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Mackenzie Harms
University of Nebraska at Omaha, mharms@unomaha.edu

Roni Reiter-Palmon
University of Nebraska at Omaha, rreiter-palmon@unomaha.edu

Douglas C. Derrick
University of Nebraska at Omaha, dcderrick@unomaha.edu

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The Role of Information Search in Creative Problem Solving

Mackenzie Harms, Roni Reiter-Palmon, and Douglas C. Derrick

University of Nebraska at Omaha

This study investigates the role that information search behavior plays in the process of creative problem solving. Although models of creative processing posit that information search is a necessary stage of creative problem solving, no research has separated and measured information search from earlier processes to determine the nature of the role it plays in the creative problem-solving process. Two hundred twenty-one people participated in a study where active engagement in problem construction was manipulated. Participants were allowed to search for additional information that may facilitate the generation of a creative solution. Measures of information search that have been shown to influence performance on decision-making tasks were captured. The results indicated that the length of time spent searching, the quantity of information viewed, and the breadth of information search mediate the relationship between problem construction engagement and creativity across categories. Furthermore, the relationship between the efficiency of information search and creativity depends upon problem construction engagement. For people who engaged in problem construction, the more efficiently they searched for information, the more creative their solution. The efficiency of information search had no impact on creativity for people who did not engage in information search. The implications of these findings as they relate to the overall field of creative problem-solving are discussed.

Keywords:

cognition, creativity, information search, problem construction, problem-solving

Individuals, teams, and organizations are often required to think creatively to solve complex problems that they face in their daily life. Many of these problems are ill-defined, which means they lack structure and have many possible solutions. Therefore, problem solvers often need to apply structure to the problem to develop an effective solution. This process is initiated by using existing knowledge and prior experiences with similar problems to reduce ambiguity and develop goals that an adequate solution must meet—a process known as problem construction (Reiter-Palmon, Mumford, Boes, & Runco, 1997).

Developing a solution to a problem is an information-rich process, involving the need to search for, integrate, and apply information from internal and external sources to produce an idea that is both original and appropriate (Guilford, 1950; Mumford, Baughman, Supinski, & Maher, 1996). The information available often exceeds what is practical or necessary to generate a creative solution, and identifying relevant information may be difficult due to the ambiguity in ill-defined problems. Therefore, effectively searching for information is critical to solving problems. Despite the criticality of this process, the problem-solving literature currently lacks an understanding of the unique contribution information search makes to the overall process of creativity.

In this research, we studied the role of information search as an intermediary process in creative problem-solving, using theories grounded in the robust body of work exploring creative cognition, as well as from the decision-making literature. Creative cognition— referring to the cognitive processes that contribute to the generation of a creative product—is critical to problem-solving because it explains both how idea generation occurs, as well as potential biases that may hinder creativity (Finke, Ward, & Smith, 1992; Mumford, Mobley, Uhlman, Reiter-Palmon, & Doares, 1991). Despite the work that has been accomplished in this domain, much of what is currently known about the role of information search in the creative cognition process is theoretical. However, information search has received substantial empirical support in the decision-making literature exploring welldefined problems—those problems with a concrete number of possible solutions.

Though decision-making employs many of the same processes as creative problem-solving, the nature and application of those processes for an effective outcome is quite different in well-defined problems compared with ill-defined problems (Jonassen, 1997, 2003; Schraw, Dunkle, & Bendixen, 1995). Therefore, we drew from the decision-making literature to identify information search processes that tend to contribute to performance on well-defined problems, and applied those same processes to performance on ill-defined problems. We propose that information search processes are both the mechanism through which problem construction influences creativity, as well as a potential boundary condition for when this relationship holds. We begin with a more thorough explanation of this hypothesis by reviewing relevant literature, then we outline the results of a study designed to explore this theory.

Problem Construction

Problem construction is a cognitive process that contributes to performance on ill-defined problems, and is studied as a component of the larger field of creative cognition. Creative cognition is an analytic-process based approach to understanding creativity, and is particularly useful as a means of explaining creative problem solving (Bink & Marsh, 2000; Newell, Shaw, & Simon, 1962). We define creativity in the context of problem-solving as the processes that facilitate the generation of a solution that is both novel and appropriate (Amabile, 1983; Guilford, 1950). Although problem solving may apply to a variety of problem types, creative problem solving focuses specifically on problems that are illdefined and ambiguous (Anderson, 1983; Mumford, Whetzel, & Reiter-Palmon, 1997).

Well-defined or convergent problems are highly structured, have few or only one possible solution, and have limited pathways to solve, such as a math problem, a binary decision, or a story problem to test learning goals in a textbook (Jonassen, 2003). These problems require convergent thinking skills to solve, by eliminating pathways that detract from the correct solution. Conversely, ill-defined problems, such as reducing employee turnover or resolving a conflict with a coworker, have many possible solutions that may be effective, and nearly infinite possible pathways to get to a solution. Because ill-defined problems are more complex and engage higher-levels of cognitive processing than do well-defined problems, they tend to require creative thinking to solve (Jonassen, 1997; Kitchner, 1983; Simon, 1973).

Indeed, research has suggested that performance on well-defined problem-solving tasks is independent of performance on ill-defined problem-solving tasks (Schraw et al., 1995). Solving ill-defined problems requires the problem-solver to apply structure to the problem in early stages, to guide later stages of the process (Butler & Scherer, 1997; Schraw et al., 1995). The process of employing existing knowledge structures to reduce ambiguity and guide idea generation is commonly referred to as problem construction, and is critical to creativity (Reiter-Palmon et al., 1997; Simon & Newell, 1971). Problem construction is widely held as the initiating process of creative cognition because it allows people to reconstruct problems according to their specific interpretations, reduces ambiguity, and provides structure and direction for subsequent cognitive processes (Csikszentmihalyi & Getzels, 1988; Mumford et al., 1991; Reiter-Palmon et al., 1997). To reduce ambiguity in an ill-defined problem, problem solvers must develop a goal state (i.e., solving the problem) by defining the problem and generating a series of discretionary actions that will achieve their goal (Anderson, 2000). This goal-directed process is guided by the integration of past experiences and existing knowledge to offer novel perspectives that may lead to more creative solutions (Dillon, 1982; Getzels, 1975; Pretz, Naples, & Sternberg, 2003).

Though research has suggested some people are naturally better at problem construction than others (e.g., Getzels & Csikszentmihalyi, 1976; Okuda, Runco, & Berger, 1991; Reiter-Palmon, Mumford, & Threlfall, 1998), initiating active engagement in problem construction has been shown to influence creativity by stimulating multiple problem frameworks (Redmond, Mumford, & Teach, 1993; Reiter-Palmon et al., 1997). These frameworks are known as problem representations, and are used to create structure for information presented in the problem (Holyoak, 1984; Mumford, Reiter-Palmon, & Redmond, 1994; Pretz et al., 2003; Sternberg, 1988). In practice, problem construction as a process is typically initiated by instructing problem-solvers to restate the problem in as many ways as they can think of in a short amount of time. When comparing those who are instructed to engage in this process with those who are not instructed to engage in it, research shows that initiating the process leads to more creative solutions, above and beyond individual differences in problem construction ability (e.g., Reiter-Palmon et al., 1997). Furthermore, the impact of problem constructions on creativity has been shown to be influenced by other factors, such as the creativity of problem restatements (Arreola & Reiter-Palmon, 2016) and the presence of constraints (Medeiros, Steele, Watts, & Mumford, 2017), Accordingly, we propose the following hypothesis:

> *Hypothesis 1:* Creativity will be higher for those who actively engage in problem construction than for those who do not actively engage in problem construction.

