# PSYCHOLOGISTS' VIEWS ON NONOBVIOUSNESS: ARE THEY OBVIOUS?

*by*
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*This Article discusses how a partnership between patent lawyers and cognitive psychologists could help resolve patent issues surrounding nonobviousness and advance what is known about innovative problem solving. Despite the fact that psychologists typically do not have ordinary skill in the prior art of patent law, such a partnership seems like an obvious solution to the non-routine problem of nonobviousness. Focusing on human creativity, problem solving, and memory, the authors explore the important roles played by insightful problem solving, problem finding, collaboration, and hindsight bias in innovation and in the determination of its nonobviousness. Noting that insightful solutions might well result if patent lawyers and cognitive psychologists form a collaborative web, the authors conclude by providing suggestions for how psychologists can help reform section 103 of the Patent Act.*



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## I. INTRODUCTION

The Articles by Sawyer (2008), Seifert (2008), and Smith (2008) make several important points about nonobviousness.[***] However, they also make a painfully obvious one: The Supreme Court, despite its reasonable decision in *KSR v. Teleflex* (2007), does not fully understand how the human mind works. People are less rational and innovation is more complex than the Court acknowledges. Perhaps the Justices should have learned from *Brown v. Board of Education* (1954) that there is a role for psychological research in legal issues. Unfortunately, judges and many other individuals often assume that common sense can explain human behavior. It cannot. Problem solving, memory, and innovation do not always work the way common sense predicts.

Sawyer (2008), Seifert (2008), and Smith (2008) cover aspects of human creativity, problem solving, and memory that would benefit patent law. Four in particular—insightful problem solving, problem finding, collaboration, and hindsight bias—play important roles in innovation or in the determination of its nonobviousness. Each of these concepts will be discussed in turn. In addition, several of the three psychologists' other points will be incorporated where relevant.

## II. ROUTINE VERSUS INSIGHTFUL PROBLEM SOLVING

What do you call a fish without an eye? This dismal joke intentionally sends people down a garden path searching for the names of blind fish. Once this wrong path is pursued, it is often difficult for individuals to backtrack and start over. However, when hints related to the letter "I" are provided, the wrong path disappears and the answer "fsh" is quickly reached. If the joke is told again, these individuals have a restructured mental representation of its elements and can directly arrive at the obvious answer. The reasons for their changed mental response to the same joke are similar to the differences between non-routine (ill-defined) and routine (well-defined) problems.

As Seifert notes, routine problems have well-specified givens, goals, and obstacles. In other words, problem solvers can search the constrained problem space and clearly identify the steps (or paths) to the correct solution. This type of problem generally requires several actions that change the initial state of the problem into the final one. Typically, the solution does not follow rapidly once one or two crucial steps have been made. Instead, arriving at the right solution depends on making the

[***] This Article is part of a multi-disciplinary conference on *KSR v. Teleflex* held at Lewis & Clark Law School on October 5–6, 2007. In respect for the multi-disciplinary nature of this conference, the Articles written by non-lawyers are presented herein in a modified APA citation format, rather than the usual Bluebook citation format. We have added some pinpoint citations to aid the legal reader.

correct sequence of steps. Moreover, problem solvers can accurately predict their progress toward correct solution of routine problems (Metcalfe, 1986a, 1986b; Metcalfe & Weibe, 1987). Even though well-defined problems can be difficult and often require years of preparation in a domain, they are usually straightforward. This implies that the structure and function of most inventions that stem from routine problem solving would be fairly obvious to persons of ordinary skill in the relevant art.

