluate the results they acquire and translate it into personally relevant knowledge, and then, they will make a decision either to continue to engage in navigation again or to end the whole information retrieval process. For users, the key task in process stage is to assess the results and consequently to make decisions. The key mission of interfaces also has to assist to do so and facilitate their effort as possible.

It should be noted, furthermore, Hill indicated that users' performance in process stage is highly affected by their prior knowledge about the information they are browsing. Consequently, non-expert users' performance suffers while transporting to process stage from navigation. It means they might have no idea what and how to do next in process stage. It would be difficult for non-expert users to summarize several individual product information they are not proficient in and to integrate the information with their knowledge. A way to alleviate users' effort of this situation might be an interface providing between-product information, which clearly presents the different product information at once, was proven to be a way to facilitate users' effort while evaluating the results they acquired (Haubl & Trifts, 2000).

2.3. Comparison interface

The concept of comparison shopping might provide a clue (Brown & Goolsbee, 2002; Kim & Stoel, 2005; Singh, 2002). In literatures, the reason why people would

like to purchase products online is that the Internet provides e-services to help users easily make a comparison among products in terms of a wide range of the product attributes and consequently help them make an accurate purchase decision (Brown & Goolsbee, 2002; Haubl & Trifts, 2000; Huarng & Christopher, 2003; Kim & Stoel, 2005; Singh, 2002). Therefore, one of the most important purpose consumers need a comparison interface is to improve their decision quality that largely determined by how they performed in navigation stage and process stage(Haubl & Trifts, 2000; Hill, 1999).

In Haubl & Trifts's study, they proposed two kinds of aids, recommendation agent (RA) and comparison matrix (CM), to facilitate consumers' effort of shopping online. RA is responsible to provide a product list based on consumers' preference, and CM provide an interface where consumers can compare the products they want to purchase in detail. Their findings indicate both RA and CM have a positive effect on consumers' decision quality, though the effect of RA is significant stronger than CM. Their comparison matrix successfully provided the between-product information and thus addressed the problem that users suffer poor performance while transporting to process stage from navigation. In other words, this kind of interface is indeed able to make the whole information retrieval session go smooth.

2.4. Refining the interface

Hill's framework could be the guidelines to refine the contextual multifaceted browsing interface. In this thesis, we aimed to enhance the aids for process stage in two ways. First of all, in Wu et al's study, the only interface for process stage is specification page. This page provides the within-product information, which only presents the specification of an individual product in detail. As discussed above, it is not sufficient for users engaged in process stage. Therefore, a comparison interface providing the between product information was integrated into the multifaceted browsing interface. Second, contextual factor was not only applied to the attribute list for navigation stage as Wu et al did, but also integrated into the interfaces for process stage—specification page and comparison interface. In other words, the whole multifaceted browsing interface was contextualized as the aid that supports both navigation stage and process stage.

Furthermore, there were two questions we attempted to answers. First, at present, research that focuses on the effect of providing the comparison interface for users engaged in process stage is very scarce. Although Haubl & Trifts has indicated that such kind of interface could improve users' decision quality, whether it enhances users' perceived effectiveness of multifaceted browsing interface as we expected should be further verified. Second, the effect of contextual interface was not as strong as we expected in Wu et al's study. Although we applied the contextual interface to

the interfaces used in process stage, whether it improves users' perceived effectiveness of multifaceted browsing interface should be further verified as well. Based on these questions, hypotheses were developed.

2.5. Hypotheses

In this thesis, we expected that the aids for multifaceted browsing interface, contextual interface and comparison interface, would have an positive impact on the effectiveness of multifaceted browsing interfaces, and thus we used five measurements to assess the effects: (1) users' perceived usefulness, (2) users' perceived ease of use, (3) users' perceived disorientation, (4) users' perceived satisfaction, and (5) users' perceived control.

By definition, perceived usefulness is the degree in which users believe that using a particular system would improve their task performance, and similarly, perceived ease of use is the degree in which users believe that using a particular system to complete their tasks would be free of effort (Davis, 1989). Furthermore, Davis also indicated that perceived usefulness and perceived ease of use both are theorized to be fundamental determinants of system use. As a result, we used both perceived usefulness and ease of use as constructs to assess the effectiveness of our design in present paper.

Hypothesis 1: Users will perceive that the contextual multifaceted browsing

interface is more useful and easier to use than the non-contextual interface.

Disorientation, a tendency to lose one's sense of location on a Web site, is widely used as a construct to assess the effectiveness of a particular interface of information retrieval in the literature (Ahuja & Webster, 2001; McDonald & Stevenson, 1998; van Schaik & Ling, 2003). McDonald & Stevenson noted that users who are attempting to browse a large amount of information will benefit from a well-designed aids, and furthermore, a proper spatial structure that reflects the conceptual structure also aids users while browsing information. Therefore, the following was hypothesized:

Hypothesis 2: Users will perceive that the contextual multifaceted browsing interface is less disoriented than the non-contextual interface.

Several studies (Bechwati & Xia, 2003b; Bliemel & Hassanein, 2007; Garland et al., 1989; Wu et al., in press) have noted that satisfaction is widely used as a measurement to estimate the effectiveness of a particular system structure or interface. Moreover, Bechwati & Xia argued that users' satisfaction of decision making is positively associated with their perception of effort saved for them by electronic aids. Moreover, perceived user control has also been seen to be closely relevant to user's satisfaction and task performance. (Eveland & Dunwoody, 2001; Morris & Marshall, 2004; Smith & Necessary, 1996; Xie, 2003). Bates (1990) argues that an information

retrieval system should support both searcher control and system retrieval power. Therefore, we hypothesized that:

Hypothesis 3: The level of satisfaction is higher for the users who use the contextual multifaceted browsing interface than for the users who use the non-contextual interface.

Hypothesis 4: The level of perceived user control is higher for the users who use the contextual multifaceted browsing interface than for the users who use the non-contextual interface.

3. Research methodology

3.1. Experimental design and procedure

For verifying our hypotheses, a modified multifaceted browsing interface based on Wu et al's one was built. An interface providing a product × attribute matrix for users to make an in-depth comparison among different products was integrated into the multifaceted browsing interface to measure the effectiveness of comparison interface. As to the contextual interface, two components of the interface—namely, the comparison interface and the specification page that presented the detailed—were integrated with three different predefined context scenarios, where the appearances of the interfaces would be differently shown in each scenario. Therefore, there were three independent variables in this study: comparison interface (no comparison interface, context-insensitive comparison interface, and context-sensitive comparison interface), specification page (context-insensitive and context-sensitive), and context (cost-effective, operatability, and safety). Furthermore, the method to carry out this study was using an experiment, and all independent variables of this study were between-subject variables. As a result, a 3 x 2 x 3 between-subjects factorial design was adopted. This design is reffered to as SPF-pqr. t. The four parameters p, q, r and t are defined as follows: p represents the three comparison interfaces; q represents the two specification pages; r represents three contexts; t represents the number of

questions used to measure the effectiveness. The question is the only within-subject variable, and the others are all between-subject variables.