Information Search

Most models of creative cognition highlight the importance of not only problem construction, but also of information in the development of a creative idea (e.g., Mumford et al., 1991). Information search is the necessary step that occurs following problem construction, regardless of active engagement. Say an individual was faced with the following every day, ill-defined problem: "I'm having trouble with my roommate." Problem construction involves creating frameworks for the problem to identify possible solutions. The individual may consider whether there is a way to resolve things with the roommate or whether it is possible to move out. These frameworks likely require additional information to start developing possible solutions. For instance, the individual may need to know whether they are currently in a lease, and what options are there for breaking leases in this apartment. The individual may need to consider what the source of the conflict is, and whether there are ways of cohabiting that reduce the conflict. In addition, the individual may need to consider what their current financial options are, and the cost of alternate living situations.

As this example suggests, creative problem-solving is an information-intensive process, involving the ability to integrate diverse information from both internal and external sources. This type of information seeking reflects an individual-guided search, and a person's ability to solve a problem is related to the mental framework or problem representation guiding their search (Saad & Russo, 1996). Despite this theoretical connection, most creative problem-solving research measures information search as a component of problem construction, rather than a separate process. However, in real-world problem-solving scenarios, these processes are more likely to occur in tandem, as the individual develops a framework for the problem that initiates the search for additional information to generate a novel solution.

Although a great deal of theoretical work has been done to explain the role of information search in creative cognition (Amabile, 1996), most of what is currently known about information search has been demonstrated only on well-defined problems. Research exploring information search during a decision-making task typically assesses information search according to several indices: length of information search, quantity of information searched, and strategy of information search. Within these indices, constructs such as the breadth of information search and efficiency of information search are also considered to influence performance. The efficiency of information search is particularly important, given that the amount of information available often exceeds what any individual needs to generate a solution, and the cognitive costs associated with information search have implications for the outcome of the process (Barrick & Spilker, 2003; Blay, Kadous, & Sawers, 2012). The following sections briefly outline indices of information search that are expected to influence creativity.

Length and Quantity of Information Search

Length of information search is typically measured from the onset of the task to the moment a decision is made, commonly referred to as the termination point or stopping point (Browne & Pitts, 2004). The length of information search may be determined by the task, where problem solvers are given either a fixed amount of time or a fixed amount of information. However, in many search models, individuals determine the length of information search, and the termination point is typically a function of the quantity and depth of information attributes reviewed (Davelaar, Yu, Harbison, Hussey, & Dougherty, 2012; Harbison, Dougherty, Davelaar, & Fayyad, 2009). Researchers have proposed various models to explain individual differences in the decision to terminate an information search. Early models, referred to as fixed sampling theories, hypothesized that the length of time an individual would engage in information search is relatively stable, an assumption which does not account for individual fluctuations in length of search (Petrusic & Jamieson, 1978; Robles, Roberts, & Sanabria, 2011).

Later models attempted to address these concerns by integrating other facets of information search that may contribute to differences in the length of time spent searching prior to termination. Sequential sampling models, for instance, posit that individuals are sensitive to the attributes of the information they are searching, and terminate information search according to the degree of discrepancy an information attribute provides between alternatives (Aschenbrenner, Albert, & Schmalhofer, 1984; Busemeyer & Rapoport, 1988). In sequential sampling models, individuals evaluate the subjective differences between alternative solutions based on each additional piece of information reviewed. Once enough cumulative support is gathered such that a problem-specific threshold is crossed, information search is terminated (Bockenholt, Albert, Aschenbrenner, & Schmalhofer, 1991). As more information is reviewed, several possible alternatives converge. Assuming the point of convergence marks the implied threshold where one alternative surpasses the others, the length of information search decreases as highly relevant information is reviewed. Thus, the length of information search is often a function of the relative importance and the degree of discrepancy a piece of information holds in a given problem.

These models suggest that the length of time spent searching is related to the quantity of information searched prior to termination. Asking individuals to actively engage in information search experimentally allows researchers to quantify the amount of information viewed prior to solution generation. Although the quantity of information search refers to the actual number of pieces of information measured, research has indicated that, similar to the length of information search, it is often a function of the subjective weight or importance of information searched. Models such as the determinant attributes model (Myers & Alpert, 1968) and the core attributes heuristic (Saad & Russo, 1996) posit that individuals will continue to search until several highly important attributes are available, or a criterion-dependent threshold is crossed. According to this theory, a threshold could be met by searching either a large quantity of less relevant information or a small quantity of highly relevant information. In sequential sampling models, the quantity of information searched is therefore a function of the given attributes, their relative importance, and the order in which they are presented.

Sequential sampling models have been criticized for biasing participants toward the full breadth of possible attributes prior to the search task by asking them to rate all possible attributes first, but not allowing them to select which attributes to view during the task (Bearden & Connolly, 2007; Brownstein, 2003; Fischer, Jonas, Frey, & Schulz-Hardt, 2005). In response to these criticisms, some researchers have used simultaneous search methodologies, presenting participants with several dimensions of information concurrently during the search phase and asking participants to choose which attributes they would like to review (Billings & Scherer, 1988; Schulz-Hardt, Frey, Lüthgens, & Moscovici, 2000). Research has shown that presenting information to participants prior to a sequential information search task results in a stronger bias toward decision-supporting information than does presenting information in a standard simultaneous information search design (Jonas, Schulz-Hardt, Frey, & Thelen, 2001). The reduction in bias means that simultaneous methodologies yield more realistic measures of search behavior than do sequential search methodologies.

Breadth and Efficiency of Information Search

One benefit of simultaneous search methodologies is that they require participants to develop a strategy for searching for information that provides enough breadth of knowledge while not exhausting valuable resources. If participants had unlimited time and resources to complete problem-solving tasks, they could search all available information. However, this is not a realistic or efficient manner to solve problems. Research exploring how people search through large data sets of information has suggested that information arranged categorically leads to more efficient search behaviors than either alphabetical or random arrangements (McDonald, Stone, & Liebelt, 1983), but only when the problemsolvers have some domain-expertise that activates mental frameworks organizing the information in a similar categorical representation (Hollands & Merikle, 1987). This would suggest that differences across individuals contribute to their search patterns, search breadth, and strategies. By nature, several possible paths to a solution exist in any ill-defined problem (Hogarth, 1980); therefore problem-solvers must select the path that offers the best solution given the task constraints. Process-tracing research examines these pathways to determine the order in which information is selected and reviewed during information search, and how the efficiency of the chosen pattern relates to task performance.

