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Perceptual grouping does not affect multi-attribute decision making if no processing costs are involved

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ABSTRACT

Adaptive strategy selection implies that a decision strategy is chosen based on its fit to the task and situation. However, other aspects, such as the way information is presented, can determine information search behavior; especially when the application of certain strategies over others is facilitated. But are such display effects on multi-attribute decisions also at work when the manipulation does not entail differential costs for different decision strategies? Three Mouselab experiments with hidden information and one eye tracking experiment with an open information board revealed that decision behavior is unaffected by purely perceptual manipulations of the display based on Gestalt principles; that is, based on manipulations that induce no noteworthy processing costs for different information search patterns. We discuss our results in the context of previous findings on display effects; specifically, how the combination of these findings and our results reveal the crucial role of differential processing costs for different strategies for the emergence of display effects. This finding describes a boundary condition of the commonly acknowledged influence of information displays and is in line with the ideas of adaptive strategy selection and cost–benefit tradeoffs.

1. Introduction

Perceptual cues are often used to influence behavior. For instance, green lit signs point toward exits and should attract people's attention and in case of emergency evacuations, people are supposed to follow these signs. But aspects of perceptual design can also exert their influence in subtler ways. For instance, roads can be designed to create the illusion of increasing speed. By applying parallel stripes across the tarmac with increasing spatial frequency, the impression of increasing speed is induced, and with a curve ahead, the impulse is to slow down (Thaler & Sunstein, 2009). These behavioral effects notwithstanding, do purely perceptual design aspects of information presentation also influence the selection of decision strategies in information-based decisions?

The influence of information presentation manipulations on the decision process has long been taken for granted (Payne, Bettman, & Johnson, 1993), and was investigated already decades ago (e.g., Bettman & Kakkar, 1977; Bettman & Zins, 1979; Jarvenpaa, 1989; Russo, 1977). Decision makers adapt information processing to the way the information is presented (Bettman & Kakkar, 1977; Jarvenpaa, 1989).

Bettman and Kakkar's (1977) research is representative of the experiments that led to the above conclusion. In their Experiment 1 Bettman and Kakkar presented information on different alternatives of breakfast cereal brands in an alternative-wise (i.e., brand-wise organization), an attribute-wise (i.e., organized according to the different properties of breakfast cereals) and a matrix format. The alternative- and attribute-wise formats were implemented by organizing the information in different booklets; either one booklet per alternative or one booklet per attribute. This manipulation strongly influenced participants' information acquisition strategies. Bettman and Kakkar concluded that "consumers seem to process information in that fashion which is easiest given the display used" (p. 237).

There is plenty of evidence supporting this conclusion (see Section 1.2 below). However, the evidence for display effects on decision processes due to the grouping of information stems from experiments that used rather strong grouping manipulations. They relied on implementations of grouping that go beyond a manipulation of perceptual aspects of the display and which therefore imply high processing costs for strategies deviating from the one suggested by the display format.

Throughout this paper, we will consider the costs induced by different grouping manipulations as different implementations of processing costs. Specifically, we consider processing costs as a continuum. Processing costs like the ones resulting in Bettman and Kakkar's (1977) experiment are toward the high end of the continuum. With such manipulations, each booklet contains several pieces of information, grouped according

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to different dimensions to form the different experimental conditions. Similar manipulations group information on different sheets of paper instead of using different booklets. These manipulations require actual switching between different booklets or sheets of paper (motor activity) and therefore more time to perform these acts for strategies that deviate from the strategy suggested by the display than for the suggested strategy. The resulting costs for deviating strategies are considerable and we will refer to these high level processing costs as opportunity costs. Importantly, depending on the kind of grouping, some decision strategies are easier (e.g., quicker) to apply than others; in other words, the manipulations imply differential processing costs for different strategies. At the other end, at the minimum extreme of the processing cost continuum, there are merely *perceptual* information grouping manipulations. With these manipulations, strategies deviating from the one suggested by the type of grouping are not more costly to apply than the suggested one. As mentioned above, evidence for display effects has hitherto been based on manipulations inducing high processing costs (or opportunity costs) for deviating strategies, and possible effects of minimal cost manipulations like perceptual grouping manipulations are yet to be explored.

In a nutshell, grouping of information influences the decision process, but the boundary conditions for these effects are yet to be explored. That is, how far can these effects be pushed? Our goal in this article is to investigate whether purely perceptual grouping manipulations may also impact the decision process. Specifically, whether grouping of information, which induces no differential processing costs for different strategies, influences the decision process, and therefore, whether there is an influence of grouping of information that cannot be explained by adaptive behavior reducing processing costs.