Many of life's problems, unfortunately, are ill structured and individuals do not have a routine set of procedures for solving them (Seifert, 2008). These problems often require insight, which has been defined as a sudden realization of the solution procedure (e.g., Duncker, 1945; Kaplan & Simon, 1990; Kohler, 1969; Worthy, 1975). Several findings support this definition. For example, Metcalfe (1986a, 1986b; Metcalfe & Weibe, 1987) found that incremental increases in confidence (or warmth) that one is nearing the solution of an insight problem actually predicted wrong answers. In contrast, correct individuals tended to think they were far from solving the insight problems and then suddenly realized they knew how to get the solution. Metcalfe (1986b) concludes that a subjectively catastrophic process is necessary for solving insight problems, while incremental processes work well for routine problems. Moreover, different areas of the brain are activated when problem solvers are working on insight problems, such as the "Two Strings Problem" illustrated by Seifert (2008), than when they are solving analytical problems, such as the anagrams described by Smith (2008) (Bowden & Beeman, 1998, 2003; Lavric, Forstmeier, & Rippon, 2000).

Insight has long been associated with creative thoughts and innovations. For example, Graham Wallas (1926) included it as one of his four stages to the creative process. These stages are (1) preparation, where the individual acquires relevant information and begins conscious work on a problem; (2) incubation, which is a period of time away from conscious work on the problem; (3) illumination or insight, when the problem solver suddenly "sees" how to solve the problem; and (4) verification or evaluation, where the solution is worked out and checked for accuracy. Many important contributions to the world have been attributed to the third stage, where insight or illumination occurs (Gruber, 1981). According to Ron Finke (1995, p. 255), "Insight is what distinguishes the enlightened from the benighted, the inspiring from the denigrating, the magical from the mediocre. It is the essential process by which we come to make surprising discoveries and realizations. . . ."

However, just because insight seems to happen suddenly and without any clear introspective correlates does not mean that it must remain elusive or mysterious. Three mental processes appear to be the basis for insight, and these three also occur in ordinary, everyday, pedestrian cognition. Insight, in other words, feels remarkable and appears remarkable, but it is grounded in familiar, well-understood mechanisms of thought. The three mechanisms are: (1) selective encoding, (2) selective combination, and (3) selective comparison. The remarkableness of an insight comes not so much from the use of extraordinary processes, but rather from what happens when the use of rather ordinary ones leads to abrupt change in one's internal representation of a problem's givens, goals, and obstacles (Davidson, 1995). Each of these processes will be discussed briefly and related to the Articles by Sawyer (2008), Seifert (2008), and Smith (2008).

### A. *Selective Encoding*

The first of the three core processes has to do with how we encode a problem. The mental representation of a problem typically has within it both less and more than the problem itself. More, because we bring previous knowledge to bear on the problem, and less, because we generally cannot know which things in the problem are essential and which are not. Unlike the trivial fish joke, significant problems generally present an individual with large amounts of information, some of it relevant and some irrelevant. "Selective encoding" occurs when someone's mental representation of a problem is restructured so that information that was originally viewed as being irrelevant is now seen as relevant for problem solution or vice versa (Davidson, 1986; Davidson & Sternberg, 1986). For example, the invention of the ballpoint pen occurred only after Laszio Brio selectively encoded that newspaper ink, unlike many other types, dried quickly and did not smudge.

Colleen Seifert's example of the thirty-six black socks and brown socks mixed in the ratio of five to seven also illustrates selective encoding. Some individuals first try to use the ratio information to determine how many socks to remove to guarantee a pair the same color. This strategy, however, leads to an absurd number of socks. Some problem solvers then return to the problem and restructure their mental representation of it to exclude the irrelevant ratio information and focus on the fact that there are only two colors. It is now easy for them to see that drawing three socks guarantees two that match. However, when the irrelevant information is absent from this problem (Seifert, 2007) or relevant information is highlighted (Davidson, 1986), no restructuring of one's mental representation is required.

Interestingly, selective encoding often occurs when problem solvers have reached an impasse and are no longer consciously working on a problem. Incubation, or taking a break after one has been pursuing an unproductive path for solving a problem, is Wallas's second step in the creative process mentioned earlier. This step fosters selective encoding in one of two ways: through opportunistic assimilation or breaking fixation.

