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ABSTRACT

This paper provides an overview of theory and research regarding problem construction and identification. Specifically, the paper reviews a theoretical model of processes associated with problem construction and empirical evidence in relation to the model. Finally, the paper reviews the literature on team problem construction.

Keywords:

creativity, cognition, groups, problem construction, problem identification.

One major approach to the study of creativity is the examination of cognitive processes involved in creative problem-solving and creative thinking. Most of the cognitive process models include problem construction and identification or an associated process (problem finding, formulation, definition, or problem discovery) as the first step (Mumford, Mobley, Reiter-Palmon, Uhlman, & Doares, 1991; Osborn, 1953; Runco & Chand, 1995; Wallas, 1926; Ward, Smith, & Finke, 1999). While specific definitions of each term vary somewhat, all have a common thread. All these terms denote a process by which a problem is identified by the problem solver, an ill-defined problem is structured, and the parameters of that problem are defined, in order to facilitate problem-solving. For clarity, in this article, the term problem identification and construction is used to refer to this process.

It is important to note that while problem finding is seen as the first step in creative problem-solving, followed by other processes such as information search, idea generation, and idea evaluation, the creative problem-solving process is not as fixed. Many process models assume a more cyclical nature where individuals may cycle back to earlier processes (Mumford et al., 1991).

MODEL OF PROBLEM CONSTRUCTION AND IDENTIFICATION

While most creative problem-solving models include problem identification and construction as the first process, there only a limited number of models of the problem identification and construction process itself. One such model has been suggested by Mumford, Reiter-Palmon, and Redmond (1994). This model starts with attention and perception. Individuals need to attend to and perceive a gap or a problem in the environment. It seems that when problems are well-defined, there is no such perception, and the process of problem finding either is bypassed or occurs quickly and automatically. This first step corresponds to what appears in theoretical models as one aspect of problem construction—problem anticipation or identifying opportunities in the environment. Attention and perception of environmental cues trigger problem representations. Problem representations are knowledge structures based on past problem-solving efforts and include four types of information (a)the goals and outcomes associated with the problem-solving effort, (b) information required to define and solve the problem, (c) procedures and operations performed on the information in order to solve the problem, and(d) constraints and restrictions on the problem-solving effort.

Problem representations are activated through environmental cues. If the problem representation has been associated with a specific cue in the past, it will be activated. More ill-defined problems and situations are likely to have more diverse and complex set of cues. In addition, ill-defined problems will likely have cues that are associated with multiple problem representations resulting in more problem representations being activated. As the problem or situation is more well-defined, structured, and less complex, it is more likely that a small number, or even one, problem representation will be activated. If the problem is identical or very similar to a problem solved in the past, the problem representation associated with that problem-solving effort will be activated. When only one problem representation is activated, it is likely that the problem solver quickly and automatically completes the problem finding process moving immediately to problem-solving. When multiple problem representations are activated, and a single problem representation cannot be used, the problem solver must find a way to create a new problem representation which includes a mix of the elements from the activated problem representations to guide problem-solving. This will likely result in a more creative way to define the problem, and therefore more creative solution.

EMPIRICAL FINDINGS

In a meta-analysis, Ma (2009) found that problem construction and identification had the largest effect size of all cognitive processes associated with creativity. As problem construction and identification provides the first step in the creative problem-solving effort, and likely provides the structure on which this effort proceeds, the finding that problem construction and identification has the strongest effect size is not surprising. Other research supports many of the tenets of the model suggested by Mumford et al. (1994). One important implication of this model is that problem construction will occur automatically in many cases. When problems are routine and similar in nature to previously solved problems, only one problem representation will be elicited. Active engagement in problem finding will occur only when the problem is different enough from past experiences or includes diverse information that elicits multiple problem representations. Much of the research on problem construction and identification suggests that active engagement in problem construction is indeed related to increased creativity and that creative individuals are more likely to engage in problem construction and identification (Csikszentmihalyi, 1990; Getzels & Csikszentmihalyi, 1975, 1976; Okuda, Runco, & Berger,1991; Reiter-Palmon, Mumford, & Threlfall, 1998; Rostan, 1994).

Other findings support additional aspects of the model. For example, Reiter-Palmon, Mumford, O'Connor Boes, and Runco (1997) found that inconsistent cues, that is, cues that were not consistent with the rest of the problem description resulted in more creative solutions to the problem. This finding provides support to the notion that attention is more likely to be paid, and problem construction will occur when the problem in not routine. Wigert and Reiter-Palmon (2017) have found that when participants were asked to diverge (generate as many restatements as you can) and then converge (select the most important restatements) during the problem construction process, they were more likely to generate creative solutions. This finding indicates that indeed the problem construction process, as suggested by the model, includes a convergent phase, an issue that has not been investigated. In fact, most studies where participants are instructed to restate the problem as a manipulation of problem construction focus on the divergent aspect of problem construction.