Next, we will introduce the relevant decision strategies and summarize previous research on the effects of displays on decision strategies in multi-attribute decisions. Thereafter, we will outline our approach to investigating perceptual display effects and the details of our experiments. Our manipulations are based on Gestalt principles; that is, the display is manipulated such that different groupings of the task-relevant information should be perceived. We will present four experiments, including three Mouselab experiments and one eye tracking experiment. All of them show that there is no effect of purely perceptual Gestalt-like display manipulations on decision strategies in multi-attribute decisions. Finally, we will discuss our findings in light of previous research by highlighting the differences to our experiments, which may have caused the display effects in that previous research.

1.1. Decision strategies

In our investigations of perceptual grouping effects, we will focus on multi-attribute or multi-cue[1] decisions, which are characterized by various cues providing information about different choice alternatives (options). A number of different inference strategies are commonly investigated for these decision tasks and they are often divided into the two broad categories *compensatory* and *non-compensatory* strategies. The classes differ in their rules on how cue information is searched for, when information search is stopped and how the information is integrated.

One prototypical non-compensatory inference strategy was introduced by Gigerenzer and Goldstein (1996) as the Take-the-Best heuristic (TTB). With this heuristic, information search is cue-wise and goes through the cues in order of their validity. In a two-options decision, a TTB user would acquire the information from the most valid cue for both available options. If this cue discriminates between the options, the information search is stopped and the option favored by the most valid cue is chosen. Otherwise, information search is continued on the second most valid cue and goes on until a discriminating cue is found. The Equal Weight Rule (EQW; Dawes, 1979), a compensatory strategy, describes a strategy that integrates all cue information for each alternative and the option with the highest sum is chosen. Similarly, the compensatory Weighted Additive Rule (WADD, e.g., Payne, Bettman, & Johnson, 1988) prescribes option-wise integration of information, but with this strategy, each piece of cue information is weighted by its importance (i.e., a measure of the cues' validity) before the sum for each option is computed. These compensatory strategies are usually associated with option-wise search for information (e.g., Payne et al., 1988; but see Bröder, 2000b, for a critical discussion).

Various factors that influence the selection of decision strategies have been identified with research conducted in the fast and frugal heuristics framework (Gigerenzer, Todd, & the ABC Research Group, 1999; see Pachur & Bröder, 2013, for a review of factors influencing strategy use). In that framework, it is assumed that people possess an array of different cognitive strategies from which they can select adaptively depending on the task and situation. There is considerable evidence that strategy selection is indeed influenced by and adapted to the payoff structure (e.g., Bröder, 2003; Bröder & Schiffer, 2006; Rieskamp & Otto, 2006) and further task-relevant factors such as, for instance, time pressure (e.g., Pachur & Hertwig, 2006; Payne et al., 1988; Rieskamp & Hoffrage, 1999; but see Bröder, 2000a). But potential effects of purely perceptual manipulations have not gotten much attention, and to the best of our knowledge, the effect of perceptual grouping of information on strategy selection has so far not been investigated directly.

1.2. Influences of displays on strategy selection

The above-mentioned research by Bettman and Kakkar (1977) is but one example of the influence of the task display on people's decision behavior (e.g., Bettman & Kakkar, 1977; Bettman & Zins, 1979; Jarvenpaa, 1989; Russo, 1977; Schkade & Kleinmuntz, 1994; but see Sundström, 1987). Jarvenpaa (1989) reached a conclusion similar to Bettman and Kakkar's: "The results support the notion that decision processes are strongly contingent upon the graphical presentation format" (p. 298). In her experiment, she provided separate graphs for either alternatives or for attributes (i.e., a separate graph for each alternative with all the attribute information or a separate graph for each attribute containing information on all alternatives) printed on separate sheets of paper (and there was a mixed condition, as well). In addition, she provided participants with strategy instructions. Two of the prescribed strategies in the set required alternative-wise processing and the other two required attribute-wise processing. Combined with the different graphical formats, congruent and incongruent conditions resulted. The results mainly supported the hypotheses stating that the format is responsible for the direction of information acquisition and that congruence influences the evaluation phase. In congruent conditions, participants acquired and evaluated in the direction required in the task and supported by the format. But when there was incongruence between the search behavior implied by the graphical format and the kind of search pattern required to complete the instructed task, people searched in the simplest manner given the format, but they adapted information integration to the task instruction. Bettman and Zins (1979) showed that a mismatch between strategy instruction and display format severely increased decision times.

The above-mentioned effects primarily concern the information search process and Jarvenpaa's (1989) results imply that the search and choice rules do not always correspond. There is further evidence

[1] Note that our experiments investigate (multi-cue) inference tasks; however, multi-attribute preference tasks are similar with the crucial difference that there is no objective external criterion for choice quality. In the following, we will not make a difference between preferences and inferences, though, because we are mainly interested in information search patterns rather than in accuracy. The terminology for preferences usually is *alternatives* and *attributes*; with inferences, the terms *options* and *cues* are usually used.