

How to Make Decision Support Systems More Human Centric?

An Analysis of Three Digital Effort Feedback Mechanisms

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Introduction

Decision support systems (DSS) help people to make more sound decisions when being confronted with complex decision situations. One category of complex decisions are situations in which multi attributive decision making (MADM) is required. The complexity of MADM arises from the difficulty to find the optimal balance between multiple, often conflicting, decision criteria, and their corresponding attributes [1]. To support humans, DSS integrate mathematical and statistical methods [2]. However, due to their foundation on mathematical and logical models, many DSS are perceived hard to understand and to use by humans [2], [3]. Gaining more insight into DSS design in respect to more human centric approaches is therefore suggested an important field of future DSS research [4]. To contribute to this area the underlying research intends to explore DSS feedback mechanisms, which provide the users with information on their decision processes and outcomes [5], as a means to provide more human centric DSS.

Hitherto, DSS research concentrated on either the technical or the behavioral aspects of DSS [4]. Consequently, interconnected research was neglected. This calls for interdisciplinary research in the DSS field[6]. A previously conducted literature review, classifying the literature on DSS feedback mechanisms according to four layers of human computer interaction (HCI) interface design [7], confirms this view. It presents plenty of concepts for DSS feedback mechanisms to be found in literature but also a lack of research on the more detailed levels feedback mechanism design. These more detailed levels of feedback mechanism characteristics e.g., the time when feedback is provided [5] or by which means the feedback is provided [8], may also affect the impact of the feedback mechanism. To provide more insight into these relations this study reports on a comparison of three experiments which tested effort feedback in a multi-attribute decision making environment. Based on the insights gained from the comparison it is planned to conduct experiments to test the effects found.

Comparison of three effort feedback studies

The three studies on effort feedback [9]–[11] have been chosen due to their closeness in terms of tested feedback mechanisms, theory foundation, and experimental design. The four layer concept of HCI interface design, used in the preceding literature review to analyze and classify feedback mechanisms, was adopted to analyze the effort feedback mechanisms used in the three papers. These consist of the conceptual layer, the semantic layer, the syntactic layer and the lexical layer. An overview on the three studies, their findings regarding the effects generated by the feedback mechanism on the participant's time investment behavior, and the analysis of the feedback mechanisms according to the four layers, are presented in Table 1.

Table 1. Analysis of effort feedback according to four layers of HCI feedback design and their effects on time investment

Study	Analysis according to four layers of HCI interface design				Effects on time investment
	Concept	Semantic	Syntactic	Lexical	
Creyer et al.[9]	<u>Aim</u> • Support sense of invested time	<u>Data</u> • Time elapsed since start of trial <u>Calculations</u> • Relative to maximum of 200 seconds	<u>Timing</u> • During each trial	<u>Presentation</u> • Shading circle	Not significant under same task conditions
Fennema and Kleinmuntz [10]	<u>Aim</u> • Support sense of invested time	<u>Data</u> • Time elapsed since start of trial	<u>Timing</u> • After each trial	<u>Presentation</u> • Numeric text message	Decreasing effect on time investments
Maier et al.[11]	<u>Aim</u> • Persuade users to increase time investment	<u>Data</u> • Dwell time per information unit <u>Calculations</u> • Average over 6 information units • Relative to an average of 0.6 seconds	<u>Timing</u> • During each trial	<u>Presentation</u> • Numeric, colored text message • Evaluative text message • Smiley graphic	Strong increasing effect on information unit level, weaker on task level

Despite the large commonalities, each experiment reported a different effect of the feedback mechanism on the time decision makers invested in the decision making process. Creyer et al. [9] reported that their feedback mechanism, displayed as a shading circle during each trial, had no significant effect on the participant's time investment. The experiment conducted by Fennema and Kleinmuntz [10], in which the participants were presented the elapsed time as numerical text message after each trial, showed a decreasing effect of the feedback mechanism on time investment. In contrast to these studies, Maier et al. [11] showed that an effort feedback mechanism, presented during the trial and implicating a social norm, is actually able to increase time investment behavior.

Conclusion and future research

The analysis shows that, while providing the same type of information, the mechanisms differed in the way the feedback provided meaning. Creyer et al. [9] provided a feedback mechanism which actually had the potential to implicate a time restriction. However, the calculation was explicitly designed not to implicate a time restriction by selecting a timespan as a threshold that would hardly be exceeded by the participants. Maier et al. [11], on the other hand, implemented a threshold that would most surely lead to a conflict between the subject's actual time investment and the implemented threshold. Fennema and Kleinmuntz [10] did not implement any calculation function to introduce a threshold. Yet, the difference in timing could be the explanation why the feedback mechanism had this effect.

To examine whether these differences in the feedback mechanism design actually caused the observed effects, it is planned to conduct one or multiple experiments to examine the influences of design varieties on the semantic, the syntactic and the lexical layer. The big challenge now is to plan the experiments. One major question, for instance, is whether and how to split up the experiments. While single experiments bear the risk to merely confirm existing findings, a combined experiment would dramatically increase the complexity of the conducted research.

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