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A theory of iterative choice in lists[☆]

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ABSTRACT

In a list, alternatives appear according to an order and the decision maker follows this order to evaluate alternatives. He records the first alternative as the initial survivor and then at every stage, he compares the current survivor with the next alternative in the list to determine whether the next alternative replaces that to become the new survivor. When the entire list is exhausted in this manner, the agent chooses the survivor in the last stage. We call this procedure "iterative" and provide an axiomatic characterization for it when the order in every list is observable. Then, we also study characterizations of the iterative procedure that is prone to the well-known primacy and recency effects. Finally, we analyze situations where the order of alternatives is unknown to an outside observer and provide a characterization result that enables such an outsider with limited information to understand whether the decision maker can indeed be an iterative list chooser for some order.

1. Introduction

The classical theory assumes that agents choose from *sets* of alternatives. However, in reality, a variety of daily life decisions require choices to be made from sets of alternatives *presented according to a specific order*. We call such an ordered set of alternatives a *list*. Alternatives in a list may appear all at once according to an order as in the case of selecting a dish from a menu, a product from a store shelf and a candidate from a ballot; or they may appear successively as in the case of beauty contests, figure skating competitions, and song contests.

The order of alternatives is known to influence choices in a way that go against rationality. Primacy and recency are the most well-known order effects.[1] The primacy effect refers to an alternative being evaluated more positively when it appears earlier in a list and is typically observed when a decision maker faces alternatives all at once in a given order (Miller and Krosnick, 1998; Krosnick et al., 2004; Meredith and Salant, 2013). On the other hand, the recency effect refers to the value of an alternative being accentuated when it appears later in a list and is more commonly observed when alternatives appear successively (Wilson, 1977; Bruine de Bruin and Keren, 2003; Bruine de Bruin, 2005; Fasold et al., 2012; Unkelbach et al., 2012).

The main purpose of this paper is to propose and axiomatically characterize a theory of choice from lists where the order is allowed to influence choices. Our theory can accommodate primacy and recency effects. We also provide characterizations of choices that are prone to each of these effects and therefore establish the distinction between these effects in terms of the parameters of our model.

The present paper is built on the framework introduced by Rubinstein and Salant (2006).[2] We consider a *list* as a finite *sequence* of *distinct* elements of a grand set X. A *choice function* is then defined as a map assigning to any list a single element of it. We impose two axioms on the choice function. The first postulate imposes a restriction on the impact of adding an alternative to the end of a list. The other axiom restricts the choice from the resulting list when two lists are spliced under appropriate conditions.

The two axioms above together characterize the iterative choice procedure: the decision maker has a binary relation in his mind

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1 Rubinstein et al. (1996) and Attali and Bar-Hillel (2003) document another effect where middle options are favored in strategic environments (e.g. while placing (searching for) the correct answer in a test).

2 Rubinstein and Salant (2006) characterize a choice procedure where the decision maker uses the order only to resolve indifferences by choosing either the first or the last maximizer in a list. In particular, the agent's choice coincide with the rational choice if his complete preference relation is anti-symmetric. In contrast to its sole role of tie-breaking there, the order plays a more crucial role in our model. For a more detailed discussion, see Section 3.1.

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which we interpret as conveying the replacement relation between any two options. When confronted with a list, the agent evaluates alternatives in the given order according to his binary relation. He starts with comparing the first alternative in the list with the second option. If the second option replaces the first one, then the second option becomes the "survivor". Otherwise, the first option survives. He then carries this survivor to the next stage and compares it with the third option in the list. If the third option replaces the previous stage's survivor, then it becomes the new survivor. Otherwise, the previous survivor stays as the current survivor. The process continues in this manner till the end of the list is reached and eventually, the agent chooses the survivor in the last stage. Later in the paper, we study the same procedure when the order is unobservable and endogenously derived in the model.

The rest of the paper is organized as follows. In Section 2, we provide an overview of the related literature. In Section 3.1, we introduce our framework, axioms, and the main result. In Section 3.2, using additional axioms, we characterize choices that are prone to primacy and recency effects. In Section 4, we extend our framework to analyze cases where the order of alternatives is only known to the decision maker but not to an outside observer. Finally, Section 5 concludes and all proofs are provided in the Appendix.

2. Related literature

The procedure characterized in this paper has already attracted attention. Rubinstein and Salant (2006) mention it in an example attributed to Salant (2003) who shows that it is the unique procedure using a single memory cell.[3] Unlike these papers, we provide an axiomatic characterization of the procedure, study its connection to primacy and recency effects, and also extend it to the cases of unobservable order.

