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Abstract

Choice overload is a phenomenon that can frequently occur in online decision-making by individuals. In this paper, we explain the concept of choice overload and explore the causes of choice overload by contrasting the characteristics of two distinct types of individual decision-making: the traditional search-dominated decision-making and the modern processing-dominated decision-making.

By comparison, we demonstrate that choice overload is a phenomenon that happens in the transitional stage between these two modes of decision-making. As decision-making by individuals move to online environments, the traditional mode of decision-making that is characterized by high search cost and low processing cost is being gradually replaced by a different mode that has a low search cost, but very high processing cost. This transformation implies that a focus on effectively reducing processing cost will be the decisive factor in improving the effectiveness and efficiency of decision-making in online environments.

The emergence of web-based product comparison agent is one step towards assisting online decision-makers to cope with choice overload. However, more substantial development in information technology, especially the advancement of theories in Human Computer Interaction is needed to significantly improve the quality of this kind of decision-making assistance.

Keywords: Decision support system, choice overload, search-dominated decision-making, processing-dominated decision-making, product comparison agent

Introduction

Choice Overload

If we review history, we will find that most of our past has been spent in an information scarce age. Consequently, for many decisions, the high cost of searching for alternatives may have resulted in what may be called "choice underload." The decision makers would stop searching upon finding a set of "satisficing" choices (Simon 1956). Actually, finding a "satisficing" set of choices with least effort is inherent in human nature (Todd 1988; Platt and Glimcher 1999), and may well be an adaptation to an information-scarce environment.

In contrast, in the last 30 to 40 years, we have entered an information-rich age. Searching for information has become easier; we are more satisfied and more confident because we have access to more choices *with ease*. Paradoxically, more choices have brought another creeping problem – that of choice overload (Huang 2000; Iyengar and Lepper 2000; Kwak 2001; Schwartz, Ward et al. 2002).

Choice overload happens when the information size of a choice set of alternatives exceeds the cognitive capacity of human beings.[1] Though "overload" is a mental construct that is hard to measure directly, there are many indicators of choice overload, such as deferring the decision to buy, using too many heuristics when making the choice or making non-optimal decisions (Haubl and Trifts 2000; Iyengar and Lepper 2000).

Recent development of information extraction technology makes retrieving data from heterogeneous online resources far easier than before, which makes it possible to offer individuals a vast and information-rich choice set in a short time (Firat, Madnick et al. 2000). At the same time, having access to many sources and many types of information poses several challenges in determining what kind of data to retrieve about a specific product, how to analyze, categorize and structure these data, and how to present them to the decision-maker in a concise way. As a result, the decision-maker is saddled with abundant but often-irrelevant information provided by electronic agents and is forced to engage in effortful processing to make sense of it. This can lead to choice overload.

Choice overload has been observed in traditional shopping environments. In one field research (Iyengar and Lepper 2000) at a local grocery store, where two different sizes of choice set of exotic jams[2] were presented to consumers, it was found that the extensive-choice condition attracted more customers to stop (60% vs. 40%), but the limited-choice condition actually resulted in many more purchases (30% vs. 3%). The researchers concluded that choice overload in the extensive-choice condition made shoppers hesitate to buy because there were too many jams to look over and they were afraid of the *regret* they might feel if the forsaken options turned out to be better than the one actually chosen. In another recent study (Schwartz, Ward et al. 2002), it was found that individuals who tried to maximize utility in choice decisions by considering more choice options felt worse off and less satisfied with their decisions than individuals who made "satisficing" choices and considered less alternatives.

There have been observations of choice overload in online shopping environments when online shoppers use various web-based product comparison agents. One research (Brynjolfsson and Smith 2000) found that when consumers use price comparison agents (one major type of product comparison agent) to search for price information on books and CDs, instead of picking the online vendor offering the lowest price, they tend to choose the branded vendor who charged a higher price. In addition to explanations associated with trust and convenience, choice overload is also a major factor contributing to this behavior. Consumers' limited cognitive capacity prevents them from examining too many choices and they rely on heuristics to simplify the task. In this case, they use the branded vendor as a surrogate for simplification of the decision-making (Tversky and Kahneman 1974; 1993). As a result, PCA is under-utilized in decision-making and consumers choose to pay the premium to avoid risk.

