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INVESTIGATING DECISION SUPPORT AIDS IN ONLINE MARKETPLACES BASED ON THE EFFORT-ACCURACY CO-EXISTENCE FRAMEWORK

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Research in Progress

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Abstract

With the increasing prosperity of online marketplaces, millions of items are available on a single platform. Due to the limited cognitive capacity of human beings, consumers make purchase decisions in a way that balances both effort and accuracy, as contended by the effort-accuracy trade-off (EATO) framework. However, we propose that the rich functionality of online decision support aids (DSAs), namely image-based searching, cross-platform comparison and collocation recommendation, can first simplify consumers' information processing in terms of problem identification, alternative generation and product evaluation. DSAs can then help consumers achieve a high level of accuracy in the decision elicitation and making process with minimal effort. We refer to this as effort-accuracy co-existence (EACE) that highlights the non-inversed relationship between effort and accuracy as well as the extended cognitive boundary in consumers' purchase decision making. We plan to validate the conceptual model using experiments with online buyers. The proposed methodology and implications are discussed in this research-in-progress paper.

Keywords: Decision Support Aids (DSAs), Functionality, the Effort-Accuracy Co-existence (EACE) Framework

1 Introduction

Online marketplaces provide a great deal of product information to consumers. Due to human being's limited processing capacity, dealing with the mass product information in a limited time is often an issue for consumers (Hilbert and López, 2011). In order to help consumers locate their desired products, online shopping platforms (such as eBay, Amazon, and TaoBao) have developed various decision support aids (DSAs) to assist consumers in their purchase process. Typical examples of these DSAs include Taotaosou[1], iSearch[2], and NowDiscount[3]. The functionality of DSAs has developed from recommendation, price listing, customer review, product and merchant comparison to more recent image-based searching, collocation, and cross-platform comparison. From the practical perspective, we suspect that these new DSAs' functions will significantly influence the way people process information and so play an instrumental role in consumers' decision making when buying in (multiple) online marketplaces in a fair and trustworthy way. Recent empirical research also indicated that DSAs can provide information in an efficient way (Zhu et al., 2015). However, the functionality and the usage of DSAs are yet to be verified conceptually and systematically, not to mention that "there is still a long way to go in terms of user satisfaction" for recommender systems (Adamopoulos and Tuzhilin, 2015).

When information is received from multiple sources, some consumers find it difficult to make purchase decisions (Sweeney and Soutar, 2001, Branco et al., 2015). To address the problem, information processing researchers have made significant efforts to investigate the cognitive processes associated with decision making. From a theoretical perspective, the notable effort-accuracy trade-off (EATO) framework (Payne, 1982) has nicely described how a decision maker's behavior is shaped by the interaction between effort and accuracy in the information-processing system. Therefore a consumer's decision-making process can be considered as involving a trade-off between raising the accuracy and reducing the effort (Speier and Morris, 2003; Gregor and Benbasat, 1999).

For example, consumers often experience complexity in their decision making in the online context because they have difficulty imagining all of the possible consequences that might occur. On the initial screening, a comparison matrix plays an interactive role by assisting consumers in making in-depth comparisons among those options that appear most promising. However, the tools do not currently allow for side-by-side comparisons of products in terms of their attributes (Häubl and Trifts, 2000). As a result, decision makers often compromise the accuracy of their information processing when encountering such complex information in order to minimise their efforts within the scope of the available cognitive resources. Similarly, the selection of the product purchase choices suggested by online recommendation agents also often require users to make trade-offs between effort and accuracy (Lee and Benbasat, 2011).

In theory, the EATO framework has nicely outlined the trade-off people tend to prefer when making a decision: a high level of accuracy or a reduced cognitive effort due to the boundary of the cognitive resources (Gallupe, et al. 1988; Payne, 1993; Luce, 1997). However, we argue that the boundary of information processing capability can be significantly enhanced with the aid of IT, specifically the rich

1 Taotaosou is the largest image-based searching and shopping engine in China. It covers about 1 million merchants and more than 50 million product pictures. Taotaosou can help a consumer quickly find the right product, based on the input of a picture as a search item, in the mass product list http://www.taotaosou.com/.

2 iSearch is open-source text retrieval software first developed in 1994 by Nassib. iSearch's PHP search engine allows a consumer to build a searchable database for shopping on web sites. http://www.isearchthenet.com/isearch/.