Lastly, Arreola and Reiter-Palmon (2016) evaluated whether the quality and originality of problem constructions generated were related to the creativity of the solution to that specific problem. Past research has either evaluated problem construction as a stable ability (Okuda et al., 1991; Smilansky, 1984; Reiter-Pal-mon et al., 1997) or whether engaging in problem construction was related to the creativity of the solution generated, without evaluating the problem restatements directly (Redmond, Mumford, & Teach, 1993). The direct relationship between the restatement generated and the solutions generated to the same problem have not been evaluated. Arreola and Reiter-Palmon found that indeed there was a direct relationship, and that quality and originality of the restatement was predictive of the creativity of the solution.

PROBLEM CONSTRUCTION IN TEAMS

In recent years, interest has emerged in how cognitive processes that influence creativity occur at the team level (Reiter-Palmon & Robinson, 2009). Reiter-Palmon, Herman, and Yammarino (2008) presented a multi-level model for creative problem-solving processes in teams, including the initial phase of problem identification and construction. Reiter-Palmon et al. suggested that as a result of different past experiences, knowledge, and educational background, as well as personality and values, individual team members are likely to have different problem representations, which would result in different ways of framing the same problem. These differences are likely to be more pronounced in diverse teams. Furthermore, individuals in teams will be less likely to be aware of these differences (Cronin & Weingart, 2007), leading to disagreements about the best solution.

Empirical research, however, is lagging, but a few studies have been conducted on problem construction and identification in teams. Weingart, Todorova, and Cronin (2010) found that interdisciplinary teams indeed had heterogeneous problem constructions across different team members, but these different perspectives on what the problem was led to greater product quality and innovation. This relationship, though, was contingent on teams discussing these differences, as manifested by task conflict and having effective conflict management. However, Weingart, Cronin, Houser, Cagan, and Vogel (2005) found that teams where members had different representations of the problem tended to have difficulty during the problem construction phase of the task, leading to poor cognitive integration as a team and less creative outputs. Work by Reiter-Palmon and colleagues has found, in one study (Reiter-Palmon et al., 2011), that teams that were instructed to actively engage in problem construction were less creative than teams that were not. However, in a second study (Reiter-Palmon, 2017), the opposite was found—teams that engaged in problem construction generated more original solutions than teams that did not engage in the process.

In a study of R&D teams, Leonardi (2011) found that people working from different departments on technology innovation differences in problem construction were found between departments in the goals identified, key problems, strategies to solve the problem, knowledge required, and criteria that a solution should meet, which then had an adverse effect on the innovation process. Furthermore, interviews revealed that people were largely unaware that other individuals were constructing the problem differently. In a related study, Gish and Clausen (2013) found that people working together from different departments were biased by their preexisting knowledge frames guiding the way they constructed the problem. Similar to what Leonardi (2011) found, this led to conflict and disagreements during idea generation because team members were unaware that they were constructing the problem differently and were unable to resolve team conflict.

Similar to the findings at the individual level, convergence during problem construction has been found to be important. McComb, Cagan, and Kotovsky (2014) using a sample of engineering student teams designing abridge according to several design constraints, provided various modifications to the initial problem restatements. These modifications added additional constraints, goals, and complexity to the initial problem. Designs were evaluated for their quality and originality at each modification to the overall design. The results showed that all teams tended to diverge in design characteristics during the initial problem construction period. How-ever, high-performing teams quickly began to converge on their design plan following the initial divergence, while low-performing teams had difficulty converging toward a single goal or problem construction, and there-fore struggled to develop a cohesive, high-quality design idea. As additional problem constructions were introduced, high-performing teams continued to improve their designs and produce better, more creative ideas. In teams where convergence on a single problem definition was not achieved during the initial phase, performance across design modifications continued to decline as more problem constructions were introduced.

CONCLUSIONS

In the last 20 years, research on problem construction and identification at the individual and team level has increased. Research findings provide support for the models proposed by Mumford et al. (1994) and Reiter-Palmon et al. (2008), however, much more research is needed to provide a more nuanced and detailed understanding of the factors that influence problem construction and identification effectiveness, ways to improve the process, and a more nuanced understanding of how the process influences creativity. For example, at the individual level, we have a very limited understanding of the types of specific ways in which problems are constructed and restated and how these directly influence creativity. Arreola and Reiter-Palmon (2016) provided a first step, but more is needed. Specifically, does the specific content of there statement matter? Is eliciting contradictory restatements result in more creative solutions? How do teams reconcile different and contradictory problem constructions?

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