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Problem identification and construction: What do we know, what is the future?

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Abstract

Many cognitive process theories of creativity include an initial process of problem identification, definition, and construction. Previous research suggests that problem identification and construction is related to creativity, and that creative individuals and experts tend to engage in problem identification and construction. Finally, previous research suggests that inducing active engagement in problem identification and construction, through instructions or training, facilitates creativity. In this paper we further offer our views regarding important future direction for researchers in this area. Specifically, issues regarding methodology, the relationship between personality and values and how problems are constructed, and problem identification and construction in teams are suggested as important avenues for future research.

Key Words: Creativity, Problem construction, Problem identification, Cognitive processes

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Starting with the work of Guilford (1950), creativity researchers have been interested in understanding the cognitive processes that influence creative production. Over the years, many cognitive processes models of creativity have been suggested (Amabile, 1988; Basadur, 1995; Mumford, Mobley, Uhlman, Reiter-Palmon, & Doares, 1991; Osborn, 1953; Runco & Chand, 1995; Wallas, 1926; Ward, Smith, & Finke, 1999). While these models do not completely overlap in terms of the specific cognitive processes that are identified, all models include as a first step a process in which a problem is recognized, identified, and constructed. Various terms have been used to identify this first stage, including problem definition, problem identification, problem recognition, and problem construction. However, all of these different terms refer to the process in which a problem is identified by the problem solver, an ill-defined problem is structured, and the parameters of that problem are defined. For clarity, we will use the term problem identification and construction to refer to this process.

While early theoretical approaches of creativity have included problem identification and construction (Osborn, 1953; Wallas, 1926), empirical work was lacking. The seminal study by Getzels and Csikszentmihályi (1975, 1976) on art students marks the beginning of empirical work on problem identification and construction. In this study, art students were asked to create a still life painting. Several measures of problem identification and construction were used, including the uniqueness of the objects selected for the final painting, how the objects were handled, and the time it took to select the objects and create the still life scene to be painted. These measures were strongly related to the originality and aesthetic evaluation of the painting. Moreover, these behavioral measures of problem identification and construction were also

related to long term success as an artist measured seven and 18 years later (Csikszentmihályi, 1990).

However, even after the publication of this work, research on problem identification and construction lagged. Only in the 1990s have we seen a substantial increase in the empirical study of problem identification and construction. In addition, an edited book on the topic was published (Runco, 1994). Additional theoretical work has lead to the development of a model of problem identification and construction (Mumford, Reiter-Palmon, & Redmond, 1994). This model provided a starting point for understanding the factors that influence problem identification and construction. Based on the cognitive literature, Mumford et al. suggested that problem identification and construction is based on past experiences. Based on these past experiences, individuals develop problem representations, or cognitive structures reflecting the problem solving effort (Holyoak, 1984). Problem representations include information on the goals of the problem solving effort, the information and procedure used, and any constraints and restrictions placed on the solution. When encountering novel problems, multiple problem representations may be activated and incorporated into a new way of constructing the problem.

This model provided a framework for later research on problem identification and construction. The purpose of this paper is to review the state of the current research on problem identification and construction, and to identify future trends and important research questions.

State of Current Research – What Do We Know?

Much of the early research has focused on the identifying and measuring problem identification and construction ability as a stable trait. For example, Smilansky (1984) evaluated both problem identification and construction and problem solving using Raven Matrices, and found stable individual differences in problem construction above and beyond intelligence. Other

research has focused on the differences in problem identification and construction between more creative and less creative individuals or experts and novices. In her study of artists and scientists, Rostan (1994) found that critically acclaimed artists and scientists devoted more time to problem identification and construction as compared to professionally competent artists and scientists. Similarly, Voss, Wolfe, Lawrence, and Engle (1991) compared experts in political science to novices solving a political science problem, and noted that experts devoted more time to defining and constructing the problem.

Other research has focused on the link between creativity and problem identification and construction as a stable characteristic in various samples, including children and university students. Artley, Van Horn, Friedrich, and Carroll (1980) found that fluency in problem finding was correlated with fluency in verbal divergent thinking tests in a sample of college students. Okuda, Runco, and Berger (1991) evaluated problem finding, creative problem solving for real-world problems, and standard divergent thinking tests as predictors of participation in creative activities in children. They found that problem finding was the best predictor of creative accomplishments and added significantly above and beyond the real-world creative problem solving and divergent thinking tasks. Reiter-Palmon and her colleagues (Reiter-Palmon, Mumford, O'Connor Boes, & Runco, 1997; Reiter-Palmon, Mumford, & Threlfall, 1998) have found that problem construction ability was correlated with both quality and originality of solutions to a variety of real-world problems. Mumford, Supinski, Baughman, Costanza, and Threlfall (1997) found that problem identification and construction ability was predictive of solution quality and originality across two different kinds of real-world problems. More importantly, problem identification and construction was an important predictor even when other

creative processes (i.e., idea generation) and basic abilities (i.e., intelligence) were taken into account.