#### 1. *Opportunistic Assimilation*

Seifert and her colleagues (Seifert, Meyer, Davidson, Patalano, & Yaniv, 1995) note that when problem solvers cannot generate a solution path, "failure indices" in their long-term memories mark the problem as unsolved. Even though individuals are not consciously working on a problem, these indices initiate unconscious processing of the environment in light of the unsolved problem. Previously ignored information that might be relevant to solving the problem now receives special attention.

Seifert et al. (1995) tested the opportunistic-assimilation model of insight using two different methods. In one, participants were shown target items and asked to judge whether they were words or non-words. As is often typical in psychological experiments, the participants were unaware that some of the target items were related to general information questions they had tried to answer earlier. When old and new general information questions were given to participants the following day, the relevant target items helped them answer their previously failed questions. Importantly, problem solving performance did not benefit from the mere passage of time or prior exposure to target items that were related to new questions. In other words, failure indices in long-term memory resulted in the selective encoding of information related to previously missed questions.

Similarly, results from a methodologically different study (Seifert et al., 1995) indicated that participants were more likely to remember problems when they had reached an impasse in solving them than when they had reached correct solutions or had been interrupted prior to reaching an impasse. Seifert's studies and the opportunistic- assimilation model are related to the issue of nonobviousness. Being stuck on a problem changes how information is processed and remembered. Unless two individuals reach the same impasse followed by an incubation period, information that might be selectively encoded by one problem solver could easily remain nonobvious to another.

*2. Overcoming Fixation*

Sometimes selective encoding is impaired when problem solvers become fixated on an irrelevant or inefficient solution procedure (Kaplan & Davidson, 1989). These individuals reach an impasse because information they know is incorrect dominates their thoughts. As Smith (2008) notes, fixation occurs on a wide-range of tasks, including ones related to creative inventions. Fortunately, taking a break from problem solving can often reduce one's focus on irrelevant information and increase the selection of the relevant. For example, Smith and Blankenship (1989) examined the relationship between fixation and incubation by asking participants to solve rebus problems. The task is to generate a common phrase that fits the situation illustrated in a problem. For example, the solution to "timing tim ing" is "split second timing" because the second word in the problem is divided into two parts. Deviously misleading cues, such as "clock," were given along with the rebuses in order to inhibit problem solvers' access to the correct solution. Smith and Blankenship found that relatively long incubation periods allowed individuals to forget the irrelevant cues, thus increasing their chances of accessing the relevant solutions.

A similar type of fixation is "topic fixation," which often occurs in group brainstorming sessions (Sawyer, 2007). More specifically, individuals who generate ideas together tend not to cover the same range of relevant categories as do those who brainstorm alone. Fortunately, this type of fixation can be avoided by having individuals think of ideas on their own before coming together in a group.

A third type of fixation, which the Gestalt psychologists named "functional fixedness," also interferes with selective encoding and calls into question the Supreme Court's view that "[c]ommon sense teaches, however, that familiar items may have obvious uses beyond their primary purposes, and in many cases a person of ordinary skills will be able to fit the teachings of multiple patents together like pieces of a puzzle" (*KSR v. Teleflex*, 2007, p. 1742). The Gestaltists believed that individuals' inability to produce an insightful solution for a problem is often due to their fixation on past associations. To test this view, Karl Duncker (1945) gave people candles, matches, thumbtacks, and three small cardboard boxes and asked them to mount a candle vertically on a screen so that it could serve as a reading lamp. The solution is to light a candle, melt wax onto the top of a box, stick the candle into the wax, and tack the box to the screen. Individuals who were given boxes filled with candles, matches, and thumbtacks had much more difficulty solving the problem than did those who received the same items outside of the boxes. According to Duncker, seeing a box serve its primary purpose as a container made it difficult for problem solvers also to view it as a structural support. Seifert's recent experiments (2007; 2008) clearly support the Gestalt view: Individuals rarely encode new functions for old items. When functional fixedness is avoided, as in Sawyer's (2008) example of Arm & Hammer Baking Soda being marketed for a new purpose, conceptual elaboration and nonobvious innovation can result.