3 NowDiscount is a shopping assistant for those seeking to find the best local deals, discounts and coupon codes. It includes several advanced features to ensure that consumers always get the best deal, including a barcode reader and scanner, price comparison tools, online price match and much more http://nowdiscount.com/nowdiscount_web/.

functionality of DSAs, without lowering the accuracy of decision making and simultaneously saving considerable effort. In other words, we argue that the rich functionality of DSAs can help overcome the conflict between effort and accuracy and achieve their co-existence. That means effort saving and accuracy improvement may not exhibit an inverse relationship when using DSAs in purchase decisions. Prior research on DSAs has provided us with rich insights on how they can facilitate decision making, especially with the purpose of saving time (Fennema and Kleinmuntz, 1995). We build on this stream of studies and bridge them with the research domain of cognitive process. In particular, we argue that three stages of the cognitive process, viz., problem identification, alternative generation and evaluation/selection (Schwenk, 1984) can be simplified with the aid of DSAs with the consequent achievement of both effort saving and accuracy. We term this process as the effort-accuracy co-existence (EACE) framework.

To illustrate, an online DSA like Taotaosou can effectively crawl and summarize the information about product/merchant referrals, compare the prices across different online platforms, and enable image-based searching. After processing multiple-sources of information at the back end, Taotaosou can visualize the results of complex information processing in a single web page with only one click by online consumers. Although such DSAs have been popularly used in practice, the effectiveness of their rich functionality still awaits consolidated conceptualization and empirical evidence. More importantly, how these DSAs can help overcome the EATO remains theoretically and empirically unexplored. In order to address these issues, we thus propose the following research question: How can the functionality of DSAs enhance consumers' purchase experience via an effort-accuracy analysis?

Following this introduction, we explain the theoretical background of the EATO framework in the literature review. We then describe the proposed model, the EACE framework. The methodology is briefly explained in this work-in-progress document.

2 Theoretical Background

Over the past few decades, considerable research has been undertaken into consumer decision making. Studies of human information processing in the context of consumer behaviour have suggested that rational choice theory has limitations as an approach to understand how consumers make decisions in reality (Robey and Taggart, 1982; Todd and Benbasat, 1987; Rao et al., 1992). Considering the mental processing capacity limitations of people, scholars (e.g. Bettman et al., 1998; Agosto, 2002; Smith and Sewell, 2013) contend that bounded rationality exists in the decision-making process.

2.1 A brief review of the effort-accuracy trade-off (EATO) framework

The Effort-Accuracy Trade-Off (EATO) framework was first proposed by Payne (1982) to understand contingent choices via the cost-benefit (accuracy-effort) analysis approach. As the basic premise of this accuracy-effort analysis approach, each decision strategy can be characterized by its accuracy and by the effort required in any given situation. The EATO framework is largely associated with the work of Tversky (1972) and Newell et al. (1958). Payne and his colleagues (Payne et al., 1993) suggest that the EATO framework is useful in assessing cognitive tasks and making decision strategies.

Following the call from Harvey et al. (2007) for effective approaches to address consumer decision strategies in the marketplace, we argue that the EATO framework plays an effective role to explain consumers' decision making with the aid of DSAs. In the last three decades, scholars have invested considerable attention on how to reduce effort, rather than how to improve accuracy, in the process of decision making (Kou et al., 2004). The focus on effort saving can be partially explained by social psychology (e.g., Fennema and Kleinmuntz, 1995), which suggests individuals are able to predict a behavior more easily than predict a behavioral outcome (such as achieving an accurate decision) (Fennema and Kleinmuntz, 1995). Nevertheless, Benbasat and Todd (1996) point out that decision makers are inclined to use decision aids to reduce the amount of effort required to complete a task, though in

reality it is more difficult to achieve higher accuracy. In a similar vein, decision makers prefer to reduce their normative accuracy when time pressure increases.