The task of this experiment was to browse through a large amount of car information presented by our multifaceted browsing interface and then to select a car best fit the given context scenario. The whole experiment had certain processes. First, all participants chose a context scenario best met their purposes of purchasing a car, and then they were randomly assigned to the six different interfaces. The context scenarios and the detail design of these six interfaces will be described in Section 3.3 and Section 3.4. After choosing a context scenario, all participants were provided one training scenario to learn how to use our multifaceted browsing interface to perform their tasks before encountering the given context scenario for the real experiment. When participants decided to choose a car during the training stage, they had to fill in a simplified questionnaire, and the data collected during the training stage was not used for further analysis. Next, a specific context scenario was given to the participants based on the purpose they chose above, and then they browsed and selected a car as what they did in the training stage. Finally, they were asked to complete a more complicated questionnaire for measuring the effectiveness of the interface in terms of their perception of usefulness, ease of use, disorientation, satisfaction, and control. These measurements will be discussed more detailed in

Section 3.5.

3.2. Participants

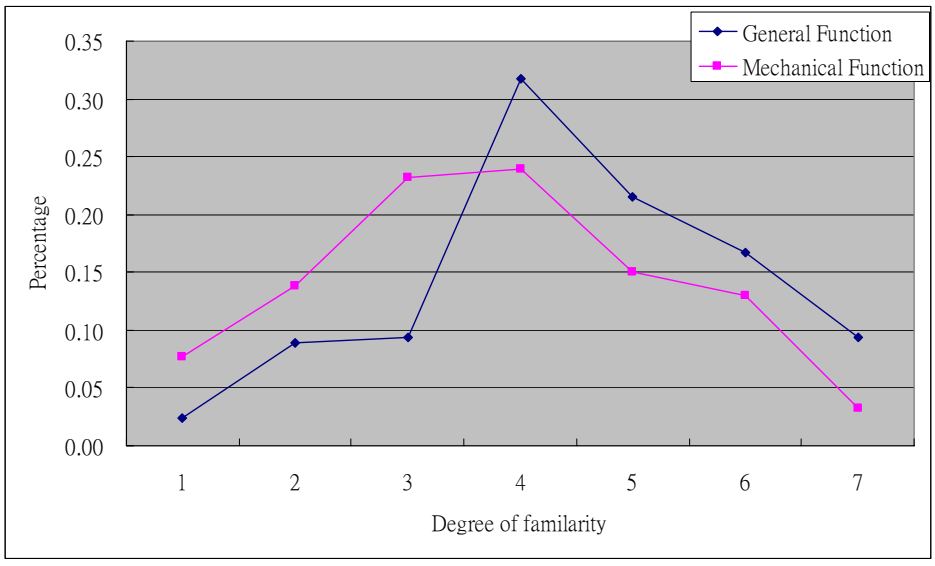
Participants were 243 volunteers recruited through the advertisements on the Internet and the poster at several universities of north Taiwan, and 300 NT dollars were paid for their participation as the compensation. These participants were invited to our behavior science lab in NTU, Taiwan, and then they completed the experiment in the same lab as well. They were asked to sign a consent form for participation and to fill in a form to record their personal information, and also, they were informed that their personal information would be used only for academic purpose and never be abused.

There were two requirements for participating in the experiment: (1) they're able to drive and have the driver license, and (2) they use the Internet frequently. Probably due to the requirement of driving capability, the proportion of female in this sample was relatively smaller (30%) than that of male (70%). Out of the 243 participants, 30% (75/243) participants chose the cost-effectiveness condition, 23% (56/243) the operatability, and 47% (115/243) the safety. With an average age of 26.91 years, 52% (128/243) were students, and 48% (118/243) were non-students who working in a wide range of industries.

93% (229/243) of the participants owned at least one car in their family with

4.25 years of driving experience on average. In spite of having the capability to drive, their purchase experiences of cars were different. 12% (29/243) had the experience of purchase a car for themselves or their family, 46% (113/243) had the experience of participating in the car purchase processes and decisions for their family or friends, and 42% (104/243) had no experience of purchasing a car or participating in a car purchase decision. Moreover, the participants were asked to estimate their knowledge about functions of car components and mechanics of cars by using a 7 Likert scale, with 1 representing no understanding to 4, average degree of understanding to 7, complete understanding. The average of knowledge about car functions is 4.48, and the knowledge of car mechanics is 3.77. No matter the knowledge about functions of car components or mechanics, our sample presents a normal distribution, as shown in Figure 1, which indicated the sample in our experiment is representative.