The research presented above supports the link between creativity and problem identification and construction. More creative individuals engage in problem identification and construction. In general samples, higher creativity is linked to higher problem construction ability. However, the model suggested by Mumford et al. (1994) indicates that problem identification and construction typically occurs in an automatic fashion. Because problem identification and construction has such an important effect on creativity, it is not surprising that research has focused on how to influence engagement in this process and the factors that influence effective application of this process.

Research on problem identification and construction suggests that inducing active engagement in the process results in increased creativity compared to those participants that were not instructed to do so (Mumford et al., 1994; Reiter-Palmon et al., 1997). In these studies, active engagement in problem identification and construction was manipulated through instructions to participants. Specifically, participants in the active engagement manipulation were asked to restate the problem in multiple ways prior to solving the problem (Baer, 1988).

The importance of active engagement is further supported by research on the effects of training in problem identification and construction on creativity. Research on training of problem identification and construction, not surprisingly, finds an effect for this specific process for both children and adults (Fontenot, 1993; Kay, 1991). More importantly, training in problem identification and construction was related to improved creative problem solving (Basadur, Graen, & Green, 1982; Ellspermann, Evans, & Basadur, 2007). Finally, Scott, Leritz, and Mumford (2004) conducted a meta-analysis on creativity training and its relation to creativity

outcomes, and found that a focus on problem identification and construction was related to improved training outcomes and creative performance across multiple studies.

Future of Problem Identification and Construction

One of the most difficult issues in the study of problem identification and construction is that the process is generally automatic and the outcome invisible (Mumford et al., 1994). Evaluating problem identification and construction or its outcome (how the problem is constructed) directly is possible only if participants are asked to define and construct the problem prior to solving it. Therefore**,** it is very difficult to measure problem construction without manipulating it at the same time. Without asking participants to provide information on how they define and construct the problem, it is not possible to evaluate problem construction, at least for that problem solving activity. However, just asking participants to do so creates conditions for active engagement in problem identification and construction, which will likely have a direct effect on creative problem solving (Mumford et al., 1994; Reiter-Palmon et al., 1997).

The issue of measurement of problem identification and construction is an important one that must be addressed in order to advance research in this area. A typical method for determining problem identification and construction ability in general or for a specific problem presented is to use a variation of Baer's (1988) method, which asks participants to generate as many problem restatements as possible, starting with "*how can I* or *how can we*". While this sort of manipulation allows researchers to determine the quality, originality, and fluency of the problem construction, it is limiting in a number of ways. First, this sort of manipulation, as suggested, creates active engagement which in turn has an effect on the resulting creativity of the solution. Secondly, this type of manipulation focuses attention of the problem solvers to goals at

the expense of the other elements of the problem representation, such as restrictions, procedures, or information needed.

The focus on goals may lead to unintended consequences. Mumford, Baughman, Threlfall, Supinski, and Costanza (1996) evaluated the effect of selecting from the four different elements of the problem representation during problem identification and construction on the creativity of the resulting solution. Participants were asked to solve two problems, and prior to solving the problem, they were asked to select from among 16 restatements of the problem that represented high quality or high originality statements in terms of the goals, information needed to solve the problem, procedures, and restrictions. The results of the study suggest that goals were not predictive of solution quality or originality. Rather, focus on high quality restrictions and procedures seemed to be more important for solution quality and originality.

However, work by Herman (2008) suggests that a focus on constraints and restrictions may be detrimental to creativity. In her study, participants were either asked to generate problem restatements by focusing on both goals and restrictions prior to solving a problem or to proceed directly to problem solving. It was found that those that generated goals and restrictions produced less original ideas than those that did not. Given that previous studies found strong effects for active engagement in problem identification and construction through the generation of goals on creativity (Redmond, Mumford, & Teach, 1993; Reiter-Palmon et al., 1997, 1998), the results seem to indicate that the generation of restrictions may be the reason for the finding of lower originality. These contradictory results may be explained by the different methodology used. While Mumford et al. (1996) asked participants to select the best problem restatements from a given list, Herman asked participants to generate goals and restrictions.

The previous discussion highlights two important issues for future research. The first issue is the importance of the methodology used to elicit problem restatements, or to make the outcome of the problem identification and construction process observable. Future research should identify and evaluate alternatives for obtaining problem restatements. Further, future research should identify ways to elicit problem restatements without triggering active engagement in problem identification and construction. Finally, previous research has typically used the generation of problem restatements, but the study by Mumford et al. (1996) used selection. Future research should determine whether the specific methodology may influence the outcome for both the problem identification and construction process and the entire creative problem solving process.