One method of process-tracing research involves cost– benefit tasks. Cost–benefit information search tasks are those in which some type of monetary or temporal cost is applied to each item of information viewed during the search, and the participants are asked to evaluate the perceived benefit of selecting that item in relation to the associated cost. The efficiency of information search refers to the proportion of relevant information selected, relative to the total amount of information selected (Blay et al., 2012). An efficient search is one that maximizes the search for relevant information within a given search constraint. Research has shown that participants in cost– benefit tasks tend to select strategies that minimize effort while maximizing efficiency and accuracy (Gilliland, Schmitt, & Wood, 1993). Typically, these strategies adhere to theory known as elimination by aspects (Isen & Means, 1983; Tversky, 1972). Elimination by aspects is a heuristic in which problem solvers eliminate all alternatives at each stage of the idea selection process that do not meet the criteria of a specific attribute, and continue searching for information using only the remaining alternatives (Isen & Shakler, 1982). Individuals employing a search strategy utilizing elimination by aspects focus on the information in a single dimension they consider highly important and eliminate alternatives that do not meet their criteria for relevant information (Payne, Bettman, & Johnson, 1988). These types of patterns tend to narrow the search too early in the process, leading to less breadth of information and biases later in the task (Billings & Scherer, 1988; Gilliland et al., 1993). For instance, individuals using convergent search strategies such as elimination by aspect tend to terminate search earlier, and view less relevant information (Gilliland & Landis, 1992). Consequently, efficiency and quality are not necessarily related during information search tasks.

Biases in information search tend to arise when individuals fail to search for sufficient breadth of information across several problem-relevant categories. Although this tendency may be less problematic in well-defined problems where converging on a relevant category may lead to the correct solution, it is likely to be an ineffective strategy in ill-defined problems. Cognitive capacity limits and cognitive fixation have been shown to lead to error during information search because they result in inefficient search strategies (Mumford, Blair, Dailey, Leritz, & Osburn, 2006). For instance, individuals operating with limited available cognitive capacity may not search information that is highly relevant to the problem. This may cause distraction, which further hinders the quality and originality of solutions generated. The more expertise people have, the less they will be affected by cognitive capacity (Ericsson & Charness, 1994). Experts tend to exhibit a slower, more controlled deliberation during information search, causing them to search more relevant information and generate higher quality and more original ideas (Moxley, Ericsson, Charness, & Krampe, 2012). Experts also tend to spend more time identifying and defining problems prior to information search, leading to higher efficiency (Selnes & Troye, 1989). Thus, this research supports the notions problem construction is likely to influence information search behavior, and we propose the following hypotheses:

> *Hypothesis 2a:* Active engagement in problem construction will lead to a longer information search process.

Hypothesis 2b: Active engagement in problem construction will lead to a higher quantity of information searched.

Hypothesis 2c: Active engagement in problem construction will lead to a greater breadth of information searched.

Creative Problem-Solving

The cognitive process model developed by Mumford et al. (1991) outlines stages of creative processing that work sequentially to facilitate or hinder creativity. Mumford et al. (1997) advocate for research that separates and examines these processes to determine whether they operate in the manner they're hypothesized to through models of creative cognition. One way of accomplishing this is by manipulating the process of interest and comparing creative performance between groups. Another way of accomplishing this is by instructing participants to complete a problem-solving task in such a way that engagement in each process of interest is separate and measurable. Given the theoretical link between problem construction and information search, and the existing link between problem construction and creativity, we propose examining both problem construction and information search in the same task to better understand the role information search plays.

Although information search during creative problem solving is relatively under researched, several studies have indicated preliminary evidence that the quality of information search influences creative performance (e.g., Illies & Reiter-Palmon, 2004; Mumford et al., 1996). However, the exact nature of the relationship between information search and creativity, as well as factors that influence it, is yet undetermined. Mumford et al. (2006) suggest that active engagement in all processes necessary for creative thought requires substantial attentional support. Consequently, researchers have theorized that the effectiveness of early processes influences the problem solver's ability to effectively engage in later stage processes, facilitating creativity (Estes & Ward, 2002; Mumford et al., 2006). In this research, we propose that problem construction's influence on creativity may be explained via the quality of information search engaged in. The relationships between length, quantity, and breadth of information search illustrated in decision-making research suggest that these indices will likely be positively related to creativity, given that they reflect a high-quality search, particularly in ill-defined problems. Accordingly, we propose the following hypotheses:

Hypothesis 3: The length of information search will mediate relationship between problem construction and creativity.

Hypothesis 4: The quantity of information searched will mediate the relationship between problem construction and creativity.

Hypothesis 5: The breadth of information search will mediate the relationship between problem construction and creativity.

Given that the efficiency of information search is not necessarily correlated with other indices of information search (Blay et al., 2012), it is less clear how search efficiency will interact with problem construction as it relates to creativity. In accordance with the decision-making literature, we define an efficient information search as one that includes a higher proportion of relevant information compared with the total quantity of information searched. In previous research, more efficient information searches tend to lead to higher quality decisions (Chinander & Schweitzer, 2004). However, this study differs from decision-making research in that we examined a range of information relevance, as opposed to dichotomizing relevant and irrelevant information. Previous research has suggested that the quality of problem representations may influence the efficiency of information search because faulty problem representations introduce bias into the search process (Selnes & Troye, 1989). Therefore, we expect that the efficiency of information search may operate differently in relation to problem construction engagement than other indices of a quality information search. Given how little is known about the efficiency of information search, we propose the following exploratory hypothesis:

Hypothesis 6: The relationship between information search efficiency and creativity will interact with problem construction engagement to predict creativity.

Figure 1 shows the proposed research model summarizing all six hypotheses.