How does choice overload happen? In the next section, we will introduce and compare two distinct types of decision-making, and demonstrate that choice overload is a transitional phenomenon as we adapt ourselves from the traditional search-dominated decision-making mindset to one that is processing-dominated.

Two Types of Individual Decision-Making

Basic Logic of Decision-Making

To facilitate discussion, we describe the logical procedure of decision-making in preferential choice problems.

[1]The information size of a choice set is determined by the number of choice alternatives, the features describing each alternative, the complexity of features as well as other factors (such as correlation and trade-offs between features).

[2]One extensive-choice (24 choices) set and one limited-choice (6 choices) set.

As we can see from figure 1, the cognitive cost for the entire decision-making process is incurred at various steps: *identification of the choice set of alternatives, formation of a consideration set (i.e., pick the n choice to consider further) and compare among these n alternatives to determine a final choice)*. We will demonstrate next that two types of decision-making exist that are distinguishable in the allocation of total cost among these steps.

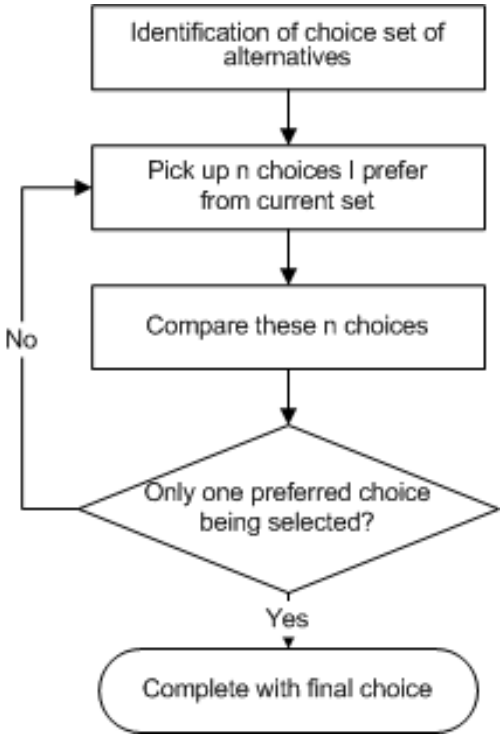

Figure 1. Logical Procedure of Decision-Making for Preferential Choice Problems

Search-Dominated Decision-Making

Traditionally, search cost refers primarily to the cognitive effort used to identify the alternatives in the initial choice set. However, there does exist some level of search costs in later steps when additional information may need to be retrieved from long-term memory or external sources for decision-making (Card, Moran et al. 1983; Morowitz and Singer 1995). For clarification purpose, we use the terms search and retrieval respectively to differentiate these two similar actions.

Due to the high cost of search in traditional environments, people often choose to curtail search when they find a choice set that is *satisficing* (Simon 1955) in utility instead of *optimizing* or maximizing. In addition, because individuals contend with fewer options in the choice set, the initial choice set is often small enough to qualify as the consideration set. In this situation, there may exist choice underload but overload is unlikely to happen. There is an old Chinese proverb that aptly describes this situation: "*When comparing products, you have to visit at least three vendors.*" So we can see, in traditional environments, though people are fully aware of the advantage and importance of a larger choice set ("*three vendors*") for making decisions, they are constrained by high search cost.

In this context, the total cognitive cost is incurred mainly in the identification of the initial choice set. We define this type of decision-making as *search-dominated decision-making*. In other words, the efficiency and effectiveness of the decision-making is mainly determined by how the search cost is reduced.

Search-Dominated Decision-Making

Search-dominated decision-making refers to the decision-making process where the cognitive workload for the task is dominated by the cost of identifying alternatives for the initial choice set.