Consistent with the above observations, our literature review (a much longer review is available on request from the authors) also indicates that not every study using the EATO framework defined and investigated accuracy. Although some studies referred to it, accuracy is often considered as a kind of perceived decision quality or outcome (Chu and Spires, 2003; Todd and Benbasat, 1991). Specifically, Wang and Benbasat (2009) demonstrated that accuracy (perceived advice quality) is less important than effort in influencing the usage intention of DSAs. However, we argue that the extant research on DSAs has not yet opened the black box of information processing and therefore these findings are subject to the restrictions associated with the EATO. In the online context, DSAs can help compute multiple-sourced information and personalize choices according to a consumer's preference. The rich and innovative functionality of DSAs can expand or break down the existing boundary of information processing by increasing the accuracy and effort saving, which subsequently influences the purchase amount, unplanned consumption and the continuous usage of the DSAs.

2.2 The decision support aids (DSAs)

DSAs are referred to as a "technology available for implementing in online shopping environments" that has "the potential to provide consumers with unparalleled opportunities to locate and compare product offerings" (Häubl and Trifts, 2000). DSAs are also known as personalization agents (e.g., Tam and Ho, 2006), recommendation agents (e.g., Häubl and Trifts, 2000; Xiao and Benbasat, 2007), personal shopping assistants (e.g., Riggins, 1999), and comparison platforms (e.g., Broeckelmann and Groeppel, 2008; Mantel and Kardes, 1999). Even with different names and definitions, we argue that these aids are generally designed to provide a better decision experience/outcome by either reducing user effort required or improving the accuracy of recommendation (or the combination).

However, the use of a DSA might also cause the expenditure of effort (Todd and Benbasat, 1992). With this contradictory effect in mind, the design of DSAs should be kept simple, with little effort needed to enter commands. In a related research study (omitted in this RIP paper, but available on request), we summarized the major functions of DSAs used in practice and the corresponding representative DSAs. Among them, three innovative functions of DSA are noticeable and now increasingly draw the attention of both users and online marketplaces, as listed in Table 1. Although these three kinds of functionality do not constitute an inclusive list of all DSA functions, they represent the market-driven factors in the functions of the scope of searching, the searching process itself and the searching results. The previous EATO framework is consistent with the principle of Pareto optimal combination by maintaining an adequate level of both effort and accuracy in decision making. We argue that the three functions of DSAs can help consumers in a number of cognitive processes as outlined by Schwenk (1984), covering problem identification (e.g., identifying the shopping task), alternative generation (alternative products generation) and evaluation/selection (providing review and comparison). That means the use of DSAs can help extend consumers' cognitive boundary and help the decision to reach a higher level of Pareto optimization. This basic assumption and the popularity of these three functions of DSAs in reality leads to our proposed theoretical development below.

Functionality of DSAs and Reference	Definition	Application products and Example Marketplace
Image-based searching (Li et al., 2013)	An image-based searching service is a kind of visual approach that allows users to find and compare visually similar items. Such image searching engines usually convert visual features, like shape, texture, colour into visual signatures and encode each item image into a high-dimensional vector. Then all the vectors in the database are compared with the vector of query images within the limited time to produce the searching results for users.	Commonly seen in the soft goods industry such as apparel, footwear, and accessories; NowDiscount, Taotaosou
Cross-platform comparison (Broeckelmann and Groeppel, 2008; Mantel and Kardes, 1999)	A Comparison Platform is an agent-based cross-merchant that compares the attributes of target or ideal products, especially their price, for the consumer during online shopping on a third-party platform. It provides a product searching function that allows a user to specify certain optimization parameters and runs automatically for the user over a period of time.	Both standard products and soft goods industry; Taotaosou, NowDiscount, Google Express
Collocation Recommendation (Linden, et al., 2003)	Intelligent collocation is a form of item-to-item collaborative recommendation. It is suitable for users of a complete set of matching clothes, simulating what would happen in a physical shop. According to the target goods, the DSA can give corresponding a collocation solution automatically. In addition, the DSA groups products together so that when one item is purchased, complementary items are identified for purchase.	Original from Amazon, now commonly seen in the soft goods industries; Amazon, NowDiscount, Taotaosou

Table 1. Three Major Functionality of DSAs.