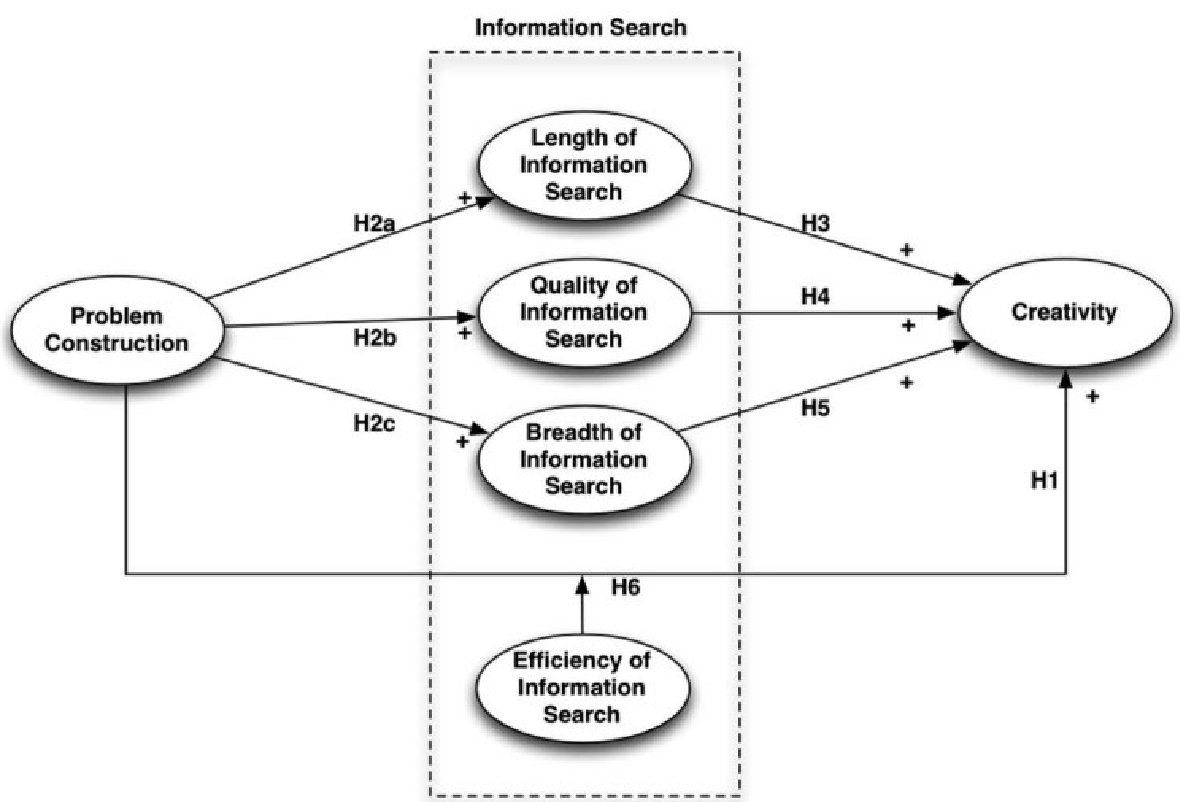

Figure 1. Graphic representation of the hypothesized research model.

Method

Participants and Design

Two hundred twenty-five students at a Midwestern university participated in this study (M = 21.62 years old, SD = 3.71, 54.6% female). Students received extra credit or equivalent course credit in one of their classes in exchange for their participation. The sample was predominantly white (70.5%), and varied in terms of year in school (freshman = 24.5%, sophomore = 22.8%, junior = 21.5%, senior = 21.9%, other = 4.2%). The study employed a two-cell, between-subjects randomized experimental design (problem construction or no-problem construction), and took approximately one hour to complete. The information search task was designed as a simultaneous search model, in which all information was available and the participant determined his or her search pattern.

Development of the Stimulus Materials

To measure information search in a controlled setting, a computer program was developed that would track information search behavior during a problem-solving task. The materials for the search program were developed through a series of three pilot studies. The problem was designed to be ambiguous, complex, and hypothetical, and to reflect a realistic scenario that an undergraduate might experience. The selected problem (referred to as “Andrea’s Problem”) was rated as both the most engaging and realistic, and also the most difficult to solve by a sample of 55 pilot study participants. Andrea’s Problem refers to an undergraduate student who is juggling competing personal, academic, and social demands while trying to complete a class project. The information for the search task was developed by asking participants in the second and third pilot studies what additional information they would need or be interested to know to solve the problem.

A panel of three trained raters identified problem-relevant categories (e.g., Andrea’s Class Project, Andrea’s Social Life), developed the information generated through the pilot study, and sorted the information into the categories. Next, a panel of 15 trained raters independently reviewed all information generated and rated how relevant or useful the information was to the problem on a 5-point Likert-type scale ranging from 1 (*irrelevant*) to 5 (*highly relevant*) using a modified version of the consensual assessment technique (Amabile, 1996). An example of an item of information rated as relevant would be “Is there another class or activity or project that would increase Andrea’s chances in getting the grant?” An example of an irrelevant item of information would be “What does Andrea do for fun?” Agreement was calculated using within-group variance (r_{wg}; James, Demaree, & Wolf, 1984) and intraclass correlations (ICCs; Shrout & Fleiss, 1979). Results revealed strong agreement across raters (r_{wg} = .80, ICC = .88). The information was reduced to reflect a range of relevant and irrelevant information within each of the nine categories, and then entered into the search program. The program was designed to allow the participant to guide his or her own search behavior and to record information search behavior throughout the task.

Procedure

Upon signing up for the study, participants were informed about the nature of the research and provided informed consent. Next, they were guided through a brief web-based tutorial on the setup of the program, how to navigate between categories, and how to complete the task. After the tutorial, participants began the problem-solving task by reviewing Andrea's Problem, which refers to an undergraduate student who is have trouble managing her time commitments, and then proceeded to the main task.

In the next phase, participants were randomly assigned to either the problem construction (PC) or no problem construction (No PC) condition. Following the process for manipulating active engagement in problem construction outlined by Reiter-Palmon et al. (1997), participants in the PC condition were asked to read the problem and restate it in as many ways as they can think of before moving to the information search task. In the No PC condition, participants were asked to read the problem and move to the information search task. The remainder of the task was consistent across participants.

Next, participants were instructed to select as many pieces of information as they felt necessary to provide a creative solution to Andrea's problem. No limits were placed on the manner in which participants searched for information. The main screen presented participants with nine categories. Once a category was chosen, the subsequent screen provided specific information that participants could choose to view. The order of categories and information within each category were randomized. Once an item of information was selected, the answer to the item was revealed. If another item was selected, the answer to the previous item was hidden. Participants were allowed to navigate freely among categories, and to select the solution generation option when they were ready to terminate their information search and provide a solution to the problem. After entering their solution to Andrea's Problem, participants exited the problem-solving task, completed the post measures, and were debriefed.

Information Search Measures

Length of information search. The total length of information search was assessed from the point the individual enters the main page of the search task to the point they proceeded to solution generation. Length of information search was calculated in seconds spent engaging in the search task. Search time was stopped once the participant selected the "solve problem" option. The computer program automatically and precisely timed the participants from the moment searching started until the moment he or she moved to the solution-generation screen. Once participants advanced to solution generation, they were not allowed to return to searching.

Quantity of information searched. The quantity of information searched was a count of the number of pieces of information selected and viewed by the participant, across all categories. Items of information that were selected more than once were counted only one time for the quantity measure, because no additional information was provided in subsequent viewings.

Breadth of information search. The breadth of information search was an index of the number of distinct, problem-relevant categories selected to view information within. If a participant selected a category but did not choose to view any information from that category, it was still included in this count. Categories that were accessed more than one time during the search task were counted only once.

Efficiency of information search. The efficiency of information search is an index of the proportion of relevant information selected relative to the total amount of information selected by a participant. Highly relevant information was determined as any items with an average relevance score greater than or equal to a four on the relevance scale.

Covariates

Divergent thinking. Divergent thinking tests are traditionally used as a means to estimate the potential for creative thought, and are therefore expected to influence creativity (Hocevar, 1980). To control for individual differences in divergent thinking skills, participants completed a verbal divergent thinking task where they were asked to generate multiple ideas in response to a verbal prompt to assess their cognitive fluency (Guilford, 1950; Kim, 2006).

Problem construction ability. Although only half of the participants were asked to complete the problem construction manipulation, some people are inherently more skilled at PC than others. To control for the effects of problem construction ability, all participants completed a modified version of Baer's (1988) problem-finding task. Participants read a short problem and then restated the problem as many ways as they can without solving it.

Intelligence. Given the nature of complex problems, intelligence is often a factor that influences performance on creative problem-solving tasks (Hocevar, 1980). In this study, Intelligence was controlled for using the short form of the Standard Raven's Advanced Progression Matrix (1993). This is a measure of observation and clear thinking (α =.83). Participants were given 15 min to complete 12 problems of increasing difficulty. For each problem, they were shown the first eight components of a 3 x 3 matrix and asked to select what the ninth component should be according to the pattern.