In summary, selective encoding, the choosing to include in our mental representation some elements of a problem rather than others, is a basic mental process required for most problem solving, insightful or not. Insight occurs when the search for previously overlooked relevant information results in the sudden restructuring of one's mental representation of the problem. Fixation can impede this process.

### *B. Selective Combination*

The second of the three cognitive processes underlying insight is "selective combination." It is not enough to correctly notice and encode the most important features of a problem. Features or concepts often must be combined and some combinations are simply more creative than others. As Sawyer (2008) notes, for example, linking two similar concepts (e.g., slipper socks) is more obvious than putting together ones that are quite different in their properties or structure (e.g., wearable computers). Furthermore, Sawyer (2008) and Smith (2008) both point out that combined ideas can, at times, result in emergent properties. This occurs when a relatively small number of components are properly put together to yield qualitatively different functions. For example, a single molecule of water is not wet but, when molecules of water are combined, the property of wetness emerges.

Insightful combination takes place when an individual searches for and suddenly discovers a previously nonobvious way to arrange elements in a problem situation. In other words, existing components or operations need to be put together in a novel way in order to obtain a different outcome. Even when the relevant features or concepts have been identified, it is often difficult to know that these features should be combined and to then find a procedure to combine them appropriately.

A famous example of selective combination is Kary Mullis's Nobel Prize winning invention of polymerase chain reaction (PCR). "There was not a single unknown in the scheme. Each step involved had been done already" (Mullis, 1998, p. 9). While driving, Mullis suddenly realized that the steps could be combined to replicate short sequences of DNA. Furthermore, even though his combination allows the production of limitless supplies of specific DNA sequences, the majority of his colleagues did not immediately see its relevance.

As noted in *KSR v. Teleflex* (2007, p. 1741), ". . . claimed discoveries almost of necessity will be combinations of what, in some sense, is already known." However, not all of these claimed discoveries require insightful problem solving in general, or selective combination in particular. As the Federal Circuit Court of Appeals and Supreme Court recognized, the Engelgau patent was not based on a restructuring of a mental representation or the nonobvious arrangement of relevant elements. Furthermore, its combination of parts resulted in a predictable function. In other words, "[a] person having ordinary skill in the art could have combined Asano with a pedal position sensor in a fashion encompassed by claim 4, and would have seen the benefits of doing so" (p. 1743).

In summary, an insightful solution to a problem may be the result of a mental restructuring due either to selective encoding or to selective combination or to both (Davidson & Sternberg, 1986; Dominowski, 1981). In addition to these two key cognitive processes, insightful solutions may result when the current problem is seen as similar to a problem solved long ago.

### C. *Selective Comparison*

The third cognitive process underlying insightful problem solving is comparison of current information with past experience. Sawyer (2008) nicely describes conceptual transfer, where prominent inventions occur when a concept or solution strategy from one domain is transmitted to another. This type of transfer takes place when one discovers a nonobvious connection between a new situation and prior knowledge, which can be called "selective comparison." The process of selective comparison uses analogies, models, and metaphors to solve problems and create inventions. The inventor realizes that a new problem is similar to old information in some ways and then uses this similarity better to understand the newly acquired information. Consider the following minor problem:

> A covered container holds three different sizes of buttons; there are twenty-three small buttons, sixteen medium buttons, and eight large buttons. You need three buttons of the same size. How many buttons must you take out of the container in order to make sure that you will have three small, three medium, or three large buttons?

If individuals know how to solve the "two colors of socks" problem mentioned earlier and see its relation to this new problem, they will ignore the frequency information about the various buttons and imagine the longest sequence of drawings needed to ensure three of the same size (i.e., seven).