3 Theoretical Development of the EACE Framework

As briefly explained in the Introduction, effort saving and accuracy seeking have been generally considered as mutually exclusive given human beings' limited mental processing capacity. Although effort saving and accuracy seeking always seem to be traded off against each other, researchers have argued that people may develop simplification strategies through a "feeling of knowing" that are adaptive to different problem environments (Reder, 1987). With such a strategy, either the effort can be minimized or the decision outcome can be maximized according to some explicit and measurable criteria (e.g. profits, errors, time) by simplifying one or more environmental assumptions (Einhorn and Hogarth, 1981). The "feeling of knowing" process can both save effort and ensure that a reasonable level of accuracy in a given task can be maintained. This is related to our ideas with respect to the cognitive simplification processes. However, the simplification process has not yet been explored in terms of its explicit relevance to effort and accuracy, not to mention in the specific domain of DSAs.

As mentioned previously, Schwenk (1984) summarizes previous research on cognitive simplification into a number of processes: problem identification, alternative generation and evaluation/selection. It is noteworthy that the complex cognitive processes can be simplified by external conditions such as IT support. For instance, Jackson and Brownie (1992) argue that IS support for senior executives focuses on the thought support of decision makers for the problem or opportunity recognition and diagnosis in their decision-making process. Moreover, Singh (1998) emphasizes that decision support systems (DSS) can effectively help process information and solve problem that make up a formulated decision strategy. DSS are of significant value for decision makers in complex situations, where there is a need to analyse multiple sources of data (Martinsons and Davison, 2007).

Using the same logic, we argue that the rich functionality of DSAs constitutes both an effective tool and a salient external condition for effort saving and accuracy improvement of searching and making purchase decisions by simplifying a consumer's cognitive process in problem identification, alternative generation and product evaluation, following Schwenk (1984). Subsequently the overall evalua-

tion of the purchase experience is enhanced. We refer to this process as an effort-accuracy co-existence (EACE) framework (Figure 1). We justify each proposed hypothesis below.

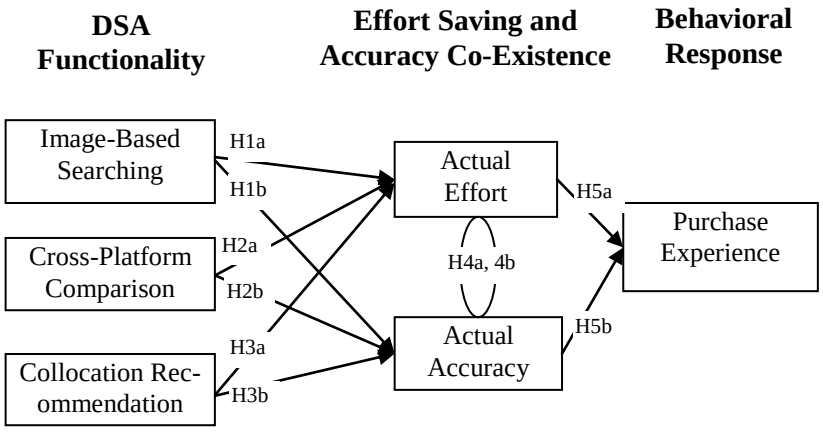

Figure 1. The proposed effort-accuracy co-existence (EACE) framework

According to Mintzberg et al. (1976), problem identification consists of two activities: recognition and diagnosis in the cognitive process. In the routine of recognition, the problem must be identified in the ambiguous data from the environment (Schwenk, 1984). When facing ambiguous product information, it is preferable for consumers to find and compare products that share a similar appearance. To accomplish this, access to DSAs with image-based searching can help consumers locate potential products and distinguish the characteristics of different products. Image based searching (Li et al., 2013) converts visual features, like shape, texture, colour into visual signatures and encodes each item image into a high-dimensional vector before matching it with the existing products in the database. If consumers can search for products based on a picture (such as a picture of shoes, or an item of clothing), much efforts can be saved to describe the ambiguous information of the focal product (such as colour and style), much simplifying the cognitive process of describing an item. More importantly, the multiple dimensional vector largely enhances the accuracy of the description and search results based on the computer-recognizable product features. We thus argue that image-based searching at DSAs can significantly help consumers effectively identify what they want efficiently. Therefore we propose that:

Hypothesis 1 The use of image-based searching in a DSA can help consumers both save effort (H1a) and enhance the accuracy (H1b) of making a purchase decision.