Figure 1. Participants' understanding about functions of cars in this study



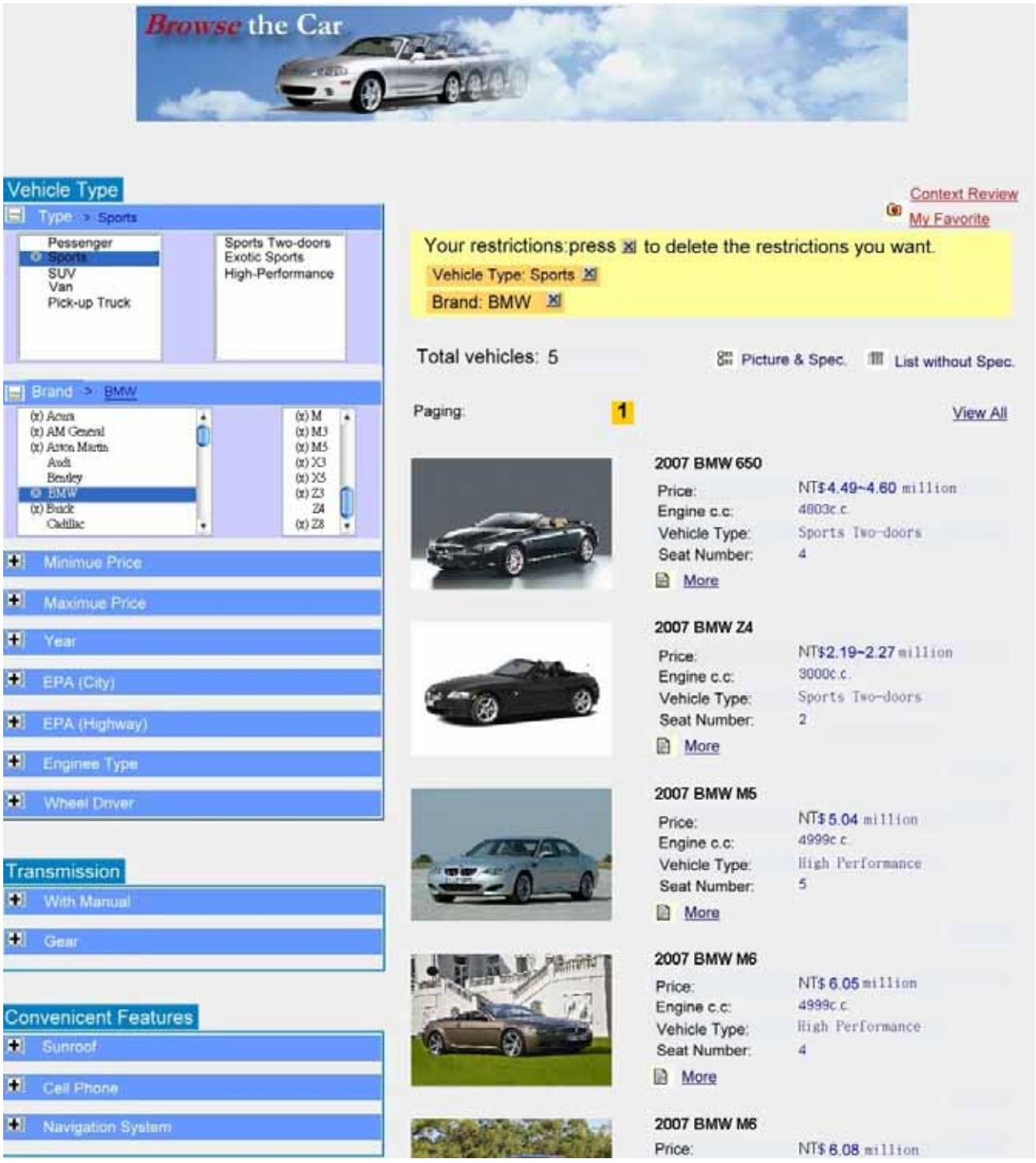
3.3. Material

In this study, participants were asked to browse product information of cars in order to select a car best met their needs in a given context scenario, and the product information of cars was used as the information collection for two reasons. First, cars are complicated enough, so most people are not experts and are likely to adopt browsing strategy to seek product information of cars on the Internet. Second, the number of attributes of car is large enough to overwhelm participants if the information is not organized properly. As a result, the information of cars sold on the United States market from 2001 to 2007 was collected. A total of 9476 records, extracted from a wide range of automobile marketplaces on the Internet, were assembled in our database as information collection, and 45 car attributes were used as the experimental material in this study.

Wu et al. has built a multifaceted browsing interface to explore the contextual effects on browsing (Figure 2). In their study, they developed three different context scenarios—cost-effective, operatability, and security. The order of attributes located on the left hand side would be adjusted based on the irrelevance of attributes in a particular context scenario. For example, in security context, the attributes related to security such as brakes, airbags, and ABS would appear on the top of attribute list. On the contrary, the attributes irrelevant to security will be put on the bottom of attribute

list. In this thesis, we adopted Wu et al's context scenarios, and also, we applied their design concept to build our multifaceted browsing interface.

Figure 2. Multifaceted browsing interface in previous research (Wu et al., in press)



3.4. Interface design

In this thesis, a multifaceted browsing interface based on Wu et al's study was constructed (Figure 3). Although our interface was similar to Wu et al's Context Dependent Interface, it differed in two ways. First, a comparison interface was integrated into our multifaceted interface to facilitate the effort to make an in-depth comparison among cars (Figure 4). While browsing, participants could add the cars that likely meet their needs into the comparison interface for more detailed comparison, and the cars added into the comparison interface was presented in a product (row) × attributes (column) matrix. Only the attributes that users selected during previous browsing would be presented in this matrix. Besides the matrix, participants could dynamically add any attributes they want to further comparer with by clicking the attribute buttons on a control panel below the matrix. The order of attributes on the control panel would be different based on the context scenarios. For assessing the effect of contextual comparison interface, three different types of manipulation on the comparison interface were adopted: (1) a context-sensitive control panel on the comparison interface, where attribute buttons were prioritized according to the context scenarios, (2) a context-insensitive control panel on the comparison interface, where the attribute buttons were arranged in a fixed way, and (3) no comparison interface available during browsing. See Figure 5 for an example of

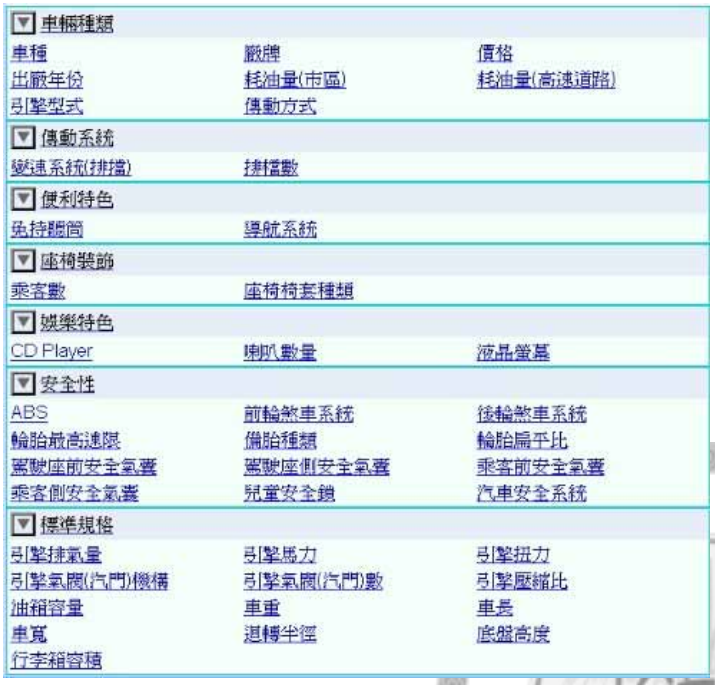
the different types of comparison interface.

