The role of timing and analogical similarity in the stimulation of idea generation in design

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An experiment was conducted to gain an understanding of how people assimilate and apply newly acquired information when ideating solutions to a design problem by studying how the nature of problem-relevant information and timing of when it is given can affect idea generation in an open-ended design problem. More specifically, the effects of presenting surface similar information before design conceptualization, or surface dissimilar information before and during design conceptualization on the quantity, breadth, and novelty of solutions generated were analyzed. The effects of open goals, fixation, and priming, as well as their implications in design problem solving are examined. It was found that information that is more distantly related to the design problem impacted idea generation more when there was an open goal to solve the problem, while information that is more obviously similar to the problem impacted idea generation more than distantly related information when seen before problem solving has begun. Evidence of induced design fixation and priming were also observed.

Keywords: problem solving, design cognition, creativity, conceptual design

We have observed professional designers breaking from the conceptualization process at points of frustration or impasse to browse magazines or surf the web, seemingly with no specific purpose. When returning to the ideation process, new concepts begin to emerge. This paper contributes to the literature of foundational cognitive principles that inform the design process. In particular, this work studies the types of analogies that most impact design creativity, as well as the time during problem solving when it is most effective to seek such analogical stimulation.

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The initial stages of design often consist of generating ideas for a conceptual solution to the design problem. There have been many attempts to formalize

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this ideation process beginning with the initial proposal for brainstorming (Osborn, 1957) to more recent attempts to experimentally compare different ideation methods (Shah, 1998; Linsey et al., 2005). During these initial conceptual stages, it has been shown that designers are particularly susceptible to information from example solutions such as existing products that are similar to what is being designed (Jansson and Smith, 1991; Purcell and Gero, 1996; Chrysikou and Weisberg, 2005; Perttula and Liikkanen, 2006). Designers have even been observed to incorporate poor aspects of existing solutions into their own solution (Jansson and Smith, 1991). One possible explanation for this is that designers become fixated on existing design solutions to the extent that they are not able to think of any other ways to solve the current problem. In this situation, fixation on existing solutions could prevent the designer from being able to come up with an innovative solution to the problem. While these findings may be useful in routine design when similar products already exist, new design problems seldom come with example solutions. Instead, designers often subconsciously look to other devices that they have encountered or may encounter while working on the problem.

Some theories of creativity posit that the source of creative ideas is the combination of distantly related concepts (Campbell, 1960; Simonton, 1999). Perhaps if designers were able to think of distant but relevant ideas, they could avoid becoming fixated on existing solutions. However, research has shown that people are not very good at retrieving and using information that is analogically related to the problem they are trying to solve (e.g., Gick and Holyoak, 1980; Forbus et al., 1995). These findings lead to the conclusion that people only rarely make use of distantly related information when they are trying to solve a problem.

However, it has been noted that much of this work on analogical transfer has made use of an experimental design where people learn about some material and then later attempt to solve a problem where the learned material could be analogically mapped on to the problem to help solve it. Alternatively, people could encounter relevant information during a break in problem solving that may lead to a higher rate of analogical mapping (Christensen and Schunn, 2005). People who encounter information after work on a problem has begun have an open problem-solving goal. An open goal has been defined as a goal which has been set but one for which the associated task has not been completed. In fact, it has been shown that having an open goal to solve a problem leads to the implicit acquisition of relevant information even while not working on a problem (Moss et al., 2007). Additionally, people may be most sensitive to new information around the time when they reach an impasse on a problem (Moss et al., 2008).

In research on analogy, a distinction is often made between surface similarity and structural or deep similarity (e.g., Holyoak and Koh, 1987; Forbus et al.,