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The effect of attribute-alternative matrix displays on preferences and processing strategies

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ABSTRACT

When analyzing discrete choice data we assume that respondents compare alternatives and make a utility maximizing choice. The majority of DCEs use a matrix display with one row per attribute and one column per alternative. A comparison by alternatives implies that respondents process the choice task column-by-column. However, evidence from psychology and judgment and decision making research suggest that learned reading patterns dominate and as such the standard matrix display might induce processing by attributes rather than alternatives. We test this using a split sample survey conducted in France where respondents were randomly allocated into a standard or transposed matrix display group. Our results show that there is no difference in relative scale between the two groups, but that elicited preferences differ. Importantly, ASCs are insignificant in the transposed condition. We find no difference in propensity to use simplifying strategies, but respondents in the standard display condition are more likely to choose according to a random regret minimization (RRM) model rather than random utility model (RUM). We discuss the implications of our findings for future discrete choice experiments.

1. Introduction

Traditionally, the choice tasks people face in discrete choice experiments (DCEs) are displayed as a matrix with one row for each attribute and one column for each alternative. Respondents are instructed to carefully consider each alternative and choose their preferred one. This implies a column wise comparison. However, some studies present the choice tasks in a matrix with one row per alternative and one column per attribute (see e.g. Bennett et al., 2004; Morrison and Bennett, 2004; Rolfe and Windle, 2005; Windle and Rolfe, 2014). This, on the other hand, implies a row wise comparison. In the DCE literature, there does not appear to be any obvious reason for why one way of displaying the choice tasks dominate, and indeed it seems that the choice of display format is rooted in tradition (ChoiceMetrics, 2014, p. 55). In this paper we ask the question: what are the behavioral effects of choosing one way of displaying the choice tasks over another?

We propose a split sample experiment to explicitly test the effect of the matrix display. We use data from a survey conducted on a sample of 600 undergraduate students at the University of Nantes where respondents were randomly allocated into either a control group, i.e. facing the standard matrix display where each row is an attribute and each column an alternative, or a treatment group, i.e.

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the transposed matrix display where each row is an alternative and each column an attribute. Under standard assumptions of rationality and utility maximization, the way attributes and alternatives are displayed should not affect elicited preferences. In a first best situation, where preferences can be described by compensatory utility functions and individuals carefully weigh all of the attribute information and consider all alternatives presented to them, the chosen alternative should always be the utility maximizing one, independent of how information is presented.

The predominant model for analyzing discrete choices is the random utility model (RUM) (McFadden, 1974). This model assumes that an individual carefully considers all the attribute information, "calculates" the utility of each alternative, compares them, and then chooses the alternative with the highest utility. This means that utility maximization is an alternative based behavioral rule. Faced with the standard matrix display, this implies reading column-by-column. This way of processing information, i.e reading, is at odds with learned reading patterns and visual routines, which is left-to-right and line-by-line[1](Navalpakkam et al., 2012 Rebollar et al., 2015; van der Laan et al., 2015; Krajbich et al., 2010). Indeed, recent evidence garnered using eye-tracking shows that changing the display format does not affect the underlying eye-movements, which suggests that different information is extracted, and by extension; different comparisons are made (Shi et al., 2013). This indicates that the way we present the choice cards may affect people's choices. Since the learned reading pattern is left-to-right, line-by-line, comparing information in a manner consistent with this may require less effort. We postulate that under the standard matrix display, comparisons by attributes are relatively easier than comparisons by alternatives, and conversely under the transposed matrix display, comparisons by alternatives are relatively easier than comparison by attributes. As such we hypothesize that transposing the matrix brings the assumption of processing by alternative in line with learned reading patterns and visual routines.