Figure 3. Multifaceted browsing interface in present study

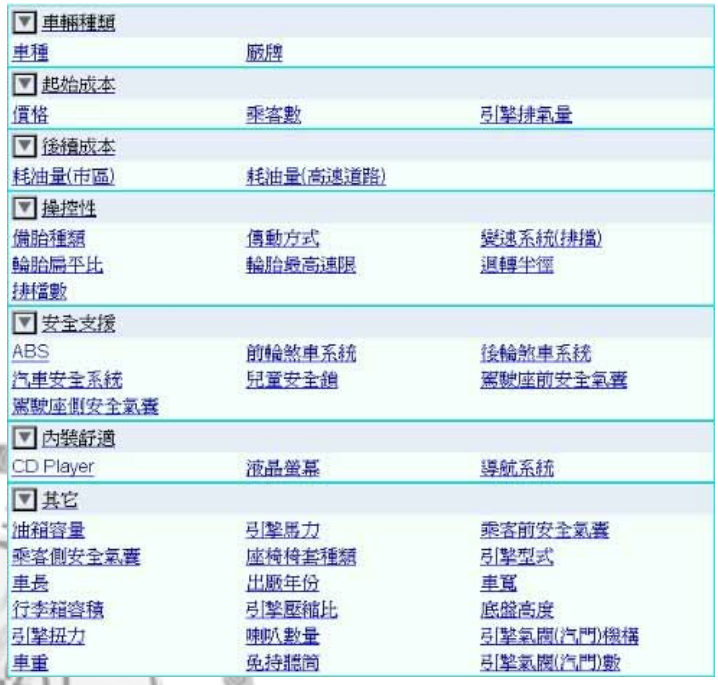
Figure 4. Comparison interface

Figure 5. Manipulation of comparison interface

(a). Context-insensitive comparison interface in the context scenario of cost-effectiveness



(b). Context-sensitive comparison interface in the context scenario of cost-effectiveness



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Second, a specification page was redesigned for our experiment (Figure 6). In this experiment, two kinds of different specification pages, context-sensitive and context-insensitive, were adopted for assessing the effect of contextual interface. In the context-sensitive specification page, the specification was prioritized according to the context scenarios. In the context-insensitive specification page, on the contrary, the detailed specification of car was arranged in a fixed way, regardless of different context scenarios. See Figure 7 for an example of the different types of specification pages.

In sum, by combining the manipulation of interfaces, there were six different interfaces as shown on Table 1: (1) context-sensitive comparison interface with context-sensitive specification page (S-S), (2) context-sensitive comparison interface with context-insensitive specification page (S-I), (3) no comparison interface with context-sensitive specification page (N-S), (4) context-insensitive comparison interface with context-sensitive specification page (I-S), (5) context-insensitive comparison matrix with context-insensitive specification page (I-I), (6) no comparison interface with context-insensitive specification page (N-I). Furthermore, each interface was influenced by three different context scenarios that determined how the attributes of a car would be arranged in each interface, so there were 18 conditions in

total in current experiment.

Table 1. The interfaces

		Comparison Interface		
		Context-Sensitive	Context-Insensitive	No-Interface
Spec. Interface	Context-Sensitive	S-S	S-I	S-N
	Context-Insensitive	I-S	I-I	I-N

Figure 6. Specification page

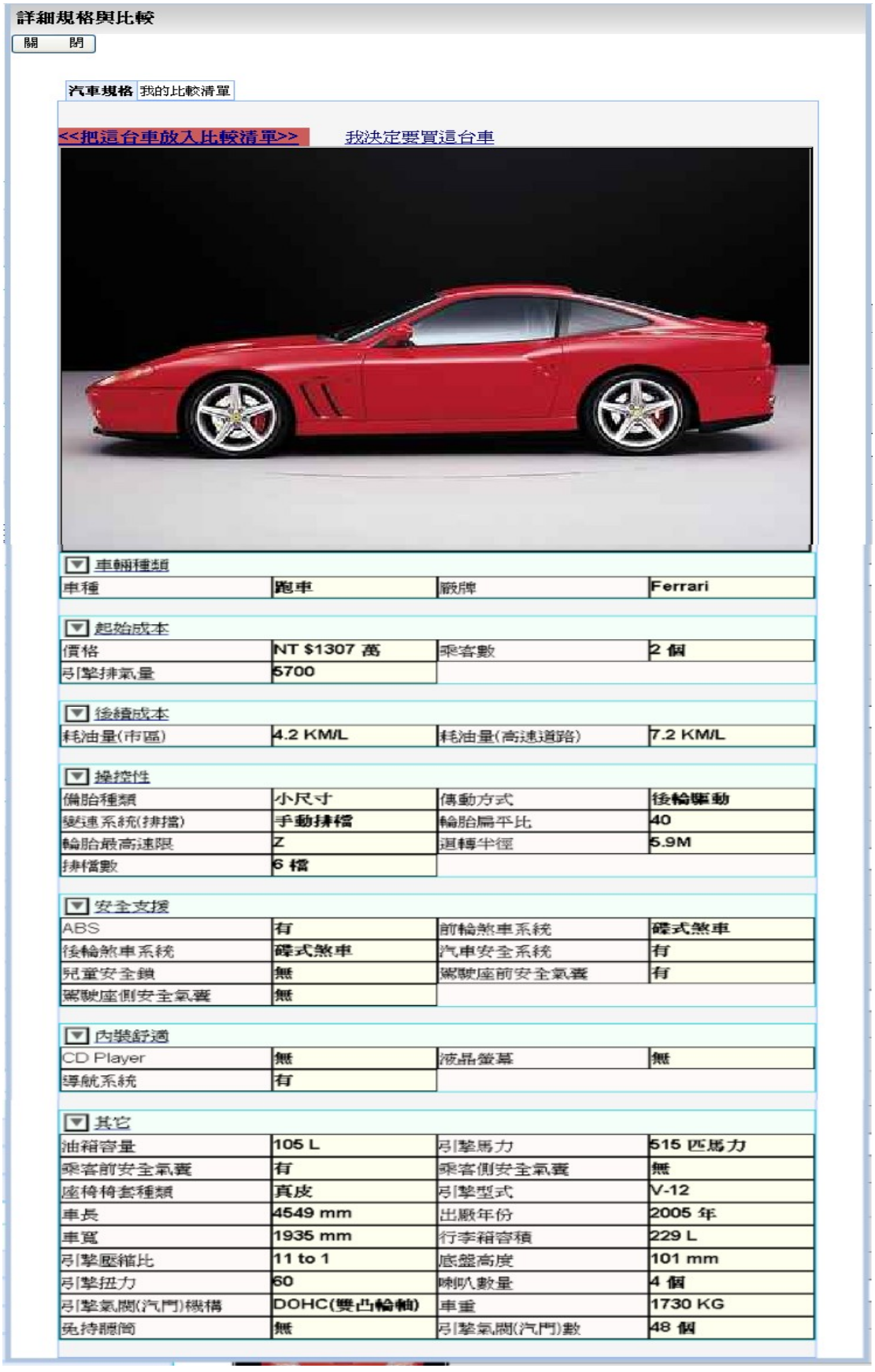

Figure 7. Manipulation of specification page

(a). Context-insensitive comparison interface in the context scenario of cost-effectiveness