In addition to problem identification, DSAs can also work effectively on alternative generation. Alternatives are usually generated through human reasoning. However, a correlation between the ability to search for alternatives and reasoning is open to an alternative explanation because of cognition differences (Klaczynski, et al., 1998). For instance, some researchers (e.g., Torrens et al., 1999; Newstead et al., 1999) indicate that the measure of alternatives generation predicts deductive reasoning performance after accounting for the effects of cognition. DSAs in general have been considered to have the capacity to help consumers to obtain a better set of alternative products and so are more likely to find the right products that match consumers' needs (Xu et al., 2014). Specifically, we argue that cross-platform comparison functions of DSAs can help collect and organize a large amount of product information automatically from different online platforms. The automatic comparison can not only save time and cognitive efforts in comparing alternative products on each platform, but also broaden the scope of searching and then reach a more accurate result that better matches with a consumer's desire. We thus propose:

Hypothesis 2 The use of cross-platform comparison in a DSA can help consumers both save effort (H2a) and enhance the accuracy (H2b) of making a purchase decision.

Recently, online platforms such as Taotaosou and NowDiscount have implemented apparel collocation. This feature originated from Amazon for cross selling and now has extended to the apparel indus-

try to provide consumers with automatic collocation in order to promote sales during consumers' online shopping. The intelligent fuzzy screening algorithms for collocation are typically based on consumer preferences, product features, and the sales history accumulated in the database (Linden, et al. (2003). We argue that such collocation recommendation can be realized by item-to-item recommendations or collaborative filtering, following (Adamopoulos and Tuzhilin, 2015). To some extent, a DSA can replace human deductive reasoning performance by organizing the relevant information so as to simplify the later cognitive process, thereby providing an optimal set of collocation alternatives for consumers with less effort but much higher accuracy. We thus propose the effect of colocation recommendation in influencing the interplay of efforts saving and accuracy improvement:

Hypothesis 3 The use of colocation recommendation in a DSA can help consumers both save effort (H3a) and enhance the accuracy (H3b) of making a purchase decision.

In this study, the actual effort in searching and reaching a purchase decision includes the selecting time, cognitive complexity and other perceived resources invested in the decision process (c.f. Xu et al., 2014). We contend that the both perceived and actual effort can be much reduced by the cognitive simplification process (cf. Venkatesh, 2000) supported by DSAs, with the "manual" work replaced by computer algorithms that work behind DSAs. As a result, tedious procedures can be minimised and both time and effort can be significantly reduced in reaching the shopping goal for online consumers.

On the other hand, with the involvement of DSAs, the three cognitive processes (Schwenk, 1984), which is applicable in purchase decision making, can be much simplified. For instance, during the problem identification process, DSAs can help the consumers to identify and narrow down the purchase task (e.g., via providing gift ideas). In the alternative generation process, DSAs can effectively list multiple alternative product choices based on consumer's keyword searching. In the evaluation and selection process, DSAs can produce recommendations via summarizing product and customer reviews, as well as via potentially collaborative filtering among multiple agents, viewpoints, data sources, etc. (Adamopoulos and Tuzhilin, 2015). Given the power of DSAs, the scope of cognitive process (Schwenk, 1984) can be much enhanced by computerized solutions, leading to a cognitive boundary (i.e., the combination of reduced effort and enhanced accuracy) in an extended level when compared to the one without using DSAs in the purchase process. As a result, it is not necessary to compromise accuracy with the saved efforts in the process of decision making in purchases, suggesting the non-inversed relationship between effort saving and enhanced accuracy. We thus propose:

Hypothesis 4 With the aid of a DSA, the relationship between effort saving and enhanced accuracy is not inverse (H4a) and consumers' cognitive boundary of effort and accuracy can be extended (H4b).

With the aid of DSAs, consumers can obtain better organized product details and comprehensive analysis of products during their purchase process. That means consumers can spend less time and efforts to achieve quality purchase decision. In other words, a purchase that better fits a consumer's need can be reached. In the integrated vein, the reduced efforts and enhanced decision accuracy can lead to overall a higher evaluation of the purchase experience. We thus propose:

Hypothesis 5 Reduced efforts (H5a) and enhanced accuracy (H5b) contribute to a higher evaluation of the overall purchase experience.