Related evidence suggests that elicited preferences are not independent of how information is presented to respondents. For example, Kjær et al. (2006) found that the placement of the cost attribute affects elicited preferences, and Campbell and Erdem (2015) found that a large proportion of respondents in a best-worst ranking experiment used an item's position as a cue. Specifically, items at the top of the list were ranked more favorably than items at the bottom of the list. This is in line with the eye-tracking evidence provided by Orquin and Mueller Loose (2013), who shows that items at the top of a list receive more attention than items at the bottom of a list, and that items in the top left corner of a matrix are more likely to draw attention first and search proceeds from there. Given these findings, the standard way of displaying the choices and trade-offs are arguably problematic under the assumption that individuals make comparisons by alternatives, when the learned visual routines and reading patterns induce comparisons by attributes.

Recently the competing model of random regret minimization (RRM) has gained traction (Chorus et al., 2008; Thiene et al., 2012). This model assumes that individuals do not seek to maximize utility of the chosen alternative, but rather minimize the regret of attribute difference. Where most RUM formulations state that the utility of any given alternative depends only on its own attributes, RRM states that the degree of regret experienced from choosing any alternative depends on its own attribute levels and those of all other alternatives in the choice task (Chorus, 2012b). This means that an individual does not compare one alternative with another, but rather compares attributes across alternatives. As such, regret minimization is an attribute based behavioral rule. Given the discussion above it is reasonable to expect that RRM is more predominant when faced with the standard matrix display relative to the transposed matrix display, because the display itself, combined with the learned reading patterns, makes for easy comparison by attributes.

The standard assumption of rational agents maximizing utility has long been challenged by non-economists and economists alike. Indeed, when faced with complex and difficult choices, people tend to use simplifying strategies and heuristics to reduce the effort necessary to make a utility maximizing choice (Gigerenzer and Gaissmaier, 2011). For the purposes of this paper we believe it is useful to group simplifying strategies into two broad categories: i) attribute based, and ii) alternative based. As an example of the former we will explore attribute non-attendance (AN-A) (Hensher et al., 2005; Campbell et al., 2011; Hole, 2011; Scarpa et al., 2013; Sandorf et al., 2016) and for the latter elimination-by-aspects (EBA) (Tversky, 1972; Erdem et al., 2014; Campbell et al., 2014). AN-A is a simplification strategy where an individual ignores one or more of the attributes in the choice task, which is the same as reducing the attribute dimensionality of the choice. We hypothesize that under the standard matrix display, when learned reading patterns implies comparisons by attributes, we observe a higher incidence of attribute based strategies. EBA on the other hand involves the elimination of alternatives from the choice task that fails to possess a desirable attribute (aspect) or do possess an undesirable one, which is the same as reducing the alternative dimensionality of the choice. We hypothesize that this type of simplification strategy will be more prevalent under the transposed matrix display, where learned reading patterns induce processing by alternative.

In summary, given the above discussion we have identified four testable hypothesis: (i) the standard- and transposed matrix display elicits the same preferences, (ii) the standard matrix display leads to respondents using more attribute based heuristics, (iii) the transposed matrix display leads to respondents using more alternative based heuristics, and (iv) random regret minimization is more prevalent in the standard matrix display relative to the transposed matrix display.

Our results show that there is no significant difference in error variance (measured by a relative scale parameter) between respondents in either of the two matrix display conditions, but that different preferences are indeed elicited depending on how the choice tasks are displayed. This result is strengthened by evidence that there is no significant difference between treatments of choosing any of the alternatives at the choice task level. Most notably, the alternative specific constants (ASCs) are insignificant in the transposed matrix display condition, which indicates that the commonly observed "ordering effect" disappears. When we consider simplifying strategies, we find no difference between display conditions in the propensity to ignore attributes or eliminate alternatives based on attribute levels. This suggests that the decision to use either of these two simplifying strategies may be more fundamental and not necessarily

[1] This is certainly not true in all cultures, but the argument that learned visual routines and reading patterns influence how information is processed is still contextually valid. In the concluding sections of the paper we discuss how this can be utilized for future research.