The Use of Pictorial Examples in Problem Solving: Fixation in a Design-Related Task

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Fixation in Problem Solving

The notion of fixation refers to an unhelpful reliance on the past during problem solving, when a new perspective is needed (e.g., Duncker, 1935/1945; Scheerer, 1963). Although the concept was introduced in psychology, fixation may occur in many other domains. Recent studies in the field of engineering design, for example, have suggested that presentation of pictorial examples with a to-be-solved problem may lead to fixation in design, even in cases where the example is specifically described as problematic (Jansson & Smith, 1991; Purcell & Gero, 1996; Purcell, Williams, Gero, & Colbron, 1993). The inherently cognitive nature of the design process makes these findings of potential significance to cognitive psychology.

The design-fixation studies suggest that fixation occurs when the physical characteristics of the example design overlap with the expertise of the designer. However, none of those studies examined fixation in a group of non-specialists. Fixation may affect equally designers and naive participants alike. This study examined whether fixation occurs when non-expert individuals are exposed to a laboratory design-problem-solving situation. Our aim was to investigate whether the inclusion of examples would negatively influence performance in a design problem-solving task. According to the example-expertise overlap hypothesis, introduced by Purcell et al. (1993), one would expect negligible fixation with naïve participants.

Method

Eighty-nine (N = 89) Temple University undergraduates (mean age 22.31 years) were randomly assigned to one of three conditions: (a) *Control* (standard instructions); (b) *Fixation* (inclusion of a problematic example, and description of its elements); (c) *De-Fixation* (inclusion of a problematic example plus instructions to avoid reproducing its problematic elements). We used two problems from Jansson and Smith (1991), the Bike-Rack and the Coffee-Cup. Participants were tested individually; each session was videotaped with subjects' consent. While solving the problems, participants were asked to (i) provide as many designs as possible and write short comments with each; and, (ii) think aloud. Participants were given specific instructions for verbalization (Perkins, 1981), and a training problem to familiarize them with the experimental task. The concurrent verbalization procedure has been established as a valid and reliable way to provide a comprehensive record of the participants' solutions, and it does not seem to interfere with the problem solving process (Eriksson & Simon, 1993).

Results and Discussion

We assessed fixation on five fixation measures adapted from Purcell et al. (1993): (a) Direct physical similarity between the design and example, (b) reproduction of elements of the design, (c) analogical similarity, (d) inclusion of flaws pointed out by experimenter, and (e) inclusion of other flaws discovered by participants. A contrast-based ANOVA revealed a significant fixation effect across the five measures for the Fixation condition compared to both the Control and De-Fixation conditions. Contrary to previous findings (Jansson & Smith, 1991), specific instructions to avoid using the example design (De-Fixation group) eliminated fixation. Results suggest that: (1) Fixation due to pictorial examples is a general phenomenon that occurs across individuals, and is not a result of expertise; (2) fixation can be diminished through instructions. The findings may have educational implications in various fields that employ examples in pictorial format (e.g., physics).

References

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