Apesteguia and Ballester's (2009) agenda rationalizable choice and Yildiz's (2013) list rationalizable choice models are similar to our work in that their procedures, following an order, compare alternatives pairwise according to a binary relation, then carry the winner to the following stage to compare it with the next alternative, and choose the winner in the last stage. However, they both use a different domain for choice problems and a more restricted binary relation.[4] Their choice problems are sets of alternatives as in the classical theory. They endogenously derive a *fixed* order on the entire grand set of alternatives and use in any choice problem the list induced by this fixed order. In contrast, choice problems in our main model are sets with exogenously given orders. Even though we later extend our analysis to situations where the order is unobservable and endogenously derived in the model, this extension still differs from those papers. For each chosen alternative in a set, we derive one list and these derived lists do not necessarily respect each other's order for their common alternatives. Also, this extension considers choice correspondences while the other studies work with choice functions only. Another important difference is that both Apesteguia and Ballester (2009) and Yildiz (2013) consider tournaments, which are asymmetric and complete binary relations, whereas our iterative choice procedure allows for *any* binary relation.

Our procedure is related to one of the prominent agenda voting institutions widely used in committee, parliamentary, and legislative settings where each pairwise comparison is made via majority voting.[5] The political economy literature calls it the amendment (Anglo-American) procedure and well-studies the nature and characterization of the elected outcomes.[6] This literature develops in two directions: strategic voting versus naive voting (Farquharson, 1969; McKelvey, 1976; Miller, 1977; Moulin, 1979; Shepsle and Weingast, 1984; Apesteguia et al., 2013). Our work is related to the latter literature. Studies on agenda voting typically take the preference profile of individuals (Apesteguia et al., 2013) or the tournament resulting from majority voting (Miller, 1977) as primitives. Unlike those, in our study of individual decision making, we derive the binary relation endogenously from choice and this can be any binary relation which is not necessarily a tournament. Furthermore, the voting literature typically derives one fixed agenda (order) endogenously and as in Apesteguia et al. (2013), when all possible subsets of the grand space are included in the domain, restriction of this fixed agenda to the relevant subset is used. This feature is similar to Apesteguia and Ballester (2009) and Yildiz (2013) and is different from our work in the ways discussed earlier.

The forward-looking feature of our model is similar to Horan's (2010) model of search in lists without recall since the decision maker never goes back to an alternative he has left earlier in a list. A major difference between the two models is that Horan's (2010) choice procedure is immune to modifications in the part of a list that follows the agent's choice while our procedure is sensitive to such modifications in the tail of a list.

In our model, alternatives replacing each other successively throughout the list is reminiscent of a dynamic procedure. Recently, Caplin and Dean (2011) and Masatlioglu and Nakajima (2013) propose dynamic choice models by the revealed preference approach. Unlike ours, both papers model choices from unordered *sets* of alternatives. Moreover, the path of alternatives ("survivors" in our model) that we endogenously derive is used by Caplin and Dean (2011) as part of their choice data.[7] Masatlioglu and Nakajima (2013) assume that the starting point of search, in addition to the final choice from a set, is observable and allow for the choice from a set to vary depending on this starting point only. Therefore, applying their procedure in lists would require the agent to choose the same alternative from any two lists that are obtained by presenting the same set of alternatives in different orders, as long as both lists have the same starting point. In contrast, our model allows for different choices from such lists even if each of these lists starts with the same alternative.

In an earlier work, Salant and Rubinstein (2008) introduce the notion of an extended choice problem (A, f) where A stands for the available set of options and f denotes the frame representing the observable information that may affect choice even though it is irrelevant for the rational behavior. Our work is related as we analyze a specific type of frame: the order of alternatives.

Finally, our iterative procedure is behaviorally equivalent to a dynamic reference-dependent model where the current reference point gives rise to a consideration set and this set, together with the order in a list, jointly determines which alternative will work as the next reference point in that list.[8] Hence, our work is also related to the growing literatures of consideration sets

3 Salant (2003, 2011) studies the optimality of choice functions (assigning to each *set* a single alternative from the set) in terms of the amount of memory as well as the computational power required to compute them.

4 Apesteguia and Ballester (2009) show that agenda rationalizable choice is sequentially rationalizable (Manzini and Mariotti, 2007); Yildiz (2013) provides an axiomatic characterization for list rationalizable choice.

5 Note that majority voting is a tournament.

6 In the voting literature, other interesting topics ranging from the optimal agenda design (McKelvey, 1981) to endogenizing the candidacy (Dutta et al., 2002) are also studied. However, our point in this study is different than analyzing the optimality of the agenda or the set of alternatives.

7 Caplin and Dean (2011) assume that, in addition to the final choice, what the agent would choose from the set at any point in time if he were forced to stop searching is also observable and impose axioms on this extended choice data.

8 More precisely, the process starts with the list's first alternative acting as a reference point. An alternative, whenever acts as a reference point, gives rise to