A second important issue for future research is the study of the different effects that different elements of the problem restatement may have on later problem solving efforts (e.g., goals vs. constraints). Much of the previous work has focused on goals, but the limited work on other elements suggests some intriguing possibilities that need to be investigated. Research is needed to determine whether a focus on restrictions limits or increases originality, and whether the mixed findings reported regarding constraints result from methodological differences (e.g., selection vs. generation). Additionally, research should evaluate whether there are other mediating variables such as the quality of the restrictions. Finally, it is possible that attention to different combinations of elements of the problem representation may result in different outcomes. Herman (2008) evaluated goals and restrictions, however, other possible combinations exists, and we do not know the effect of specific combinations directly on problem identification and construction and on the creativity of the solution generated.

Another important issue is the effect of personality and values on problem identification and construction. A few studies have looked into this relationship and found that personality variables traditionally found to be related to creativity in general, such as tolerance for ambiguity, flexibility, and openness, are also related to the creativity of problem identification and construction (Mumford, Costanza, Threlfall, Baughman, & Reiter-Palmon, 1993). Further, problem identification and construction was found to relate to adaptive coping (Carson & Runco, 1999). Finally, problem identification and construction ability was found to predict how well a solution to an ill-defined, real-world problem fit the personality of participants. Individuals with high problem identification and construction ability were more likely to generate solutions with better fit to their personality (Reiter-Palmon et al., 1998). These results suggest that individuals who have higher problem construction ability are able to generate a problem restatement that fits their personality, goals, and values.

The relationship found between personality and problem identification and construction leads to an important issue that has not been addressed empirically. Theoretical models of problem identification and construction stress the importance of prior problem solving experiences as well as other individual difference variables in determining how problems are constructed, what goals will be viewed as important, and what information will receive attention (Cronin & Weingart, 2007; Mumford et al., 1994). It is therefore expected that personality and values would have an important effect on how the problem is framed. However, to date, only one study has actually examined the direct relationship between the content of problem restatements and personality or values. Illies and Reiter-Palmon (2008) conducted a study on leader ethical decision making and values. In this study, half the participants were asked to generate problem restatements prior to solving an ethical dilemma. Those problem restatements were then coded to

the degree to which they reflected self-enhancement or self transcendence values, the same values that were measured for each participant. The results indicated that participants tended to construct the problem in a way that fit their value system. However, additional research is still needed to provide support for this notion and additional personality and value constructs should be investigated. For example, the personality variable of regulatory focus seems to be a good candidate for a personality variable that can have a direct effect on how problems are identified and constructed.

Regulatory focus theory states that behavior can be described as having promotion focus and prevention focus. Self-regulation with a promotion focus is related to advancement, growth, and accomplishment; promotion focus is about ideal states, hope, insuring against errors of omission, and an approach strategy (Higgins, 1998; 2000). Self-regulation with a prevention focus is related to protection, safety, responsibility, and security; prevention focus is about oughts, inhibiting errors of commission, and an avoidance strategy (Higgins, 1998, 2000). As such, individuals with a promotion regulatory focus may view a situation as a challenge whereas individuals with a prevention focus may view the same situation as a threat, leading to very different ways to construct the problem. Future research should address this and other questions relating to how individual differences influence the content of problem restatements, and what effect this may have on the creativity of the solution.

A final important issue for future research is that of creative problem solving in teams, and specifically understanding how problem identification and construction occurs at the team level. While we have some understanding of how problem identification and construction occurs at the individual level, and the factors that influence it, we have a much more limited understanding of problem identification and construction in teams. 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. suggest that as a result of different past experiences, knowledge and educational background, as well as personality and values, individual team members are likely to frame the problem differently. These differences are likely to be more pronounced in diverse teams. Further, individuals in teams will be less likely to be aware that other individuals are framing the problem in a different way (Cronin & Weingart, 2007), leading to disagreements about the best solution. While this model provides some suggestions for possible relationships between team diversity and problem identification and construction, there is no empirical research in this area.

Teams may address the presence of multiple perspectives and therefore multiple problem constructions in different ways, for example, ignoring the differences and focusing on similarities, selecting the majority view, or integrating the diverse problem constructions in a unique new way to view the problem. Future research should determine the factors that would lead to specific ways of addressing the diversity of problem constructions. Further, future research should evaluate the relationship between these various approaches to solution creativity.

This latter issue also points to another important consideration. What is the role of leaders in problem identification and construction by the team? Leadership research emphasizes the role of leaders in creating and communicating a vision (Bass, 1990; Strange & Mumford, 2002). This vision may in fact provide guidance as to the acceptable way in which view a problem or integrate diverse problem constructions. Future research should evaluate the role the leader plays in the development of a team problem construction.

Conclusions

This paper addresses an area that has received limited attention in creativity research. Problem identification and construction is viewed as an important cognitive process with important implications for creativity. This paper reviews the existing research on problem identification and construction and then suggests some avenues for future research. Specifically, issues relating to methodology, the role of personality and values, and team problem identification and construction have been suggested as important research opportunities.

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