4 The Proposed Methodology, Implications and Conclusion

In this study, we plan to make use of an experimental study to validate the proposed research model. We are now building the experimental website with reference to Taotaosou, the most popular DSA in China. The complete functions of the experimental website will cover image-based searching, cross-platform comparison and collocation recommendations. In terms of sampling, 73.5% of university students in China purchase online, constituting a major and active group of online consumers (CNNIC 2015). Hence we will invite students at both undergraduate and post-graduate levels in a university in China to participate in the experiments. Considering that image-based searching is one of the focal functions of DSAs, in the experimental shopping task we will target products difficult for the users to

describe, but easier to use images for searching (such as a piece of clothing or a pair of shoes). Based on the experimental protocol, participants will be randomly assigned to groups with the three functions of our website and the control group without the access to any DSAs. So it is a 2*2*2 experimental design that also allows to test the interaction effect of all three DSA functions.

In addition, we are also developing a computer application to capture the online users' browsing behaviour such as the visited pages, the route, buttons clicked and time spent on each web page in order to compute the actual effort used in the shopping process. The final purchased (or to-be-purchased) product will be evaluated by means of a survey in which we will assess perceived accuracy as well as objective matching between the product in the given shopping task and the product in the shopping cart. Objective data will be used to draw the cognitive boundary for between-group comparisons and the comparisons on the optimal combination of the efforts and accuracy. Finally, the experimental participants will fill out the survey questionnaire in order to compare their purchase experience with or without using a DSA. The combination of subjective and objective data will be used to validate the proposed research model including the existence of the inversed effort-accuracy relationship and the movement of Pareto optimal combination of the cognitive boundary. We will also conduct various post-hoc analyses including testing the effects of user experience, cultural difference, etc. on both actual efforts and accuracy combination in order to test the heterogeneity effects on the framework.

In terms of implications, we expect this research project can provide important theoretical and practical insights. For the theoretical perspective, we challenge the effort-accuracy trade off assumption in consumer decision process and propose the coexistence of effort saving and accuracy improving with the aid of IT support, namely the rich functionality of DSAs in this study context. Drawing on our argument that a DSA has the capability of simplifying the cognitive process of identifying problems (shopping tasks in this study), generating and evaluating alternatives (providing potential products and comparison in this study), the effort-accuracy boundary in a consumer's purchase decisions can be expanded.

Furthermore, this study conceptualizes and operationalizes the innovative functions of DSA in three dimensions, viz., the scope of searching (cross-platform comparison), the searching process itself (image-based searching) and the search results (intelligent collocation). Although the three focal functions do not constitute an exhaustive list of DSA functionalities, the identification of the three dimensions and the market-driven functions of DSAs in this study provide a starting point for scholars to further investigate how DSAs can influence the cognitive process in consumer decision-making and how other functions of DSAs might contribute similarly or differently.

From the practical perspective, we expect that this study can offer rich objective and subjective data to outline how consumers come to a purchase decision with respect to the efforts paid and the achieved level of accuracy in their decision process. The experimental tools can provide a precise picture of the (relative) effectiveness of DSA functionality in facilitating the positive online shopping experience. We also expect the results of our experiments to provide a set of guidelines for online marketplaces to better design their DSAs. Based on the results of experiments, we would also provide useful managerial diagnostics about the patterns underlying online buying behaviour.

In this study, we provide arguments on how a DSA's functionality can simplify consumers' cognitive process in decision-making and thus help both reduce effort and increase accuracy. Future research can further explore this theoretical direction in order to conceptualize the cognitive process of decision making with DSAs. In addition, although the three antecedents in this study are prominent DSA functions, we encourage researchers to examine additional innovative features of DSAs under the EACE framework. In order to form a complete picture about the use of DSAs, it is also worthwhile to investigate the determinants or antecedents of using the various features of DSAs. We look forward to more research that conceptualizes, operationalizes and empirically tests the significance of DSAs in online marketplaces.

References

Adamopoulos, P. and Tuzhilin, A. (2015). On unexpectedness in recommender systems: Or how to better expect the unexpected. *ACM Transactions on Intelligent Systems and Technology*. 5(4), Article 54, doi:10.1145/2559952.

Agosto, D. E. (2002). Bounded rationality and satisficing in young people's Web-based decision making. *Journal of the American Society for Information Science and Technology*, 53(1), 16-27.

Benbasat, I. and Todd, P. (1996). The effects of decision support and task contingencies on model formulation: A cognitive perspective. *Decision Support Systems*, 17(4), 241-252.