Conscientiousness. Individuals differ in the degree of effort and thoughtfulness they put into tasks, which in turn influences their performance on the task. To control for this, participants completed the Goldberg et al. (2006) 20-item measure of conscientiousness from the NEO key-facets domain (α = .90).

Solution Creativity

Each participant was prompted to generate one creative solution to Andrea's Problem. The solutions were rated for quality and originality using a modified version of Amabile's (1996) consensual assessment technique. All ratings were accomplished using three trained raters. Interrater agreement was assessed using within-group variance (rwg; James et al., 1984) and intraclass correlations (ICCs; Shrout & Fleiss, 1979). Quality was defined as the extent to which the solution addresses multiple ideas and is useful for solving the problem, and was assessed using a 5-point Likert-type scale ranging from 1(*low quality*) to 5 (*high quality*). Originality was defined as the extent to which the solution generated is novel and questions the assumptions implicit in the problem, and was assessed using a 5-point Likert-type scale ranging from 1 (*low originality*) to 5 (*high originality*). Following the suggestion of Harrington, Block, and Block (1983), the overall creativity of a solution was determined by a multiplicative index of the solution's quality (ICC = .90, r_{wg} = .83) and originality (ICC = .83, r_{wg} = .75).

Results

Descriptive statistics for the four covariate measures, indices of information search, and solutions ratings are included in Table 1. After removing individuals who did not complete the task or failed the manipulation checks, the final sample comprised 221 individuals. Of the final sample, 123 participants remained in the Problem Construction (PC) condition, and 98 participants remained in the no Problem Construction (No PC) condition. Within the problem construction condition, the average fluency of problem restatements was 4.53 (*SD* = 1.70). Correlations among the covariates, information search quality indices, and solution ratings are presented in Table 2. Overall, the correlation analyses supported the inclusion of the four covariates due to their strong relationship to solution creativity. In accordance with the decision-making literature, the results show that the efficiency of information search is not correlated with the other indices of information search quality, supporting the exploratory hypothesis (Hypothesis 6), suggesting that information search efficiency will likely play a different role in the creative process.

Problem Construction Manipulation

An ANCOVA that tested Hypothesis 1 revealed that PC engagement had a significant effect on solution creativity, controlling for PC ability, divergent thinking, intelligence, and conscientiousness, $F(1, 212) = 3.98$, $p = .05$. Thus, Hypothesis 1 was supported. We also used several ANCOVA analyses to examine whether information search quality differed between participants in the PC and no PC conditions, controlling for PC ability, divergent thinking, intelligence, and conscientiousness. For the test of Hypothesis 2a, the results revealed that participants in the PC condition engaged in a longer information search (*M* = 1322.95, *SE* = 95.76) than participants in the No PC condition (*M* = 711.57, *SE* = 85.87), *F*(1, 218) = 22.51, *p* = .001. For the test of Hypothesis 2b, the results revealed that participants in the PC condition searched for more information (*M* = 31.60, *SE* = 3.13) than participants in the No PC condition (*M* = 21.02, *SE* = 2.79), *F*(1, 218) = 6.38, *p* = .01. For the test of Hypothesis 2c, the results revealed that participants in the PC condition searched across more categories information (*M* = 3.91, *SE* = .22) than participants in the No PC condition (*M* = 2.97, *SE* = .20), *F(*1, 219) = 9.80, *p* = .002. Thus, Hypotheses 2a, 2b, and 2c were supported.

Table 1
Descriptive Statistics for Covariates, Information Search Indices, and Solution Ratings

Measure	*M*	*SD*	*min*	*max*
Covariates				
Problem construction ability	4.46	2.38	1.00	17.00
Divergent thinking	8.52	6.45	1.00	48.00
Intelligence	5.36	2.75	1.00	12.00
Conscientiousness	3.62	0.51	1.22	5.00
Information search quality				
Length of information search	1020.71	1021.63	24.00	6160.00
Quantity of information search	27.46	32.30	1.00	143.00
Breadth of information search	3.33	2.45	1.00	9.00
Information search efficiency	0.39	0.24	0.00	1.00
Ratings of solutions				
Quality of solution	3.16	1.03	1.00	5.00
Originality of solution	2.96	1.00	1.00	5.00
Creativity of solution	10.26	6.05	1.00	25.00

Note. $N = 221$.

Mediation and Moderation Analyses

Hypotheses 3, 4, and 5 were tested using mediation analyses following the steps outlined by Preacher and Hayes (2008) to determine the extent to which the relationship between PC and solution creativity is mediated by the quality of information search. The variables were entered into an SPSS macro (Hayes, 2009) to test the direct and indirect effects using a bootstrap resampling technique with a maximum number of samples set at 5,000 and a 95% bias corrected confidence interval to determine the significance of the mediator. Hypothesis 6 was tested by mean-deviating the efficiency of information search, effect-coding PC engagement, and creating an interaction term. The nature of the interaction was probed following the procedure outlined by Aiken and West (1991). All hypothesis testing was analyzed after controlling for PC ability, divergent thinking, intelligence, and conscientiousness.

Length of information search. Hypothesis 3 posited that the length of information search will mediate the relationship between problem construction and creativity. A hierarchical regression examining the effect of problem construction and length of information search on creativity, controlling for PC ability, divergent thinking, intelligence, and conscientiousness, was significant (R^2 = .40, *p* < .001). The results of this regression are reported in Table 3. The mediation analysis conducted using the bootstrapping resampling technique set to 5,000 samples and a 95% bias corrected confidence interval revealed a significant effect of PC engagement on the length of information search (b = 286.14, p =.00) and a significant effect of length of information search on solution creativity (b = .03, p =.00), controlling for PC ability, divergent thinking, intelligence, and conscientiousness. The direct effect of PC engagement on solution creativity was nonsignificant, b = - .29, p = .39, and was smaller in effect size than the total effect of PC engagement on solution creativity, b = .55, p= .19. The unstandardized indirect effect of PC engagement on solution creativity through the mediator length of information search was .91 with a 95% confidence interval ranging from .54 to 1.34, revealing that the length of information search fully mediates the relationship between PC engagement and solution creativity, controlling for PC ability, divergent thinking, intelligence, and conscientiousness. Thus, Hypothesis 3 was supported.

Table 2
Intercorrelations Among Covariates, Information Search Measures, and Solution Ratings

Variable	1	2	3	4	5	6	7	8	9	10	11
1. PC ability	—										
2. Divergent thinking	.44**	—									
3. Intelligence	.21**	.26**	—								
4. Conscientiousness	.07	.05	−.02	—							
5. IS length	.09	.08	.20**	.08	—						
6. IS quantity	.19**	.11	.23**	.01	.64**	—					
7. IS breadth	.24**	.15*	.33**	.05	.62**	.82**	—				
8. IS efficiency	.11	.04	.09	.06	.03	.02	.09	—			
9. Solution quality	.34**	.20**	.29**	.16*	.52**	.50**	.59**	.08	—		
10. Solution originality	.31**	.25**	.27**	.16*	.48**	.49**	.56**	.05	.88**	—	
11. Solution creativity	.34**	.23**	.28**	.15*	.55**	.54**	.61**	.08	.91**	.90**	—

Note. N = 221. Correlations are two-tailed. PC = Problem construction; IS = Information search.
* p < .05. ** p < .01.