車輛種類			
車種	跑車	廠牌	Ferrari
價格	NT $1034.8 萬	出廠年份	2005 年
耗油量(市區)	4.6 KM/L	耗油量(高速道路)	6.3 KM/L
引擎型式	V-8	傳動方式	後輪驅動
傳動系統			
變速系統(排擋)	手動排檔	排檔數	6 檔
便利特色			
免持聽筒	無	導航系統	有
座椅類型			
乘客數	2 個	座椅椅套種類	真皮
娛樂特色			
CD Player	有	喇叭數量	6 個
液晶螢幕	無		
安全性			
ABS	有	前輪煞車系統	碟式煞車
後輪煞車系統	碟式煞車	輪胎最高速限	Z
備胎種類	小尺寸	輪胎扁平比	35
駕駛座前安全氣囊	無	駕駛座側安全氣囊	無
乘客前安全氣囊	無	乘客側安全氣囊	無
兒童安全鎖	無	汽車安全系統	有
引擎規格			
引擎排氣量	4300 cc	引擎馬力	490 匹馬力
引擎扭力	47 KG/M	引擎氣閥(汽門)機構	DOHC(雙凸輪軸)

(b). Context-sensitive comparison interface in the context scenario of cost-effectiveness

車輛種類			
車種	跑車	廠牌	Ferrari
起始成本			
價格	NT $1307 萬	乘客數	2 個
引擎排氣量	5700		
後續成本			
耗油量(市區)	4.2 KM/L	耗油量(高速道路)	7.2 KM/L
操控性			
備胎種類	小尺寸	傳動方式	後輪驅動
變速系統(排擋)	手動排檔	輪胎扁平比	40
輪胎最高速限	Z	迴轉半徑	5.9M
排檔數	6 檔		
安全支援			
ABS	有	前輪煞車系統	碟式煞車
後輪煞車系統	碟式煞車	汽車安全系統	有
兒童安全鎖	無	駕駛座前安全氣囊	有
駕駛座側安全氣囊	無		
內裝舒適			
CD Player	無	液晶螢幕	無
導航系統	有		
其它			
油箱容量	105 L	引擎馬力	515 匹馬力
乘客前安全氣囊	有	乘客側安全氣囊	無

3.5. Measurements

The effectiveness of the difference interfaces were measured after participants completed their task. Five constructs, which are well taken measurements of interface effectiveness in literature, were used: perceived usefulness, perceived ease of use, perceived disorientation, satisfaction of decision making, and perceived control.

For assessing perceived usefulness and ease of use, questions developed by Davis (1989) were adjusted to fit the situation of car purchase. Ahuja & Webster (2001) proposed an examination to measure the perceived disorientation, and based on their research, the questions for assessing users' disorientation were adjusted to fit the situation of our experiment. As for the construct of satisfaction of decision making, the questions developed by Wu et al were adopted. Finally, the questions developed by Smith & Necessary (1996) to assess the perceived control were adjusted to fit the situation of car purchase. Factor analysis was performed on the collected data to assess reliability of individual measurement items. The items with factor loading less than .8, as indexed by * in Appendix A, were deleted from further analysis.

4. Results and Discussion

MANOVA procedure was performed and Wilk's lambda was used to testify our hypothesis. As to the dependent variables, Cronbach alpha was used to assess the reliability of the five measurements: usefulness, ease of use, disorientation, satisfaction, and perceived control. The measurements were highly reliable that the Cronbach alpha values for the five effectiveness construct were .95, .95, .88, .96, and .96 respectively. To answer questions concerning the bias of student sample, the data collected from student and non-student samples was analyzed. Participants' occupation was used as the independent variable to perform the MANOVA procedure. As shown on Table 2, no matter which dependent variable, the main effects of occupation were not significant, and the results indicated that participants' browsing pattern would not be varied due to their occupation.

Table 2. Student sample vs. non-student sample

	Wilk's Lambda	F Value	Num DF	Den DF	P-Value
Usefulness	0.92	0.79	22	220	0.7363
Ease of use	0.99	0.85	4	238	0.4919
Disorientation	0.96	1.86	5	237	0.1016
Satisfaction	0.99	0.46	5	237	0.8074
Perceived control	0.99	0.09	4	238	0.9856

4.1 perceived usefulness and perceived ease of use

The main effect of specification page was not significant (Lambda=0.97, $F(4,222)=1.51$, $p<.21$), and the difference of comparison interface was also not

significant in all conditions (Lambda=0.93, F(8,444)=2.12, p<.04). Scheffe's tests indicates that there was a significant difference between context-sensitive comparison interface and no comparison interface (5.18 vs. 4.66, p<.05), but no significant difference between context-sensitive and context-insensitive (5.18 vs. 4.86, p>.05, ns.) and between context-insensitive and no comparison interface (4.86 vs. 4.66, p>.05, ns.). Moreover, the main effect of interaction between specification page and comparison interface was significant (Lambda=0.93, F(8,444)=2.07, p<.04), so we used Student T Test to further analyze this interaction.

As shown on Table 2, S-S was significantly higher than I-I (5.53 vs. 5.08, t = 1.82, p<.04). The contextual interface was effective. Besides that, the difference between S-S and S-I was significant (5.33 vs. 4.63, t = 3.68, p<.01), and the difference between S-S and I-S was significant (5.33 vs. 4.84, t = 2.85, p<.01). The results further indicated the effect of contextual interface would be effect while one of components, no matter specification page or comparison interface, was contextualized in advanced. Moreover, the difference between I-S and I-I was significant (4.84 vs. 5.08, t = -0.98, ns.), and the difference between S-I and I-I was significant (4.63 vs. 5.08, t = -1.84, p<.04). When one was contextualized and the other was not, the interfaces became inconsistent. This consistent interface might be the reason why I-S and S-I were not effective even if they were contextualized (Ozok & Salvendy, 2004;

Rhee, Moon, & Choe, 2006). As to the comparison interface, S-S was significantly higher than S-N (5.53 vs. 4.79, t = 3.97, p<.01). I-I was significantly higher I-N (5.08 vs. 4.54, t = 2.15, p<.02). Parallel with what we found above, the result of usefulness shown below indicates that the comparison interface will be indeed effective when interfaces were consistent, namely S-S vs. S-N and I-I vs. I-N. Moreover, the pattern is the same across all the contexts such that the effect of context is not significant (Lambda=0.98, F(8,444)=0.46, p<.89).

