
Using language as related stimuli for concept generation

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Abstract

This paper examines the use of language, specifically verbs, as stimuli for concept generation. Because language has been shown to be important to the reasoning process in general as well as to specific reasoning processes that are central to the design process, we are investigating the relationship between language and conceptual design. The use of language to facilitate different stages of the design process has been investigated in the past. Our previous work, and the work of others, showed that ideas produced can be expressed through related hierarchical lexical relationships, so we investigated the use of verbs within these hierarchical relationships as stimuli for ideas. Participants were provided with four problems and related verb stimuli, and asked to develop concepts using the stimuli provided. The stimuli sets were generated by exploring verb hierarchies based on functional words from the problem statements. We found that participants were most successful when using lower level (more specific) verbs as stimuli, and often higher level general verbs were only used successfully in conjunction with lower level verbs. We also observed that intransitive verbs (verbs that cannot take a direct object) were less likely to be used successfully in the development of concepts. Overall, we found that the verb chosen as stimulus by the participant directly affects the success and the type of concept developed.

Keywords: Conceptual Design; Design Stimuli; Verb-Based Concept Generation

1. INTRODUCTION

The connection between language and reasoning has been noted since the days of the ancient Greeks, who used the same word, *logos*, to denote both concepts (Kalmar & Davidson, 1997). More recent work in cognitive sciences and psycholinguistics has established the relationship between language and reasoning (Levinson, 1996; Li & Gleitman, 2002). The relationship between language and reasoning for the purposes of design, such as in spatial reasoning and decision making, has also been established (Gero et al., 1994; Dentsoras, 2005). In this paper, we examine the effects of language on concept generation with the goal of establishing the foundation for a language-based design support system. Such a system will exploit the relationship between language and reasoning to facilitate the concept generation process.

Other researchers also recognize the overall importance of natural language to the design process. Natural language

can be used in requirements specification (Burg, 1997; Nuseibeh & Easterbrook, 2000), concept generation (Segers, 2004; Chiu & Shu, 2005, 2007), design representation (Pahl & Beitz, 1996; Stone & Wood, 2000), and design outcome analysis (Mabogunje & Leifer 1997; Dong et al., 2003). We choose to focus on concept generation, as it is a crucial stage where many decisions are made that affect the rest of the product realization cycle. It is frequently estimated that 75% of total product cost is committed by the end of conceptual design (Ullman, 2003). Using the connection between language and reasoning to improve concept generation may assist in reducing the overall cost in the product realization cycle.

Our past work involved searching for biological analogies for design in natural-language format using computational linguistic techniques (Chiu & Shu, 2005, 2007). In this context, we recognized the use of lexical relationships within natural-language knowledge sources, that is, how authors tend to think about and express their knowledge. We used these relationships to retrieve relevant biological phenomena for use as stimuli in engineering problems. The presence of lexical relationships has also been identified in design activity outputs such as in design conversations

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