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Multi-Attribute Decision by Sampling: An account of the attraction, compromise and similarity effects

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HIGHLIGHTS

- A model of the three major context effects in multi-attribute choice is proposed.
- Evaluation depends on choice options' relative positions in a sampled distribution.
- Sufficient conditions for the model to produce the context effects are derived.
- Experiments confirm the sampled distribution is affected by the choice options.
- Treatment effects are strong enough to significantly affect the context effects.

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ABSTRACT

Consumers' choices are typically influenced by the choice context in ways that standard models cannot explain. We provide a concise explanation of the attraction, compromise and similarity effects. The model, Multi-Attribute Decision by Sampling (MADS), posits that the evaluation of a choice option is based on its relative position in the market distribution as first inferred and then sampled by the decision-maker. The inferred market distribution is assumed to be systematically influenced by the choice options. The value of a choice option is assumed to be determined by the number of sampled comparators that the option dominates. We specify conditions on the sampling distribution that are sufficient for MADS to predict the three context effects. We tested the model using a novel experimental design with 1200 online participants. In the first experiment, prior to making a choice participants were shown a selection of market options designed to change their beliefs about the market distribution. Participants' subsequent choices were affected as predicted. The effect was strong enough to impact the size of two of the three classic context effects significantly. In the second experiment, we elicited individuals' estimates of distributions of market options and found the estimates to be systematically influenced by the choice set as predicted by the model. It is concluded that MADS, a model based on simple binary ordinal comparisons, is sufficient to account for the three classic context effects.

1. Introduction

A well-established challenge to the standard utility model is given by the existence of context effects in consumer choice. Context effects occur when the relative frequency with which one option is chosen over another depends on the other options in the choice set. In this paper we consider the three most-studied context effects found in multi-attribute choice experiments: the similarity effect (Tversky, 1972), the attraction effect (Huber, Payne, & Puto, 1982) and the compromise effect (Simonson, 1989).

We illustrate the three context effects in Fig. 1 which shows choice options located within price × quality space. Consider the low-quality, low-price option A, and the high-quality, high-price option B. The attraction effect occurs when one of two options is more likely to be chosen after a third option that it, and only it, dominates is introduced, e.g., $p(A|\{A, B, T_A\}) > p(A|\{A, B, T_B\})$. The compromise effect occurs when an option is more likely to be chosen when it becomes an intermediate option, e.g., $p(B|\{A, B, C_B\}) > p(B|\{A, B, C_A\})$. The similarity effect occurs when the introduction of a third option that is similar to one of the alternatives increases the probability of choosing the dissimilar alternative, e.g., $p(A|\{A, B, S_A\}) > p(A|\{A, B, S_B\})$.[1]

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[1] In the first papers to document the context effects, choices from binary choice sets were compared against those from ternary sets in order to serve as examples

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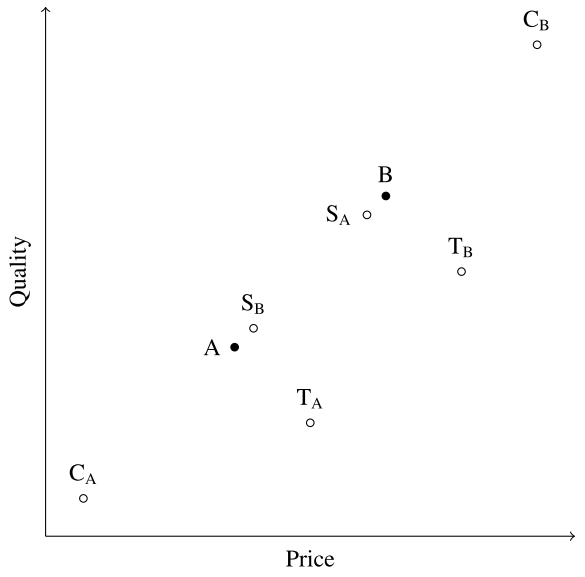

Fig. 1. Context effects. Example alternatives which form the choice sets used to demonstrate the attraction, compromise and similarity effects. Hollow dots represent the various decoys that join *A* and *B* to make up ternary context-effect choice sets.

These three context effects have been replicated many times in a variety of domains (e.g., Doyle, O'Connor, Reynolds, & Bottomley, 1999; Huber et al., 1982), and within a single study (Berkowitsch, Scheibehenne, & Rieskamp, 2014; Noguchi & Stewart, 2014). Moreover, the fit of discrete-choice models can be improved by adding estimable parameters for each context effect and some of their interactions (Rooderkerk, Van Heerde, & Bijmolt, 2011). The classical utility paradigm built on the assumption of rational preference orderings renders choice invariant to the introduction of seemingly irrelevant alternatives, and hence is not able to explain these phenomena without substantial modification.