Bettman, J. R., Luce, M. F. and Payne, J. W. (1998). Constructive consumer choice processes. *Journal of Consumer Research*, 25(3), 187-217.

Branco, F., Sun, M., and Villas-Boas, J. M. (2015). Too much information? Information provision and search costs. *Marketing Science*, 1-14. http://dx.doi.org/10.1287/mksc.2015.0959

Broeckelmann, P. and Groeppel-Klein, A. (2008). Usage of mobile price comparison sites at the point of sale and its influence on consumers' shopping behaviour. *The International Review of Retail, Distribution and Consumer Research*, 18(2), 149-166.

Choi, K. and Suh, Y. (2013). A new similarity function for selecting neighbours for each target item in collaborative filtering. *Knowledge-Based Systems*, 37(2), 146-153.

Chu, P. and Spires, E. E. (2003). Perceptions of accuracy and effort of decision strategies. *Organizational Behavior and Human Decision Processes*, 91(2), 203-214.

CNNIC (2015), *2014 China's Youth Internet Behaviour Report*, by China Internet Network Information Center, available at https://www.cnnic.net.cn/hlwfzyj/hlwxzbg/qsnbg/201506/P020150603434893070975.pdf/.

Einhorn, H. J. and Hogarth, R. M. (1981). Behavioral decision theory: Processes of judgment and choice. *Journal of Accounting Research*, 19(1), 1-31.

Fennema, M. G. and Kleinmuntz, D. N. (1995). Anticipations of effort and accuracy in multi-attribute choice. *Organizational Behavior and Human Decision Processes*, 63(1), 21-32.

Gallupe, R. B., DeSanctis, G. and Dickson, G. W. (1988). Computer-based support for group problem-finding: An experimental investigation. *MIS Quarterly*, 12(2), 277-296.

Gregor, S. and Benbasat, I. (1999). Explanations from intelligent systems: Theoretical foundations and implications for practice. *MIS Quarterly*, 23(4), 497-530.

Harvey, M., Novicevic, M., Leonard, N. and Payne, D. (2007). The role of curiosity in global managers' decision-making. *Journal of Leadership and Organizational Studies*, 13(3), 43-58.

Häubl, G. and Trifts, V. (2000). Consumer decision making in online shopping environments: The effects of interactive decision aids. *Marketing Science*, 19(1), 4-21.

Hilbert, M., and López, P. (2011). The world's technological capacity to store, communicate, and compute information. *Science*, 332(6025), 60-65.

Jackson, S. and Brownie, J. (1992). An AI-based decision support tool for strategic decision making in the factory of the future .*Computer Integrated Manufacturing System*, 5(2), 83-90.

Klaczynski, P. A., Fauth, J. M. and Swanger, A. (1998). Adolescent identity: Rational vs. experiential processing, formal operations, and critical thinking beliefs. *Journal of Youth & Adolescence*, 27(2), 185-207.

Kuo, F.-Y., Chu, T.-H., Hsu, M.-H. and Hsieh, H.-S. (2004). An investigation of effort–accuracy trade-off and the impact of self-efficacy on Web searching behaviors. *Decision Support Systems*, 37(3), 331-342.

Lee, Y. E., and Benbasat, I. (2011). The influence of trade-off difficulty caused by preference elicitation methods on user acceptance of recommendation agents across loss and gain conditions. *Information Systems Research*, 22(4), 867-884.

Li, H., Wang, X., Tang, J. and Zhao, C. (2013). Combining global and local matching of multiple features for precise item image retrieval. *Multimedia Systems*, 19, 37-49.

Linden, G., Smith, B. and York, J. (2003). Amazon.com recommendations: Item-to-item collaborative filtering. *IEEE Transactions on Internet Computing*, 7(1), 76-80.

Luce, M. F., Bettman, J. R. and Payne, J. W. (1997). Choice processing in emotionally difficult decisions. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 23(2), 384.

Mantel, S. P. and Kardes, F. R. (1999). The role of direction of comparison, attribute-based processing, and attitude-based processing in consumer preference. *Journal of Consumer Research*, 25(4), 335-352.

Martinsons, M.G. and Davison, R.M. (2007) Strategic decision making and support systems: Comparing American, Chinese and Japanese management, *Decision Support Systems*, 43(1), 284-300.