As with selective encoding, sometimes an impasse leads to selective comparison and conceptual change. Kevin Dunbar (2001) observed that scientists in a wide range of laboratories often turned to analogies to help them comprehend and move beyond obstacles in problem solving. For example, after obtaining a series of unexpected results, molecular biologists often drew analogies to different types of models. Although these analogies were within the same general domain of their research, they involved connections to work conducted by other researchers studying different organisms. As Sawyer (2008) notes, "Having the right analogy in your memory isn't enough to be creative; the key to creativity involves *noticing* the right analogy."

In sum, insightful selective comparison involves capitalizing on originally nonobvious relationships between new and old problem situations and solutions. This type of mental process seems especially applicable to the design of creative inventions. As Sawyer (2007, p. 191) notes, innovations are incrementally formed from ones that preceded them. Selective comparison occurs when seemingly unrelated aspects of old innovations are used to restructure one's mental representation of a new problem.

Overall, insightful problem solving, unlike more routine and obvious forms of problem solving, involves searching for previously overlooked relevant encodings, combinations, and comparisons of information and then restructuring one's mental representation of the problem based on the findings. The problem still needs to be solved, and this can take time, but the mental restructuring lets the individual know how to approach the solution. Selection and relevance are essential to all three of these mental processes. In encoding, one is selecting elements from the often numerous possible elements that constitute the problem situation; the key is to select the nonobvious relevant elements. In combination, an individual is selecting one of many possible ways in which elements of information can be combined or integrated; the key is to choose a nonobvious relevant way of combining the elements. Selective comparison involves selecting at least one out of countless old elements of information to which to relate new information. There are numerous relations that might be drawn; the key is to select the relevant comparison to make for one's purposes. Successful search for, and selection of, this relevant information leads to a change in problem solvers' mental representations of the problem. This conceptual change can subjectively feel as though it occurs suddenly. In contrast, non-insightful applications of encoding, combination, and comparison do not involve nonobvious search nor do they lead to an abrupt change in one's mental representations (or to an "Aha!" response). Fortunately, the Federal Circuit Court determined that nonobviousness can be established not only by a combination's result but also by how it occurred.

As Sawyer (2008) notes, the Supreme Court seems to view insight as a rare and unexpected occurrence. Certainly there are legendary creative geniuses, such as Henri Poincare and Amadeus Mozart, who felt their ideas came at unpredictable times and from an unknown source. Fortunately, insight is not exclusive to the greatest of minds. Even though intelligence is related to the insightful solution of puzzle problems (Davidson, 1995; Sternberg & Davidson, 1982), insight occurs more frequently and among a wider range of individuals than is often assumed (Lubart & Sternberg, 1995; Seifert et al., 1995).

## III. PROBLEM FINDING

Both Sawyer and Seifert make an important distinction between creative innovations that occur when individuals solve problems that are given to them and ones where individuals must first discover a problem. Problem-finding insights are typically viewed as more ground breaking than are ones that solve known problems, although after the fact they can, at times, seem predictable (Sawyer, 2007). Problem-finding insights often occur when individuals identify and define a formerly unrecognized impasse within a given domain and then recognize a new reconfiguration that overcomes it (Csikszentmihalyi & Sawyer, 1995). According to Csikszentmihalyi (1996), problems are discovered because creative people question the obvious and perceive (and define) problems before others are aware of them.

To learn more about differences between insightfully solving presented versus discovered problems, Csikszentmihalyi and Sawyer (1995) interviewed ninety-one individuals who were accomplished in a wide variety of domains. They found that solutions to presented problems tend to involve a relatively short amount of preparation time in which an individual confronts a well-defined, domain-specific problem. This preparation period is typically followed by short periods of scheduled incubation time, illumination, and spontaneous evaluation of the insight.