Quantity of information search. Hypothesis 4 posited that the quantity of information searched will mediate the relationship between problem construction and creativity. A hierarchical regression examining the effect of problem construction and quantity of information searched on creativity, controlling for PC ability, divergent thinking, intelligence, and conscientiousness, was significant (R^2 = .38, p < .001). The results of this regression are reported in Table 4. The mediation analysis conducted using the bootstrapping resampling technique set to 5,000 samples and a 95% bias corrected confidence interval revealed a significant effect of PC engagement on the quantity of information searched (b = 5.01, p = .03) and a significant effect of the quantity of information searched on solution creativity (b = .09, p = .00), controlling for PC ability, divergent thinking, intelligence, and conscientiousness. The direct effect of PC engagement on solution creativity was nonsignificant, b = .17, p = .61, and was smaller in effect size than the total effect of PC engagement on solution creativity, b =.55, p = .19. The unstandardized indirect effect of PC engagement on solution creativity through the mediator quantity of information searched was .43 with a 95% confidence interval ranging from .05 to .85, revealing that the quantity of information searched fully mediates the relationship between PC engagement and solution creativity, controlling for PC ability, divergent thinking, intelligence, and conscientiousness. Thus, Hypothesis 4 was supported.

Table 3
Length of Information Search Mediating the Relationship Between Problem Construction and Solution Creativity

Model	*b*	*SE*	β	R^2	ΔR^2	[95% CI]
Model 1				.19**	.19**	
Intercept	−1.56	2.82				[−7.11, 4.00]
PC ability	.67**	.18	.26**			[.32, 1.02]
Divergent thinking	.05	.07	.06			[−.08, .19]
Intelligence	.50**	.14	.23**			[.22, .78]
Conscientiousness	1.57*	.74	.13*			[.11, 3.02]
Model 2				.20**	.01	
Intercept	−1.35	2.81				[−6.89, 4.20]
PC ability	.68**	.18	.27**			[.32, 1.02]
Divergent thinking	.05	.07	.06			[−.08, .19]
Intelligence	.50**	.14	.23**			[.22, .78]
Conscientiousness	1.51*	.74	.13*			[.06, 2.96]
PC condition	.64	.38	.10			[−.11, 1.38]
Model 3				.41**	.21**	
Intercept	−1.54	2.43				[−6.33, 3.25]
PC ability	.60**	.15	.23**			[.30, .90]
Divergent thinking	.06	.06	.06			[−.06, .17]
Intelligence	.27*	.13	.12*			[.02, .52]
Conscientiousness	1.16	.64	.10			[−.09, 2.42]
PC condition	−.30	.35	−.05			[−.98, .38]
IS length	.003**	.00	.45**			[.002, .004]

Note. $N = 221$. PC = Problem construction; IS = Information search.
$^{*}p < .05$. $^{**}p < .01$.

Table 4
Quantity of Information Search Mediating the Relationship Between Problem Construction and Solution Creativity

Model	*b*	*SE*	β	R^2	ΔR^2	[95% CI]
Model 1				.19**	.19**	
Intercept	−1.56	2.82				[−7.11, 4.00]
PC ability	.67**	.18	.26**			[.32, 1.02]
Divergent thinking	.05	.07	.06			[−.08, .19]
Intelligence	.50**	.14	.23**			[.22, .78]
Conscientiousness	1.57*	.74	.13*			[.11, 3.02]
Model 2				.20**	.01	
Intercept	−1.35	2.81				[−6.89, 4.20]
PC ability	.68**	.18	.27**			[.32, 1.02]
Divergent thinking	.05	.07	.06			[−.08, .19]
Intelligence	.50**	.14	.23**			[.22, .78]
Conscientiousness	1.51*	.74	.13*			[.06, 2.96]
PC condition	.64	.38	.10			[−.11, 1.38]
Model 3				.39**	.18**	
Intercept	−2.04	2.48				[−6.93, 2.85]
PC ability	.49**	.16	.19**			[.18, .81]
Divergent thinking	.06	.06	.06			[−.05, .18]
Intelligence	.29*	.13	.13*			[.03, .54]
Conscientiousness	1.61*	.65	.14*			[.33, 2.89]
PC condition	.18	.34	.03			[−.49, .84]
IS quantity	.09**	.01	.45**			[.06, .11]

Note. $N = 221$. PC = Problem construction; IS = Information search.
$^{*}p < .05$. $^{**}p < .01$.

Breadth of information search. Hypothesis 5 posited that the breadth of information searched will mediate the relationship between problem construction and creativity. A hierarchical regression examining the effect of problem construction and breadth of information searched on creativity, controlling for PC ability, divergent thinking, intelligence, and conscientiousness, was significant (R^2= .43, p< .001). The results of this regression are reported in Table 5. The mediation analysis conducted using the bootstrapping resampling technique set to 5,000 samples and a 95% bias corrected confidence interval revealed a significant effect of PC engagement on the breadth of information searched (*b* = .46, *p* = .01) and a significant effect of breadth of information searched on solution creativity *(b* =1.32, *p* =.00), controlling for PC ability, divergent thinking, intelligence, and conscientiousness. The direct effect of PC engagement on solution creativity was nonsignificant, *b* = -.02*, p* = .95, and was smaller in effect size than the total effect of PC engagement on solution creativity, *b* = .55, *p*= .19. The unstandardized indirect effect of PC engagement on solution creativity through the mediator breadth of information searched was .58 with a 95% confidence interval ranging from .16 to 1.13, revealing that the breadth of information searched fully mediates the relationship between PC engagement and solution creativity, controlling for PC ability, divergent thinking, intelligence, and conscientiousness. Thus, Hypothesis 5 was supported.

Table 5
Breadth of Information Searched Mediating the Relationship Between Problem Construction and Solution Creativity

Model	b	SE	β	R^2	ΔR^2	[95% CI]
Model 1				.19**	.19**	
Intercept	−1.56	2.82				[−7.11, 4.00]
PC ability	.67**	.18	.26**			[.32, 1.02]
Divergent thinking	.05	.07	.06			[−.08, .19]
Intelligence	.50**	.14	.23**			[.22, .78]
Conscientiousness	1.57*	.74	.13*			[.11, 3.02]
Model 2				.20**	.01	
Intercept	−1.35	2.81				[−6.89, 4.20]
PC ability	.68**	.18	.27**			[.32, 1.02]
Divergent thinking	.05	.07	.06			[−.08, .19]
Intelligence	.50**	.14	.23**			[.22, .78]
Conscientiousness	1.51*	.74	.13*			[.06, 2.96]
PC condition	.64	.38	.10			[−.11, 1.38]
Model 3				.43**	.23**	
Intercept	−2.44	2.38				[−7.14, 2.26]
PC ability	.44**	.15	.17**			[.14, .74]
Divergent thinking	.06	.06	.06			[−.05, .17]
Intelligence	.13	.13	.06			[−.12, .38]
Conscientiousness	1.36*	.62	.12*			[.13, 2.59]
PC condition	−.02	.33	−.004			[−.67, .63]
IS breadth	1.32**	.14	.53**			[1.04, 1.60]

Note. N = 221. PC = Problem construction; IS = Information search.
* $p < .05$. ** $p < .01$.