In this paper we offer a concise account based on a simple cognitive mechanism, binary ordinal comparison, which is motivated by a large body of independent psychological evidence. We term the model Multi-Attribute Decision by Sampling (MADS). It contrasts with previous accounts provided in both economics and psychology. For example, it has been shown that the compromise effect can result as equilibrium behavior in markets under uncertainty where the choice set provides information for the decision-maker (e.g., Kamenica, 2008; Wernerfelt, 1995). However, these accounts of context effects do not explain well why the effects are found in domains where it is less plausible that the options carry information regarding decision-relevant attributes such as quality (e.g., consumer choices over gifts of coupons and cash: Tversky & Simonson, 1993; or choices over lotteries: Wedell, 1991). Furthermore, Trueblood et al. (2013) show that the 'big three' context effects appear when individuals judge psychophysical stimuli, suggesting that the mechanism underlying the effects is a more fundamental component of the human decision-making process. In economics, existing accounts of some of the effects have been based on psychological factors such as dimensional weighting (Bushong, Rabin, & Schwartzstein, 2015), salience (Bordalo, Gennaioli, & Shleifer, 2013), limited attention (Manzini & Mariotti, 2014; Masatlioglu, Nakajima, & Ozbay, 2012) and reference points (Ok, Ortoleva, & Riella, 2015). Some have also been predicted by the solution to an intra-personal bargaining problem (de Clippel & Eliaz, 2012).

In psychology, there are models of choice that account for all three of the major context effects (e.g., Bhatia, 2013; Roe, Busemeyer, & Townsend, 2001; Trueblood, Brown, & Heathcote, 2014; Usher & McClelland, 2004). However, none capture the three effects with one psychological mechanism, instead resorting to arguably ad-hoc parametrizations. Furthermore, most of these models are complex and can only be estimated numerically. In contrast, we offer a novel account of the three consumer choice context effects based on sampling and binary ordinal comparison, while maintaining analytic expressibility. Our argument is one of sufficiency, not necessity: We suggest that simple binary dominance relations, combined with an assumption that samples are drawn from a distribution that is influenced by the choice set, are all that is needed to account for the three context effects. We do not present data that exclude more complex accounts (e.g., accounts based on better-than-ordinal dominance relations).

Our model instantiates three key assumptions. The first assumption is that individuals evaluate choice options by comparing them to a limited sample of other items. The idea that judgments and choices are based on a process of sampling comparator items from memory and/or the immediate choice environment is ubiquitous in psychology (e.g. Fiedler, 2000; Fiedler & Juslin, 2006; Hertwig & Pleskac, 2010) and is strongly supported by the existence of context effects of the type discussed in the present paper. Related ideas are found in several recent economic models (e.g., Bordalo, Gennaioli, & Shleifer, 2012a, 2013; Gennaioli & Shleifer, 2010; Kőszegi & Szeidl, 2013) and neuroscience (Bornstein, Khaw, Shohamy, & Daw, 2017; Shadlen & Shohamy, 2016).

The second assumption is that the sampling process is systematically influenced by the choice set. We assume that a given choice set will be taken by subjects to suggest the presence of unobserved market options which the subject may therefore include in the sample they generate. More specifically, in our model people behave as if they infer a distribution over the whole marketplace of options on the basis of the choice set that they face, and sample from that distribution. This assumption resonates with much existing literature. First, Kamenica (2008) presents a model in which choosers infer that choice options reflect the preferences of the population, and thereby explains choice overload effects. In consumer psychology it also been suggested that people treat choice options as informative about the marketplace, as when a medium-height person will rationally choose a sweatshirt size near the middle of the available range of size options (Prelec, Wernerfelt, and Zettelmeyer, 1997; Simonson, 2008; Wernerfelt, 1995). A further claim, found in cognitive psychology, is that people update their estimates about quantities such as market prices on the basis of experimentally-provided options, particularly when initial uncertainty is high (Brown, Sanborn, Aldrovandi, and Wood, 2015; Shenoy and Yu, 2013; Sher and McKenzie, 2014). Our claim is of this latter type: we assume that people update prior beliefs about market distributions on the basis of sets of choice options.

The third assumption is that the probability of choosing an alternative is determined via dominance relations between items in the mental sample. This assumption is consistent with and motivated by a large body of research in psychology that suggests that subjective valuation involves a series of simple ordinal comparisons between pairs of items (e.g. Stewart, Chater, and Brown, 2006; see also Kornienko, 2013). For example, the Decision by Sampling model (DbS: Stewart et al., 2006) assumes that subjective values are determined by (a) retrieving a small sample of comparison items drawn from memory and the environment, (b) tallying via binary ordinal comparisons the number of comparison attribute values that are smaller than the target attribute

of violations of the regularity principle. In studies since, it has been common to define the context effects via comparisons of the probability of an alternative being chosen from two ternary choice sets (see Table 1 of Trueblood, Brown, Heathcote, & Busemeyer, 2013). Throughout this paper, we also define context effects via comparisons of an alternative's choice probabilities from ternary choice sets.

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