In contrast, problem-finding insights involve a relatively extended preparation period and are characterized by the synthesis of information from more than one domain. For this type of insight to occur, an individual must (1) acquire extensive knowledge of one or more domains, (2) become immersed in a field that practices one of the domains, (3) focus on a problematic situation in that domain and internalize information relevant to this situation, (4) use parallel processing to let the relevant information interact at a subconscious level with information from other domains, (5) recognize a new configuration emerging from this interaction of information that helps solve the problem, and (6) elaborate and evaluate the resulting insight in ways that are valued and understood by colleagues in the field (Csikszentmihalyi & Sawyer, 1995, pp. 358–359). Not surprisingly, the problem solving cycle for this type of innovation typically takes at least a year.

Due to the length of this cycle, and because many failures can occur before an insight is achieved, intrinsic motivation and perseverance are crucial to problem-finding creativity. Given that the correct approach is not obvious, multiple solution paths are often followed before the correct one is discovered (Csikszentmihalyi & Sawyer, 1995; Simonton, 1995). In his thorough study of Charles Darwin's accomplishments, Gruber (1981) claims that the best predictor of great discoveries is a prolonged and passionate dedication to a problematic area. Individuals must have sufficient devotion to endure ambiguity and occasional failures. Fortunately, creative adolescents and adults often maintain intense concentration and undivided attention while working in domains that match their abilities and interests (Csikszentmihalyi, 1996; Csikszentmihalyi, Rathunde, & Whalen, 1993). They become completely immersed in what they are doing and often lose track of time. This highly focused state of consciousness, or "flow," increases the likelihood that material within a domain will be mastered and creative insights will occur.

Keith Sawyer (2008) raises important points about the implications of problem finding creativity for patent law. First, creative solutions to previously unrecognized problems have a high likelihood of meeting the nonobvious requirement. Given that they do not involve a widely known problem within a domain, the solution has not been obvious. Second, he notes that problem-finding innovations are not well protected under current patent law or Supreme Court decisions. It seems likely that this will become a legal issue when one individual discovers a problem and another one creates its solution (or vice versa in the instances where an invention occurs long before a relevant problem is identified). As Sawyer argues, the creative problem finder and the creative problem solver are both necessary for the resulting innovation. However, it is not at all clear that both individuals' contributions would be patentable. The current system, which awards patents for solutions rather than for problems, is perhaps following common sense based on typical everyday experience. It is all too easy to find problems in our daily lives. However, problem discovery in technical fields is not typically as simple because, in part, it involves the merging of information from more than one domain.

## IV. COLLABORATION

Smith and Sawyer both note that creativity requires time and collaboration. However, Smith focuses on the intra-personal interaction between cognitive processes, while Sawyer concentrates on inter-personal partnerships involving groups of people. Each of these types of collaboration will be briefly discussed in turn.

### A. *Creative Cognition*

The creative cognition approach views creativity as the collaboration between two distinct types of ordinary mental processes: generative and exploratory (Finke, Ward, & Smith, 1992). "Generative processes"—such as memory retrieval, associations between memories, and analogical transfer—are used to produce creative ideas. More specifically, these processes generate preinventive structures, such as mental models, verbal combinations, and visual patterns. In order to promote multiple pathways for creative discovery, these structures (or mental representations) must be novel, versatile, and ambiguous; convey latent significance; and have emergent and conflicting features (Finke, 1995).

However, the formation of preinventive structures does not mean that they are interpreted. "Exploratory processes," in contrast, explore the creative implications of the structures produced by the generative processes. Examples of this type of process are conceptual interpretation, hypothesis testing, attribute finding, functional inference, contextual shifting, and searching for limitations (Finke, Ward, & Smith, 1992). In other words, the exploratory processes shape and refine the creative foundation laid by the generative processes.