Efficiency of information search. Hypothesis 6 was an exploratory hypothesis positing that the relationship between the efficiency of information search and creativity would depend on problem construction engagement. Information search efficiency was mean deviated, and an interaction term was created by multiplying the mean-deviated predictor with problem construction. The results of a hierarchical regression of the test of the moderation, controlling for PC ability, divergent thinking, intelligence, and conscientiousness, is presented in Table 6. The regression analysis revealed that the relationship between the efficiency of information search and solution creativity depends on problem construction engagement (β = .16, R^2 Δ=.03, FΔ[1,218] = 4.71, p =.03). A probe of the interaction was conducted following the procedure outlined by Aiken and West (1991). The results revealed that the effect of information search efficiency on creativity is not significant for people in the control condition (No PC). However, for people who engaged in problem construction (PC), efficiency of information search was positively related to creativity, such that the higher the proportion of relevant information a person searched relative to the total amount of information searched, the more creative their solution (β = .22, p =.02). A graphic representation of this result is presented in Figure 2, and Hypothesis 6 was supported.

Discussion

This study examined the relationship between problem construction engagement, the quality of information search an individual engages in, and creativity using a complex problem-solving task. Although models of creative processing posit that information search is a necessary stage of creative problem solving, no research has separated and measured information search from earlier processes to determine the nature of the role it plays in the creative problem solving process. The indices of information search tested in this study were drawn from the decision-making literature, and hypotheses were developed by combining what is known about information search in well-defined problems, with theories about cognitive processing in ill-defined problems. The results of this research support the theory suggesting that differences in the ways in which individuals search for information during problem-solving tasks influences creativity. The direct effect of problem construction engagement on creativity found in previous research (e.g., Reiter-Palmon et al., 1998) was supported by this study, even collapsing across information search dimensions. This suggests that problem construction and information search are separate but influential processes for creative thought.

In addition, active engagement in problem construction as a task manipulation was found to be related to differences in information search. Specifically, when individuals were prompted to engage in problem construction, they tended to engage in a longer information search, review more information, and search across a more diverse breadth of information categories, which led to the generation of more creative solutions. The efficiency of information search, referring to the proportion of relevant information selected, led to more creative solutions for people who engaged in problem construction, but was not related to creativity for people who did not engage in problem construction. In accordance with previous research indicating that efficiency does not necessarily correlate with other measures of information search quality, this study showed that the nature of an efficient search is a separate facet of creative cognition than traditional measures of quality.

Theoretical Contributions

This study makes several contributions to the field of creativity, problem solving, and creative cognition. First, it provides empirical evidence supporting the theorized early stage cognitive processes required to generate a creative idea, by eliciting and measuring them separately during the task. The effect of active problem construction engagement on creativity is accounted for by information search behaviors, even when controlling for other cognitive factors that influence creativity, which illustrates that creative cognition is an information-intensive process subject to errors and biases throughout idea generation. It also suggests that errors made early in the problem-solving process have implications for the quality of later processes, such as information search. When people do not engage in problem construction (an early stage process), their performance on subsequent processes such as information search is hindered, and they are less creative. This finding may be related to Duncker (1945) notion of functional *fixedness*, suggesting that people can be limited by a single approach to solving a problem, blocking them from identifying alternative approaches. In the context of this research, people who did not engage in problem construction may have experienced functional fixation when reviewing the problem, leading them to engage in a lower quality information search. Alternatively, problem representations activated through problem construction led to a longer and more thorough information search, because they draw from previous experiences and identify more information pathways. Integrating these pathways may contribute to ideas that are more original, and also more comprehensive.

Table 6

Interaction Between Problem Construction and Efficiency of Information Search Regressed on Solution Creativity

Model	b	SE	β	R^2	ΔR^2	[95% CI]
Model 1				.20**	.20**	
Intercept	−1.21	2.82				[−6.78, 4.35]
PC ability	.67**	.18	.26**			[.32, 1.02]
Divergent thinking	.06	.07	.06			[−.08, .19]
Intelligence	.49**	.14	.23**			[.22, .78]
Conscientiousness	1.57*	.74	.13*			[.11, 3.02]
PC condition	.79*	.38	.13*			[.00, 1.40]
IS efficiency	1.11	1.71	.04			[−.22, .42]
Model 2				.23**	.03*	
Intercept	−1.18	2.80				[−6.69, 4.34]
PC ability	.65**	.18	.26**			[.33, 1.02]
Divergent thinking	.05	.07	.06			[−.08, .19]
Intelligence	.45**	.14	.20**			[.20, .75]
Conscientiousness	1.51*	.73	.13*			[.06, 2.96]
PC condition	.77*	.38	.12*			[.01, 1.38]
IS efficiency	3.35	1.98	.13			[−.55, 7.26]
PC × IS	4.26*	1.96	.16*			[.39, 8.12]

Note. $N = 219$. PC = Problem construction; IS = Information search.
* $p < .05$. ** $p < .01$.

Second, this study suggests that a broader information search is necessary to generate creative solutions to ill-defined problems. This differs slightly from the decision-making literature, suggesting that some well-defined problems may benefit from a convergent search strategy when the problem-solver has successfully identified irrelevant pathways, because it shows that creativity is facilitated through the breadth of information search. The wider a problem is constructed during the identification process, the more diverse pathways are initiated, leading to a broader information search and more creative solutions. These results are consistent with previous research suggesting that diverse, inconsistent, or paradoxical information activated through problem construction leads to more creative solutions (Miron-Spektor, Gino, & Argote, 2011; Reiter-Palmon et al., 1997). This finding also highlights the importance of understanding conceptual combination, which involves the integration of diverse information categories toward a cohesive idea (Marsh, Bink, & Hicks, 1999; Scott, Lonergan, & Mumford, 2005; Ward & Wickes, 2009).

Third, this study illustrated the relationship between the relevance of information searched and solution creativity using a range of relevant information, rather than a dichotomy. The scale used to rate the information was developed for this study, and this was also the first study to show that problem construction leads to more creative solutions, depending on the proportion of relevant information searched during the problem-solving task. This may be a more realistic way to explore the role of information relevance in creative cognition than dichotomizing relevance, because it allows participants to select information that is less relevant to the specific problem, but may be used in a creative manner to generate a solution. Ill-defined problems, by nature, have many pathways that may lead to a creative solution. Consequently, the search task should allow the problem-solver to explore many possible search pathways prior to solving the problem. Given that this study was developed according to a simultaneous search model, efficiency was captured by allowing participants to engage in more exploratory behavior using an interactive, dynamic search task. The results suggested that people who actively engage in problem construction may search for more information, engage in a longer search, and search for more breadth of items, but there are still differences in the overall efficiency of their search that account for their performance on the task. Previous research has suggested that the more expertise a problem solver has, the longer they'll engage in problem definition and the more deductive their search strategy will be at identifying relevant information (Selnes & Troye, 1989). However, other research suggests that accessing inconsistent information may lead to more creative ideas than solely viewing consistent information (Mumford et al., 1996). This highlights the importance of further understanding the differences in search strategies and behavior that contribute to creativity.