Mintzberg, H., Raisinghani, P. and Theoret, A. (1976). The structure of 'unstructured' decision processes. *Administrative Science Quarterly*, 21(2), 246-275.

Newell, A., Shaw, J. C. and Simon, H. A. (1958). Elements of a theory of human problem solving. *Psychological Review*, 65(3), 151.

Newstead, S. E., Handley, S. J. and Buck, E. (1999). Falsifying mental models: Testing the predictions of theories of syllogistic reasoning. *Memory & Cognition*, 27(2), 344-354.

Payne, J. W. (1982). Contingent decision behavior. *Psychological Bulletin*, 92(2), 382-402.

Payne, J. W., Bettman, J. R. and Johnson, E. J. (1993). The adaptive decision maker. *Cambridge University Press*, 235-249.

Rao, H. R., Jacob, V. S. and Lin, F. (1992). Hemispheric specialization, cognitive differences, and their implications for the design of decision support systems. *MIS Quarterly*, 16(2), 145-151.

Reder, L. M. (1987). Strategy selection in question answering. *Cognitive Psychology*, 19(1), 90-138.

Riggins, F. J. (1999). A framework for identifying web-based electronic commerce opportunities. *Journal of Organizational Computing and Electronic Commerce*, 9(4), 297-310.

Robey, D. and Taggart, W. (1982). Human information processing in information and decision support systems. *MIS Quarterly*, 6(2), 61-73.

Schwenk, C. R. (1984). Cognitive simplification processes in strategic decision-making. *Journal of Strategic Management*, 5(2), 111-128.

Singh, D. T. (1998). Incorporating cognitive aids into decision support systems: The case of the strategy execution process. *Decision Support Systems*, 24(2), 145-163.

Smith, P. L. and Sewell, D. K. (2013). A competitive interaction theory of attentional selection and decision making in brief, multielement displays. *Psychological Review*, 120(3), 589.

Speier, C. and Morris, M. G. (2003). The influence of query interface design on decision-making performance. *MIS Quarterly*, 27(3), 397-423.

Sweeney, J. C. and Soutar, G. N. (2001). Consumer perceived value: The development of a multiple item scale. *Journal of Retailing*, 77(2), 203-220.

Tam, K. Y. and Ho, S. Y. (2006). Understanding the impact of web personalization on user information processing and decision outcomes. *MIS Quarterly*, 30(4), 865-890.

Todd, P. and Benbasat, I. (1987). Process tracing methods in decision support systems research: Exploring the black box. *MIS Quarterly*, 11(4), 493-512.

Todd, P. and Benbasat, I. (1991). An experimental investigation of the impact of computer based decision aids on decision making strategies. *Information Systems Research*, 2(2), 87-115.

Todd, P. and Benbasat, I. (1992). The use of information in decision making: An experimental investigation of the impact of computer-based decision aids. *MIS Quarterly*, 16(3), 373-393.

Torrens, D., Thompson, V. A. and Cramer, K. M. (1999). Individual differences and the belief bias effect: Mental models, logical necessity, and abstract reasoning. *Thinking & Reasoning*, 5(1), 1-28.

Tversky, A. (1972). Elimination by aspects: A theory of choice. *Psychological Review*, 79(4), 281.

Venkatesh, V. 2000. Determinants of perceived ease of use: Integrating control, intrinsic motivation, and emotion into the technology acceptance model. *Information Systems Research*, 11(4), 342-365.

Wang, W. and Benbasat, I. (2009). Interactive decision aids for consumer decision making in e-commerce: the influence of perceived strategy restrictiveness. *MIS Quarterly*, 33(2), 293-320.

Xiao, B. and Benbasat, I. (2007). E-commerce product recommendation agents: Use, characteristics, and impact. *MIS Quarterly*, 31(1), 137-209.

Xu, J. D., Benbasat, I. and Cenfetelli, R. (2014). The nature and consequences of trade-off transparency in the context of recommendation agents. *MIS Quarterly*, 38(2), 379-406.

Zhu, H., Yang, Z., Ou, C., Liu, H., and Davison, R. M. (2015). Investigating the Impacts of Recommendation Agents on Impulsive Purchase Behaviour. Paper presented at *The 26th Australasian Conference on Information Systems*, Adelaide, Australasian. Nov 30 - Dec 4th.