

Investigating the impact of representation features on decision model comprehension (Extended Abstract)⁵


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Abstract: Decision models play a crucial role in the development of information systems for tasks such as system analysis and design, as well as compliance management. The effective presentation of these models is essential to ensure their accuracy and completeness. Existing research on their cognitive effectiveness remains inconclusive. Our study advances understanding by examining the detailed representation features of decision models, including type (tree versus table), structure (expanded versus frugal), and design (monochromatic versus colored). We demonstrate that the use of color can improve model-task fit, and that structural features can enhance comprehension. Utilizing eye-tracking, we analyzed the underlying mechanisms of these effects. Our findings provide valuable insights for cognitive information systems research and practical applications, offering guidance for both users and developers of decision models.

Keywords: cognitive fit theory, decision models, experiment, color highlighting


1 Introduction

Decision-making processes, including the data employed and the relevant policies and regulations, can be effectively and visually represented and organized using decision models. These models are designed across a broad range of domains, from compliance management [RG+18] to forensic data matching [Xu07]. Careful design and quality assurance are critical in creating decision models. Although research on decision modeling has been ongoing since the 1980s, studies focusing on the cognitive aspects often produce conflicting results and face challenges in reconciling these findings with established theoretical frameworks. Cognitive Fit Theory (CFT) is a fundamental theory in information systems (IS) research [Ve06; Ve91] and has been utilized as a reference theory in conceptual modeling research [Kh06]. A persistent open research question is how representations can be more finely characterized beyond the basic dichotomy of spatial versus symbolic. In our paper, we address this research question by extending CFT. More specifically, we revisit the debate over the relative strengths of different types of decision models, including decision tables and trees.

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5 The original article has been published in the European Journal of Information Systems (EJIS) [Dj23]

2 Experimental Study

In our study [Dj23], our objective was to identify the factors driving cognitive fit at a detailed level. To achieve this, we extended previous research that primarily compared types of representations by also considering the manner in which information is presented, contrasting fast-and-frugal decision models with the more conventional expanded ones. Furthermore, we investigated the impact of color highlighting as a key visual factor that can significantly improve the understanding of these models. To examine the effects of these elements, we test three hypotheses centered on the effectiveness of decision models grounded in cognitive analysis of visual search. The formulated hypotheses were tested through a controlled experiment complemented by an explorative eye-tracking study. The controlled experiment employed a within-subject design, incorporating three factors: representation type, representation structure, and representation design. Example decision tables can be seen in Figure 1. The experiment involved 32 comprehension questions. A total of 139 participants, recruited via Prolific, participated in our study. The results corroborate our hypotheses: decision tables lead to higher comprehension accuracy than decision trees; frugal representations are more effective than expanded ones; and using color enhances comprehension accuracy for decision trees, while it appears to decrease it for decision tables. Our eye-tracking study indicates that this decrease might be attributed to distraction.

a				b			
High Income	Double Income Household	Prior Debt	Credit Score	High Income	Double Income Household	Prior Debt	Credit Score
TRUE	TRUE	TRUE	Good Score	TRUE	TRUE	TRUE	Good Score
TRUE	TRUE	FALSE	Good Score	TRUE	TRUE	FALSE	Good Score
TRUE	FALSE	TRUE	Bad Score	TRUE	FALSE	TRUE	Bad Score
TRUE	FALSE	FALSE	Bad Score	TRUE	FALSE	FALSE	Bad Score
FALSE	TRUE	TRUE	Bad Score	FALSE	TRUE	TRUE	Bad Score
FALSE	TRUE	FALSE	Bad Score	FALSE	TRUE	FALSE	Bad Score
FALSE	FALSE	TRUE	Bad Score	FALSE	FALSE	TRUE	Bad Score
FALSE	FALSE	FALSE	Bad Score	FALSE	FALSE	FALSE	Bad Score

c				d			
High Income	Double Income Household	Prior Debt	Credit Score	High Income	Double Income Household	Prior Debt	Credit Score
FALSE	-	-	Bad Score	FALSE	-	-	Bad Score
TRUE	TRUE	-	Good Score	TRUE	TRUE	-	Good Score
TRUE	FALSE	TRUE	Bad Score	TRUE	FALSE	TRUE	Bad Score
TRUE	FALSE	FALSE	Good Score	TRUE	FALSE	FALSE	Good Score

Fig. 1: Examples of Decision Tables Stimuli (a) Monochromatic Expanded, (b) Colored Highlighted Expanded, (c) Monochromatic Frugal, (d) Colored Highlighted

3 Discussion & Conclusion

In our study, we discovered that the effectiveness of a decision model type depends on its interaction with other representational factors, such as the structure of the representation (expanded vs. frugal) and the design elements (monochromatic vs. colored). Our findings extend existing arguments of cognitive fit theory by demonstrating that using color can compensate for a mismatch between the decision model and the task at hand and that structural features can significantly enhance model comprehension. Furthermore, our results contribute to integrating cognitive fit theory with the research on fast and frugal trees and feature integration theory.

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