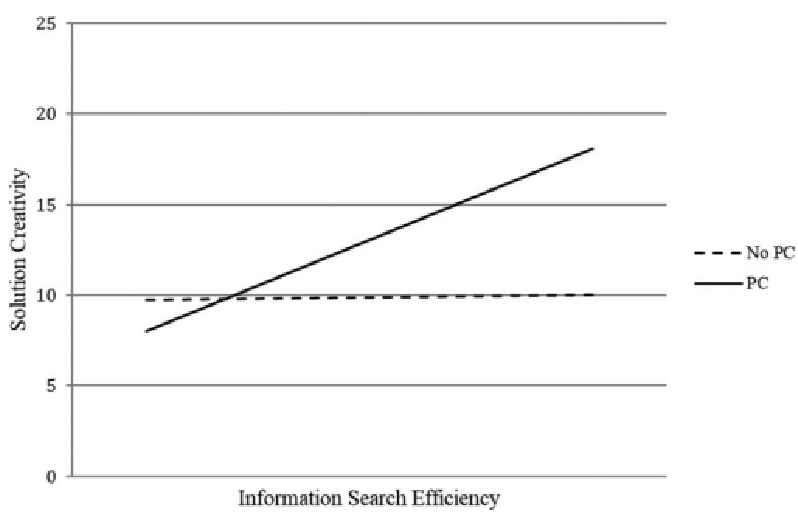

Figure 2. Graph of the interaction between the efficiency of information search and problem construction, regressed on creativity. PC = Problem construction.

Limitations and Future Directions

Despite the encouraging results of this research, some limitations should be noted. First, the problem used in this study refers to a problem that a junior or senior undergraduate student would likely encounter, but may not be as appropriate for younger or less-experienced participants. This may have influenced their engagement in information search, as well as the quality of their solutions. However, follow up tests for the effect of age revealed no significant differences in the search behaviors used or creativity of solutions, suggesting that age or experience with the content of this problem did not necessarily influence engagement in the task. Second, we did not include the time spent engaging in problem construction as part of their total search time. As Mumford et al. (1991) note, the cognitive processes involved with creative problem solving may not always occur in a linear fashion; some processes may occur in tandem. Consequently, although active, external information search does not occur during active engagement in problem construction, some information search theories would argue that internalized information search might occur as part of the problem construction process. This possibility might ultimately influence the time spent engaging in the external search process.

Third, and related to the second issue, the quantity of information search only counted each item of information once, though participants may have visited it multiple times. By measuring information search this way, we imply a linear search process, when many creative behaviors are likely to be nonlinear, as suggested by Mumford and colleagues (1991). We used this index because we were interested in the additive value of new information in a search. In a subsequent analysis, we tested the hypothesis using the total number of items selected, counting each time an item was selected as an independent search behavior. The mediation held, and the results of the hypothesis were supported. However, subsequent research may consider exploring the impact of repeat search behaviors, and examining the strategy of information search.

Fourth, though the results support a relationship between problem construction, information search, and creativity in a domain relevant problem (e.g., an undergraduate problem used in a student sample), this finding may not generalize to problems where the individual has little preexisting domain-specific knowledge or experience. Consequently, in problem-solving scenarios where the individual has little existing knowledge regarding the problem, the relationship between information search and creativity may differ or be less apparent. Accordingly, the implications of this research should be accepted with some caution. Finally, although the results presented here show promise for the role information search plays in the relationship between problem construction and creativity, this study did not account for the possibility of Type I error by correcting for multiple analyses. Though the effect sizes are quite large, and this correction is unlikely to reveal any further qualifications on the results, it is important to note. In addition, analyses regarding the interplay between facets of information search in a comprehensive model were not explored as part of this research, but may provide useful information regarding the overall role information search plays in creative cognition.

Despite these limitations, the results of this study provide a unique contribution to the field of creativity and problem solving by offering support for the theorized stages of cognitive processing that underlie creativity. Specifically, this study suggests that performance or engagement in early stage processes have implications for later processes during creative problem-solving tasks. This study is the first to actively elicit and measure these processes in an empirical study, allowing the relationship between problem construction, information search, and creativity to be observed. Given that problem construction engagement led to higher quality information search and more creative solutions, future research may further explore this relationship by examining the fluency, quality, or originality of problem restatements. Examining these indices of the effectiveness of problem construction may indicate whether the quality of problem construction has an impact on the quality of the information search, as well as the creativity of solutions generated. In follow-up analyses, considering the impact of performance on the problem construction task as it relates to the overall task performance may reveal intricacies of the processes not apparent in the overall comparison of experimental conditions.

Future research may also consider investigating the feedback loop between problem construction and information search, in which participants navigate between these processes as the conceptual model hypothesized (Mumford et al., 1991). In addition, investigating the relationship between these early process and later-stage processes, such as conceptual combination, may reveal additional biases in cognitive processing that influence creativity. Specifically, research may investigate whether the categories accessed during information search are utilized and combined in novel ways to generate a creative solution. Assessing the content and complexity of the solutions to determine how many problem relevant categories were incorporated in the overall solution generated may reveal more detail about the nature of the relationship between the strategy of search used and creativity.

This study controlled for differences in cognition that may influence creativity, to examine the effect of problem construction on information search and creativity above and beyond cognitive and creative abilities. However, future research ought to examine how individual differences influence the preliminary findings shown in this research. For instance, previous research has investigated whether personality and other characteristics of individuals influence their performance on creative problem-solving tasks (e.g., Mumford, 2003; Reiter-Palmon et al., 1998). Applying this line of research to information search may reveal whether individuals tend to seek out information that aligns with their own personal characteristics and preferences. Particularly when a diverse array of problem-relevant categories exists, people may seek out categories that reflect problem characteristics that are important to them, which in turn may influence their performance on the task. Finally, future research should consider task or contextual factors that may influence the relationship between information search and creativity, such as time constraints, or cost– benefit dynamics. For instance, problem construction may hinder performance if there is insufficient time to explore the information avenues activated through problem reframing. Conversely, under quantity constraints, problem construction may guide people to choose more effective search strategies, in which they access a wide breadth of information categories but less depth, leading to more creative solutions.

Conclusions

Overall, this study is an important first step to empirically examining the complex relationships between cognitive processes underlying creativity. This study utilized research from the decision-making literature to hypothesize indices of information search that may predict creative performance. This was also the first study to separately elicit problem construction and information search, and measure them to determine their relationship to creativity. The results suggest that engagement in problem construction influence creativity via information search. As individuals construct problems more broadly, they identify more internal information avenues and frameworks to explore, guiding a higher quality external information search. The findings from this study suggest that incorporating diverse information across several categories positively influences creative performance on a complex problem. Furthermore, the relationship between problem construction and creativity differs depending on the efficiency of information search, suggesting that some differences remain to be explored in search behaviors. As a whole, this research supports the notion that creativity is an information-intensive process, and performance on early cognitive processes influences performance on later processes, facilitating the generation of a creative idea.

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