Table 3.The average rating of usefulness

		Comparison Interface		
		Context-Sensitive	Context-Inensitive	No-Interface
Spec. Page	Context-Sensitive	S-S	S-I	S-N
	Means	5.53	4.63	4.79
	SD	1.05	1.00	1.59
	Sample size	42	42	37
	Context-Inensitive	I-S	I-I	I-N
	Means	4.84	5.08	4.54
	SD	1.10	0.88	1.08
	Sample size	42	42	37

As to the results of ease of use, the main effect of specification page was not significant (Lambda=0.98, F(4,222)=0.82, p<.52), and the effect of comparison interface was significant (Lambda=0.88, F(8,444)=3.42, p<.01). Scheffe's tests indicates that there was a significant difference between context-sensitive comparison interface and no comparison interface (5.14 vs. 4.63, p<.05) but no significant difference between context-sensitive and context-insensitive (5.14 vs. 4.91, p>.05, ns.)

and between context-insensitive and no comparison interface (4.91 vs. 4.63, p>.05, ns.). Furthermore, the main effect of interaction between specification page and comparison interface was significant (Lambda=0.92, F(8,444)=2.35, p<.02), so we used Student T Test to further analyze this interaction.

The findings of ease of use were compatible with usefulness. As shown on Table 3, S-S was significantly higher than I-I (5.58 vs. 5.12, t = 1.92, p<.03). The contextual interface was effective. Besides that, the difference between S-S and S-I was significant (5.58 vs. 4.70, t = 3.68, p<.01), and the difference between S-S and I-S was significant (5.33 vs. 4.72, t = 3.67, p<.01). Parallel with the findings above, the results further indicated the effect of contextual interface would be effect while one of components, no matter specification page or comparison interface, was contextualized in advanced. Moreover, the difference between I-S and I-I was significant (4.72 vs. 5.12, t = -1.70, p<.05). The difference between S-I and I-I was significant (4.70 vs. 5.12, t = -1.74, p<.05), the benefit of contextual interface was deteriorated due to the inconsistent interface. Also, S-S was significantly higher than S-N (5.58 vs. 4.82, t = 3.67, p<.01), and I-I was significantly higher than I-N (5.12vs. 4.45, t = 2.76, p<.01). The comparison interface will be indeed effective when interfaces were consistent. Moreover, the pattern was the same across all the contexts such that the effect of context was not significant (Lambda=0.95, F(8,444)=0.63, p<.87). Therefore,

Hypothesis 1 was supported.

Table 4. The average rating of usefulness

		Comparison Interface		
		Context-Sensitive	Context-Inensitive	No-Interface
Spec. Page	Context-Sensitive	S-S	S-I	S-N
	Means	5.58	4.70	4.82
	SD	0.79	1.14	1.24
	Sample size	42	42	37
	Context-Inensitive	I-S	I-I	I-N
	Means	4.72	5.12	4.45
	SD	1.25	0.78	1.19
	Sample size	42	42	37

4.2 Disorientation

The main effect of specification page was not significant (Lambda=0.98, F(5,221)=0.66, p<.66). Also, the main effect of comparison interface was not significant (Lambda=0.95, F(10,442)=1.03, p<.42), neither was the interaction between comparison interface and specification page (Lambda=0.94, F(10,442)=1.33, p<.21). Although the average ratings of disorientation in every condition were already low, as shown on Table 4, the pattern presented here contrasts starkly with what we found above. The effects of contextual interface and comparison interface were not significant. Therefore, Hypothesis 2 was not supported.

Although the average ratings of disorientation were low in every condition, the effectiveness of comparison interface and contextual factor were both slight. Woods's definition of disorientation provides a possible explanation for this. According to his definition, disorientation is the getting lost phenomenon that happens when users have

no idea about their present location in a system and find it difficult to make a decision. In other words, the result that Hypothesis 2 was not supported was probably because the multifaceted browsing interface we built for current study was clear enough and the tasks participants were asked to perform was also not too difficult to have them disoriented.

Table 5. The average rating of disorientation

		Comparison Interface		
		Context-Sensitive	Context-Inensitive	No-Interface
Spec. Page	Context-Sensitive	S-S	S-I	S-N
	Means	3.78	3.79	3.59
	SD	0.83	0.88	0.88
	Sample size	42	42	37
	Context-Inensitive	I-S	I-I	I-N
	Means	3.76	3.69	3.71
	SD	0.79	0.88	1.00
	Sample size	42	42	37

4.3 Satisfaction

The effect of specification page was not significant (Lambda=0.99, $F(5,221)=0.29$, $p<.92$). The effect of comparison interface was significant (Lambda=0.88, $F(10,442)=2.93$, $p<.01$). Scheffe's tests indicates that there was a significant difference between context-sensitive comparison interface and no comparison interface (5.04 vs. 4.22, $p<.05$) and between context-insensitive and no comparison interface (5.16 vs. 4.22, $p<.05$) but no significant difference between context-sensitive and context-insensitive (5.04 vs. 5.14, $p>.05$, ns.). The pattern of

satisfaction was different with those presented in usefulness and ease of use. As shown on Table 5, the interaction between specification page and comparison interface was not significant (Lambda=0.95, F(10,442)=1.12, p<.35). Therefore, Hypothesis 3 was not supported. The pattern was the same across all the contexts such that the effect of context was not significant (Lambda=0.96, F(10,442)=0.96, p<.48).

Participants perceived more satisfactory for their decisions when the comparison interface was available. Consistent with Haubl & Trifts's finding, it was possible to effectively reduce users' cognitive loading and consequently increase user's satisfaction through providing an aid that support users to make an in-depth comparison among products. However, the contextual factor, compatible with Wu et al's finding, appears not to improve participants' satisfaction in current study. Moreover, consumers' satisfaction is highly mediated by their perception of effort saving(Bechwati & Xia, 2003a) . In other words, participants perceived that comparison interface is a relative efficient effort-saving aid while making decision. It is likely because contextual interface, in contrast to comparison interface, is an indirect aid. Therefore, the effect of contextual interface was relative minor when participants estimated their satisfaction after making decision. That might be the reason why the effect of contextual interface was not significant.

