Interacting with Computers 24 (2012) 387–397

Contents lists available at SciVerse ScienceDirect

Interacting with Computers

journal homepage: www.elsevier.com/locate/intcom

Shared online spreadsheets and hidden profiles: Technological effects on dyad decision strategy ☆

I. Fajardo [a,*], S.J. Payne [b]

[a] ERI Lectura, University of Valencia, Avda. Blasco Ibáñez, 21, 46010 Valencia, Spain
[b] Department of Computer Science, University of Bath, BA2 7AY, Bath, UK

ARTICLE INFO

Article history:
Received 23 May 2011
Received in revised form 7 June 2012
Accepted 22 June 2012
Available online 3 July 2012

Keywords:
Group decision support system
Hidden profile task
Group decision strategy
Fast and frugal heuristic

ABSTRACT

We report a study in which dyads use Instant Messaging to agree a preference among a set of three apartments. The information given to participants is partially overlapping, and contains a "hidden profile" (HP), such that a single apartment emerges as the best according to an unweighted sum of feature values only if dyad members pool information that is presented to only one of them. When dyads were additionally provided with a shared online spreadsheet, their decision strategy was more likely to be compensatory and relatively exhaustive, even if the distribution of importance among the cues in which the apartments vary meant that a "fast and frugal" heuristic such as take-the-best would be a rational strategy. This study shows the potential of classic experimental tasks, the HP task in particular, for understanding technological constraints on group decision making and signals the importance of understanding decision-making strategies, and the potential of fast and frugal heuristics, for informing the design of decision support systems.

1. Introduction

Many real-world decisions involve choosing among items that vary on several relevant dimensions. For example, deciding where to live may involve choosing among apartments that vary in price, location, facilities, etc. According to classical decision theory, the best way to make such a decision is to assign weights to these different features or cues[1] so as to compute a trade-off: such a strategy is called "compensatory" because values on one dimension compensate for values on others (e.g., see Payne, 1982). Compensatory strategies are costly in terms of both time and effort, and so in many situations human decision makers may instead use "fast and frugal" non-compensatory strategies, considering only a few of the relevant dimensions (Gigerenzer, 2000; Gigerenzer and Goldstein, 1996). In fact, by means of computational modelling, Gigerenzer et al. (1999) have shown that such fast and frugal heuristics can lead to good or better decisions than compensatory strategies in some decision environments.

Since the classic work of John Payne (Payne et al., 1993), it has been recognized that the way an information space (i.e., the set of items among which a choice is to be made and the feature-values on which these items vary) is represented can play a major role in determining preferred strategy in multi-dimensional decisions. The literature suggests at least two factors that can augment the likelihood of using a fast and frugal heuristic: availability of information and variation in cue validity (Newell et al., 2003). It is therefore important to investigate how the design of decision-support tools affects or interacts with these factors and consequently influences the likelihood of using different decision strategies.

We are interested in these issues in the context of group decisions: situations in which more than one person must agree on a choice among alternatives. The classic group decision making task known as "Hidden Profile" (HP, Stasser and Titus, 1985, 2003) is a multi-dimensional decision task of this kind. It "describes a situation in which a group has to select one of several alternatives. There is one alternative that has a higher sum score (i.e., a higher difference between the number of positive and negative attributes) than any other alternative. However, this profile is hidden to individual group members. Specifically, the information items about the alternatives are distributed among the group members in a biased way such that each individual group member has more positive (and fewer negative) pieces of information on another alternative. In such a situation, groups only rarely detect the hidden profile, that is, select the alternative with the highest score." (Reimer and Hoffrage, 2005, p. 22).

In order to discover and utilise the HP, each group member must commit his/her pieces of information to memory, before entering a discussion in which these pieces of information are shared and then applying, as a group, a compensatory strategy to

☆ This paper has been recommended for acceptance by Francoise Detienne.

* Corresponding author. Tel.: +34 963983093; fax: +34 963864671.
E-mail addresses: infabra@uv.es (I. Fajardo), s.j.payne@bath.ac.uk (S.J. Payne).

[1] Throughout this article feature and cue are used interchangeably to denote the properties of alternatives which vary and which determine the attractiveness of the alternatives.

0953-5438/$ - see front matter © 2012 British Informatics Society Limited. All rights reserved.
http://dx.doi.org/10.1016/j.intcom.2012.06.004

integrate all information. For the group to engage in a fully compensatory strategy, its individuals have to remember and share critical information.

Clearly, this makes a compensatory strategy even more cognitively demanding for groups. Indeed, as we noted, the general effect in HP tasks is that group members rarely share and discuss all their pre-discussion information (especially unique information or information held by only one individual). As a consequence, the "hidden profile" (the best choice according to an unweighted, additive assessment of all the information) may not be discovered (e.g., Stasser and Titus, 1985). Nevertheless, as in the case of individual decisions, it is possible that in some HP situations, fast-and-frugal heuristics may allow groups to make good decisions (although this has so far barely been considered in the HP literature; but see Reimer and Hoffrage, 2005).