Processing-Dominated Decision-Making

Information integration technology makes the extraction of information from heterogeneous resources easier and timely (Clark 2000). As a result, search cost for the identification of alternative choices has dropped dramatically. These technology improvements have made online decision-making completely different from traditional decision-making.

In online decision-making, identification of choice alternatives is done with minimal effort with the assistance of searching technology. Online shoppers only need to provide a broad criterion or basic identification information, such as ISBN for a book or model number for computer hardware, to locate many choice alternatives, so that cognitive cost for this stage is minimal. However, in contrast, in the next stage, online shoppers are "forced" to engage in multiple "pick" and "compare" routines as indicated above, because of the large number of alternatives in the choice set. This may mean repeated comparison and reformation of the consideration set.

If we examine the "compare" routine further, we will find that it involves not only short term memory operation but also retrieval of information from long term memory or external sources (Bettman, Johnson et al. 1991). For example, if an online shopper found that the lowest priced vendor for a book is an unfamiliar one, he may want to initiate a sub-routine to retrieve information

about the reputation of the vendor from external rating agents such as bizrate.com. In other cases, the comparison process may necessitate researching an unfamiliar attribute of the product (e.g., the progressive scan feature in DVD players) from other sources, in order for the individual to understand his own attribute preferences.

The ability to integrate an increasing number of retrieval sub-routines is an important feature of this new type of decision-making. In fact, it is exactly this daunting workload of additional retrieval of information that makes most consumers use heuristic methods in decision-making rather than put a great deal of effort in conducting extensive references to external sources. Consequently, many consumers may defer buying the product (Iyengar and Lepper 2000) or stick to reputed brand names (Brynjolfsson and Smith 2000), rather than buy the wrong product based on incomplete guessing (heuristics). In this case, the technology advantage in decision-making is eliminated by choice overload.

Thus, we find that though we enjoy the advantage of reduced search cost to identify choice alternatives, the very identification of too many choices may lead us into a lengthy and effortful second stage where these alternatives have to be analyzed and processed. We call this new type of decision-making *processing-dominated decision-making*.

Processing-Dominated Decision-Making

Processing-dominated decision-making refers to the decision-making process where the cognitive workload for the task is dominated by the cost of processing choice alternatives to compare them iteratively and form consideration sets of decreasing sizes. In most cases, the iterative formation of smaller consideration sets involves frequent references to long-term memory or external sources.

Choice Overload as a Transitional Phenomenon from Search-Dominated to Processing-Dominated Decision-Making

To better illustrate the transformation of traditional decision-making, we use the following figure to assist our explanation.

The total cognitive cost for decision-making, represented by the solid line, consists of search cost and processing cost. Processing cost rises exponentially with the increasing number of choices because of the limited capacity of human mind. In traditional environments, search cost will rise proportional to the number of choices, with the slope of the line being different for different products. In online environments, however, the development of searching technology makes search cost low and constant, regardless of the number of choices.

In traditional environments, the total cognitive cost is characterized by high search cost and low processing cost. In modern environments with advancement of searching technology, the total cost is mainly determined by processing cost. Obviously, there exist a transition stage during which individuals have to adapt their traditional decision-making mindset to new environment. Choice overload as a phenomenon is almost unavoidable during the transition.