Table 6. The average rating of Satisfaction

		Comparison Interface		
		Context-Sensitive	Context-Inensitive	No-Interface
Spec. Page	Context-Sensitive	S-S	S-I	S-N
	Means	5.09	5.19	4.35
	SD	1.23	1.25	1.33
	Sample size	42	42	37
	Context-Inensitive	I-S	I-I	I-N
	Means	5.00	5.13	4.09
	SD	1.25	1.06	1.38
	Sample size	42	42	37

4.4 Perceived control

The effect of specification interface was not significant (Lambda=0.97, F(4,222)=1.43, p<.23), and the effect of comparison interface was not significant (Lambda=0.95, F(8,444)=1.42, p<.19). Moreover, the interaction between specification interface and comparison interface was significant (Lambda=0.93, F(8,444)=2.01, p<.05).

As shown on Table 6, further, the result was parallel with usefulness and ease of use. S-S was marginally significantly higher than I-I (5.46 vs. 4.93, t =1.63, p<.04). The contextual interface was effective that the average rating of contextual interface (S-S) was significantly higher than the rating of non-contextual interface (I-I). Besides that, the difference between S-S and S-I was marginally significant (5.46 vs. 4.99, t = 1.58, p<.05), and the difference between S-S and I-S was significant (5.35 vs. 4.82, t = 2.10, p<.02). The results further indicated the effect of contextual interface would

be effect while one of components, no matter specification page or comparison interface, was contextualized in advanced. Furthermore, the difference between S-I and I-S was not significant (4.99 vs. 4.82, t = 0.61, ns.). The difference between I-S and I-I was significant (4.82 vs. 4.93, t = -0.42, ns.). The difference between S-I and I-I was significant (4.99 vs. 4.93, t = 0.18, ns.). Also, the benefit of contextual interface was deteriorated due to the inconsistent interface. As to comparison interface, S-S was significantly higher than S-N (5.46 vs. 4.75, t=2.22 p<.02), and I-I was significantly higher than I-N (4.93vs. 4.44, t=1.80, p<.03). The comparison interface will be indeed effective when interfaces were consistent. Moreover, the pattern was the same across all the contexts such that the effect of context was not significant (Lambda=0.96, F(8,444)=1.03, p<.42,). Therefore, Hypothesis 4 was supported.

Table 7. The average rating of perceived control

		Comparison Interface		
		Context-Sensitive	Context-Inensitive	No-Interface
Spec. Page	Context-Sensitive	S-S	S-I	S-N
	Means	5.46	4.99	4.75
	SD	1.30	1.25	1.51
	Sample size	42.00	42.00	37.00
	Context-Inensitive	I-S	I-I	I-N
	Means	4.82	4.93	4.44
	SD	1.52	1.22	1.11
	Sample size	42.00	42.00	37.00

5. Conclusion, managerial implications, limitations, and future work

5.1 Conclusion

The interface we proposed in the current study has a major contribution. Different to Wu et al's design, the contextual interface was applied to the whole multifaceted browsing interface as the aid to enhance users' perceived effectiveness. Moreover, an empirical investigation was conducted and showed that contextual interface for process stage can significantly improve the effectiveness of multifaceted browsing interface, and the deterioration from inconsistent interfaces should be noted as well.

As the multifaceted browsing interface, featured in its highly flexible design, becomes popular, aids that can effectively facilitate users' cognitive loading are in need (Wu et al., in press). In this paper, we adopted Hill's framework, which separates the whole information retrieval session into two stages—navigation stage and process stage, to build the contextual multifaceted browsing interface. Moreover, a comparison interface was proposed to make the whole information retrieval session go smooth. We then empirically investigated whether theses aids will be effective.

Two major hypotheses were testified in current study in terms of usefulness, ease of use, disorientation, satisfaction, and perceived control. First, we hypothesized the contextual interface will positively influence users' performance while using the same interface. Second, the comparison interface will significantly increase users'

performance while using the interface we proposed. The empirical results showed that users perceived our interface more useful, easier to use, and more controllable in particular conditions where the interfaces were consistent. Also, they perceived more satisfactory when a comparison interface was available while using our interface. Consequently, the results confirmed our hypotheses that the aids we proposed can indeed enhance users' performance while using the multifaceted browsing interface.

5.2 Managerial implications

Based on our empirical results, two managerial implications can be generated. First, the contextual interface can be used as a way for customization. A website that can response the needs of individual consumers and support their purchase decisions will win consumers' patronage and loyalty (Singh, 2002). Furthermore, our findings indicate that the contextual interface can not only assist consumers to browse, but also provide a support to assess the results they acquired. Contextually appropriate results can help consumers efficiently find out what the really need and further remove the irrelevant ones they don't need. This concept could be applied to any websites that attempt to provide customized services. In short, the contextual factor provides a considerable way for online information providers, such as commercial websites or digital libraries, to customize themselves to meet online users' demands.

Second, the comparison interface, which can be viewed as an e-service that

provides a search support, is able to be applied to commercial websites, such as online auctions, where consumers have to browse a large amount of information to make a purchase decision. This kind of aid supports the stimulus-based search (Haubl & Trifts, 2000) and efficiently facilitates users' cognitive loading while purchasing online. More importantly, online consumers would prefer to interact with such an efficient websites(Singh, 2002). Therefore, commercial websites can be probably featured in the comparison interface to differentiate themselves and then to attract and retain consumers.

5.3 Limitations and future works

Although we have yielded findings that support the hypotheses we proposed, the present study is not without flaws. The first concern is the use of lab experiment in the current study, which might probably decrease external validity of our findings. We remain perfectly aware that the validity of any experimental study is limited to the scope of the experiment. However, the participants recruited to our experiment are representative in terms of their demographic background and experiences. Moreover, the sample size of our experiment is large that 243 participants were recruited in total. Therefore, the concern of external validity would be alleviated because of the representativeness of our sample.

The second limitation is rooted in the design of interface and tasks. As we

discussed above, we speculate that the failure of supporting the hypotheses of disorientation can be likely explained from the interface and tasks that were not complicated to have participants confused. Participants might find it easier to find accurate information to perform their tasks on our interface and consequently think that they were not disoriented at all. In other words, our design of interface and tasks might probably not be a proper way to estimate participants' disorientation. Therefore, future works should refine the interface and tasks in order to verify whether these aids can alleviate users' disorientation.