In this article we report an experiment on technologically-mediated group decision making in the HP task: we test the extent to which dyad decision strategies in HP are sensitive to the precise nature of the information space and its representation. We manipulate the information space (distribution of cue importance: heterogeneous vs. homogeneous) to investigate situations in which fast-and-frugal heuristics may be applicable and we investigate a technological provision (a shared online spreadsheet) that may reduce the cognitive and communicative costs of a compensatory strategy.

2. Effect of decision support systems on individual and group decision strategy

Payne (1982) showed that choice of compensatory over non-compensatory strategies in multi-dimensional decisions depends critically on the costs and benefits of the strategies relative to the decision-maker's available resources.

When using a compensatory strategy, alternatives are evaluated one after the other and an overall score is computed for each alternative by summing up the cue values (perhaps weighted according to their importance) so that some cue values may compensate for others. On the other hand, non-compensatory strategies use less information per alternative or cue and do not compute tradeoffs among the cue values. Among the most investigated non-compensatory strategies are take-the-best (TTB) and satisficing (Gigerenzer and Goldstein, 1996; Simon, 1956). In TTB (related to the well known "Elimination by Aspects" (EBA) heuristic of Tversky, 1972), the alternatives are compared one cue at a time (ordered in terms of cue validity or importance) with only the best alternatives being chosen at each comparison. This process is repeated until a single alternative remains (in EBA, all alternatives which fail to meet some absolute criterion standard on the cue being considered are rejected). In the case of the satisficing heuristic, the alternatives are considered in order of presentation (the decision maker does not exercise discretion over this order, so it may be modelled as random or as determined by the environment or the experimenter). The first alternative with above-threshold values on a set of cues is selected.

Computational Decision Support Systems might influence individuals' strategies by facilitating alternative-by-alternative or cue-by-cue search and comparison, or by providing the decision maker with sorting and scoring facilities (Chu and Spires, 2001; Todd and Benbasat, 2000). Todd and Benbasat asked individuals to perform a multi-cue preferential choice task (choose one from a set of ten apartments) in which the information was displayed in a matrix format, but with cell-values hidden until requested by the participant. The compensatory strategy was made less effortful for half the participants by providing them with additional spreadsheet functions (e.g., conditional display, sorting by cue values). Participants provided with these resources evidently were encouraged to use compensatory strategies, as shown by their think-aloud statements: they made more compensatory statements (aggregation of cue values for a single alternative) but fewer statements related to a non-compensatory strategy such as independent evaluations (e.g., compare the value of a cue for a given alternative to a reference point) and fewer elimination statements (eliminating an alternative with reference to a single cue value).

Chu and Spires (2001) reported a similar experiment (but in their case within-subjects) with a similar multi-dimensional decision required of participants who were sometimes given access to matrix-manipulation commands. In the aided trials, participants showed more comprehensive information search, lower variability of search for cue values across alternatives, and made choices that were more consistent with the additive compensatory strategy. In addition, Chu and Spires manipulated decision time, finding that even under time pressure participants used the compensatory-like strategy more often when aided than when not.

Regarding group decisions, and HP situations in particular, Mennecke (1997) suggests that Decision Support Systems can alter the group decision making process by structuring and sequencing a series of activities such as pooling information to make more information available to the group. Therefore, a structured information-generation facility could encourage groups to use a compensatory strategy by augmenting the probability of sharing unique and common information and discovering the HP. In his study, group members in the structured agenda condition were instructed to first recall and discuss relevant information about the candidates without stating preferences (for 20 min) and then discuss until reaching a consensus (for 40 min). In contrast, group members in the unstructured agenda condition were told to discuss the case as they wanted to for up to 60 min. Both groups used a voting tool only to formalize their decision agreement. Mennecke reported that Computer Mediated Communication (CMC) groups using a structured meeting agenda shared a greater percentage of both commonly-held and uniquely-held information than did CMC groups with an unstructured agenda. This result suggests that CMC could benefit certain group decision processes as a consequence of the discussion and information pooling structure that is imposed or afforded by some computer-based tools. However, Mennecke did not find a relationship between information-sharing performance and decision quality.

In a previous experiment, Dennis (1996) found that groups using a Group Support System (GSS) and a structured agenda exchanged about 50% more information in a HP task than did face-to-face interacting groups who also used a structured agenda. Put together, the Mennecke (1997) and Dennis (1996) experiments suggest that the structured agenda or the GSS do not increase information sharing if used separately but rather only when combined. However, this contrasts with previous findings of Stasser et al. (1989) who found that a structured agenda by itself increased information sharing in face to face interacting groups. Something in common between these three studies is that information sharing facilitation did not have an effect on decision accuracy.

Reimer et al. (2007) argued that one reason why shared information is more discussed than unique information may be that shared information more often comprises "common cues", i.e., cues that provide information across all alternatives. It is possible in principle to provide common cues uniquely to participants. Reimer et al. (2007) did just this, designing an experiment in which common v. unique cues was deconfounded from shared v. unique-to-participant information. Common cues did indeed facilitate information sharing, but not decision accuracy.

Reimer et al also point to another important feature of the typical HP design that may discourage information sharing, namely, "the individual group members had already formed preferences at the outset [in the pre-discussion time] and focused in the discus-