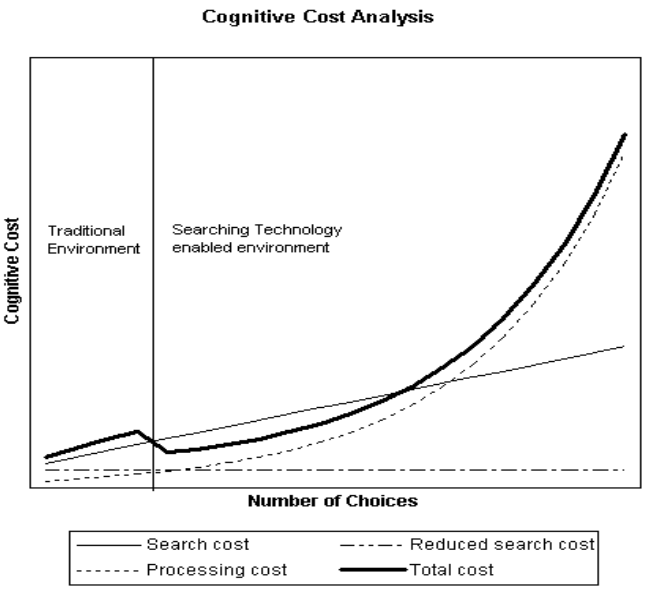

Figure 2. Cognitive Cost Analysis

In the next section, we will introduce web-based product comparison agents and discuss how it can be designed to reduce the processing cost of decision-makers.

Product Comparison Agent (PCA) and Its Contribution to Reducing Processing Cost

Product comparison agent refers to agents that could help human beings make choice decision by providing comparison information. Web-based PCAs specialize in extracting and aggregating information from heterogeneous data resources and present them to online users in appropriate formats.

The advantage of using a PCA for online decision-making is that it could completely eliminate the search cost for decision-makers and substantially reduces processing cost. Consider a book PCA (addall.com): when you type in the ISBN number or title of the book, it will automatically locate several online book vendors that have this title and list their prices for this title. This will completely eliminate the search cost for the user. If you also provide your location, it will calculate the shipping and tax charges and include them in the final prices, which will reduce the processing cost.

The design of PCA is an evolutionary process. In the very beginning, PCAs were almost universally focused on reducing search cost. They searched the Internet, extracted price information for the same product from various vendors and listed them for the consumer. However, as this list grew larger and larger, it has created the choice overload phenomenon. For example, one research study found that most PCA users were not selecting the lowest-priced vendor, but were instead, picking a branded vendor (Brynjolfsson and Smith 2000).

To reduce the choice overload problem that consumers now face, PCAs have begun to provide more comparison functions in the interface that could reduce the cost of processing. This includes providing vendor-rating information (reduces retrieval procedure), checkbox for formation of consideration set (reduces cost of reformation of consideration set), clickable button for ranking of different product attributes (reduces cost of comparison), and adding tax and shipping information (reduces the cost of aggregation comparison). We can expect that in the near future, more and more improvements will be focused on strategies that reduce the processing cost of decision-makers.

Empirical Implication

Based on the discussion above, the first priority for industry is to design an optimal PCA-like recommendation agent that can reduce processing cost to the greatest extent. For example, if we could predict the preference of an online shopper, technology can eliminate retrieving cost by collecting all the needed information and presenting them to the consumer in aggregated way, which is the utopia of a friction free online world. But due to limited advancements in areas like human computer interaction, we cannot do that at least in the foreseeable future.

In addition to improving the design of PCA as mentioned above, power vendors like Amazon have begun to provide customized comparison list for consumers by monitoring and analyzing the click-stream of registered consumers. However, features like this may take a long time to be adopted by stand-alone PCA because of their small customer bases and the anonymous way of querying.

Conclusion

In this paper, we introduced the concept of choice overload and two types of decision-making processes: search-dominated and processing-dominated decision-making. Processing-dominated decision-making is characterized by lengthy comparison of many alternatives and attempts ton form smaller consideration sets. It also typically involves references to long term memory or external sources to get additional information relevant to the comparison process. To avoid engaging in this effortful process, many consumers make choices based on heuristics. Sometimes, this results in deferred buying or paying premiums for known brand names, as documented by empirical research. This is a direct consequence of choice overload. Choice overload may well be unavoidable as we transit from a traditional search-dominated decision-making style to one that is processing-dominated. The challenge to researchers and designers of Decision Support systems is devising improvements in the design of PCA-like recommendation agents that minimize repeated iterations in processing information and frequent references to long term memory or external resources.

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