Besides that, contextual interface was failed to improve users' satisfaction of decision making. This indicated more aids that assist users more directly are in need. The recommendation agent, a software agent that elicits the preference of individual users for products and accordingly provides recommendations to improve the decision quality, could be probably undertaken to further explore (Haubl & Murray, 2003; Swaminathan, 2003). It might be of interest for future research that whether a recommendation agent could be integrated with current multifaceted browsing interface. Moreover, objective data, such as decision quality (Haubl & Trifts, 2000), should be gathered to further verify the usability of such aids.

Another limitation is the lack of a technique that can automatically adjusts the multifaceted browsing interface based on different context scenarios. In the present

study, all contextual interfaces were predefined. Although the techniques that automatically creates facets from a large amount of raw data were discussed in previous studies (M. Hearst, 2006; Stoica & Hearst, 2006), the techniques that can automatically creates an interface that matches a specific context scenario are still uninvestigated. We are hopeful that future research will investigate this area and provide a more complete and accurate contextual interface.

In sum, perhaps future research could consider how to integrate these concepts we proposed above into the current interface to build a more user-friendly and user-centric multifaceted browsing interface. This interface should not only facilitate users' effort while using such browsing strategy, but also improve their decision quality as well. This is indeed our ultimate goal—constructing a competitive multifaceted browsing interface to assist users to browse and make the right decision in online shops.

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Appendix A. Questions about interface effectiveness

Perceived usefulness:

1. The design of interface of this system is able to help me find out the information of cars more quickly.
2. The design of interface of this system is able to improve my performance of browsing the information of cars.
3. The design of interface of this system is able to accelerate my task of browsing the information of cars.
4. (*) The design of interface of this system is able to enhance my effectiveness on the task of browsing the information of cars.
5. The design of interface of this system is able to make it easier to do my task of browsing the information of cars.
6. (*) I would find the design of interface of this system useful in my task of browsing the information of cars.

Perceived ease of use:

1. Learning to operate the design of interface of this system would be easy for me.
2. (*) I would find it easy to get the design of interface of this system to do what I want it to do.
3. My interaction with the design of interface of this system would be clear and

understandable.

4. (*) I would find the design of interface of this system to be flexible to interact with.
5. It would be easy for me to become skillful as using the design of interface of this system.
6. I would find the design of interface of this system easy to use.

Perceived disorientation

1. The design of interface of this system makes me feel lost.
2. The design of interface of this system makes me feel like I was going around in circles.
3. (*) The design of interface of this system makes me difficult to find the cars I need.
4. The design of interface of this system makes it not easy to find out the cars that I’ve viewed previously.
5. (*) The design of interface of this system makes it not easy to navigate and browse among the different cars.
6. I didn’t know what cars I need to browse from the design of interface of this system.

7. I didn’t know how to get car information I need from the design of interface of this system.
8. (*) After browsing for a while, I had no idea what cars I can or I need to browse from the design of interface of this system.

Satisfaction of decision

1. How satisfied you are for your final decision of car purchase?
2. How do you agree for your final decision of car purchase?
3. (*) How confident you are for the correctness of your final decision of car purchase.
4. (*) How confident you are for that your final decision of car purchase is the optimal choice?
5. (*) What do you think the decision quality of current car purchase?
6. (*) What do you think the completeness of information retrieval for current car purchase decision?
7. (*) How do you agree with current decision of car purchase meets your needs?
8. How much do you think your decision quality is improved by the assistance of system?
9. Do you think your final decision of car purchase is good?

10. Do you think your final decision of car purchase is correct?

Perceived control

1. I can make the browsing interface do what I want it to do.
2. (*) If I had a problem using the browsing interface, I could solve it one way or another.
3. (*) I do not need an experienced person nearby when I use the browsing interface.
4. I do not need some one to tell me the best way to use the browsing interface.
5. I am in complete control when I use the browsing interface.
6. (*) I could probably teach myself most of the things I need to know about the browsing interface.
7. I would prefer to learn new browsing interfaces on my own.

Appendix B. Results of MANOVA procedure

Perceived usefulness

	Wilk's Lambda	F Value	Num DF	Den DF	P-Value
Spec. Page	0.97	1.51	4	222	0.201
Comp. Interface	0.93	2.12	8	444	0.0331
Context	0.98	0.46	8	444	0.8857
Spec * Comp	0.93	2.07	8	444	0.0374
Spec * Context	0.9	2.86	8	444	0.0042
Comp * Context	0.911	1.31	16	678.86	0.1826
Spec * Comp * Context	0.91	1.23	16	678.86	0.2367

Perceived ease of use

	Wilk's Lambda	F Value	Num DF	Den DF	P-Value
Spec. Page	0.98	0.82	4	222	0.5154
Comp. Interface	0.88	3.42	8	444	0.0008
Context	0.95	0.63	8	444	0.8634
Spec * Comp	0.92	2.35	8	444	0.0176
Spec * Context	0.3	1.88	8	444	0.0612
Comp * Context	0.91	2.62	16	678.86	0.0082
Spec * Comp * Context	0.92	1.07	16	678.86	0.3844

Disorientation

	Wilk's Lambda	F Value	Num DF	Den DF	P-Value
Spec. Page	0.98	0.66	5	221	0.6518
Comp. Interface	0.95	1.03	10	442	0.4187
Context	0.95	1	10	442	0.4391
Spec * Comp	0.94	1.33	10	442	0.2091
Spec * Context	0.98	0.51	10	442	0.8839
Comp * Context	0.91	1.12	20	733.92	0.3224
Spec * Comp * Context	0.85	1.8	20	733.92	0.0173

Satisfaction

	Wilk's Lambda	F Value	Num DF	Den DF	P-Value
Spec. Page	0.99	0.29	5	221	0.9179
Comp. Interface	0.88	2.93	10	442	0.0014
Context	0.96	0.96	10	442	0.4768
Spec * Comp	0.95	1.12	10	442	0.3446
Spec * Context	0.95	1.05	10	442	0.3977
Comp * Context	0.93	0.81	20	733.92	0.7035
Spec * Comp * Context	0.87	1.55	20	733.92	0.0582

Perceived control

	Wilk's Lambda	F Value	Num DF	Den DF	P-Value
Spec. Page	0.97	1.43	4	222	0.225
Comp. Interface	0.95	1.42	8	444	0.1866
Context	0.96	1.03	8	444	0.4103
Spec * Comp	0.93	2.01	8	444	0.0441
Spec * Context	0.97	0.76	8	444	0.6404
Comp * Context	0.95	0.69	16	678.86	0.805
Spec * Comp * Context	0.96	0.48	16	678.86	0.9556