The generative processes and many of the exploratory ones occur at the unconscious level and interact dynamically. For example, generative processes may form a novel idea that the exploratory processes judge to be of limited utility. The generative processes then use this information to produce another idea that is evaluated by the exploratory processes. This cycle continues until a desired final structure or solution is reached.

The creative cognition approach, which has been empirically and extensively tested, highlights the ordinary nature of creativity. In other words, creativity is not qualitatively different from other forms of thinking. The same mental processes are used to perform a variety of routine and non-routine tasks. However, creative ideas are the result of relatively unconscious collaborations among these ordinary processes.

### *B. Collaborative Webs*

Even though innovations can and do occur when people are alone, the preparation, evaluation, and elaboration stages surrounding them typically depend upon interaction with, and input from, one's colleagues. According to Csikszentmihalyi and Sawyer (1995, pp. 334–335), "[a]lthough the moment of creative insight usually occurs in isolation, it is surrounded and contextualized within an ongoing experience that is fundamentally social, and the insight would be meaningless out of that context." In support of this view, Dunbar (1995) found that the social structure of weekly research meetings plays an essential role in conceptual change and scientific insights. Of particular importance are questions from one's colleagues during these meetings. For example, mental restructuring frequently occurs when scientists are asked questions that cause their thinking to move from one level to another. In addition, when researchers' interpretations of their results are challenged or when they face the prospect of publicly admitting an impasse, they often develop alternative explanations that can result in insights. The most constructive laboratory meetings, according to Dunbar, occur when group members have different experiences and knowledge.

Sawyer (2008) persuasively argues that the Supreme Court's view of creative problem solving as an individual and linear process is not representative of today's innovations. Creativity is collaborative. Even the game of Monopoly evolved over several decades through the contributions of a variety of individuals (Sawyer, 2007).

According to Sawyer (2008), it is a myth that important discoveries come from solitary insights. The reality is that widely distributed social networks, or collaborative webs, generate a series of small sparks that result in creative outcomes that are greater than the sum of their individual parts. During this process, several individuals contribute ideas that cannot and should not be evaluated in real time for their nonobviousness and usefulness. These ideas are then modified and combined in creative ways, resulting in a new context for problem solving.

The positive connection between collaboration and creativity may seem counterintuitive. We all have numerous examples of useless, unimaginative, and sometimes disastrous committee outcomes (Janis, 1982). However, correctly executed collaboration increases the likelihood that many of the creative concepts previously described here will occur. For example, working with others exposes individuals to unfamiliar concepts, thus making it more likely that they will have conceptual elaborations or make distant combinations (Sawyer, 2007). Similarly, conversation or group activities can result in group flow, which is similar to an individual's intense periods of concentration and heightened consciousness described earlier. According to Sawyer, group flow occurs when individuals who share an implicit understanding of each other work flexibly together to accomplish a clear common goal. Through collaborative improvisation, each individual's performance is enhanced and problem-finding creativity is more likely to take place.

In sum, creativity is collaborative. This collaboration occurs on two levels. One is between cognitive processes and the other is in social networks.

## V. HINDSIGHT BIAS

Sawyer, Seifert, Smith, and the Supreme Court recognize that learning about an outcome irreversibly changes what is stored in memory. More specifically, individuals often falsely believe that they knew the outcome all along (Fischhoff, 1975; Fischhoff & Beyth, 1975). In a variety of experiments and domains, it has been found that people view antecedent information as more obvious in retrospect than they would have in foresight. Similarly, elements that would have originally been considered relevant to potential solutions are now viewed as unimportant (Blank & Nestler, 2007). In other words, when judging the obviousness of an invention, insightful selective encoding and the restructuring of one's mental representation do not need to occur; the inventor has already done this work. Furthermore, individuals become convinced, in retrospect, that the outcome was inevitable. This means that patent examiners and PHOSITAs can easily conclude that a design is obvious because they are judging it after it has occurred, been presented, and explained in detail. This would be a similar situation to Seifert's (2007) experiment where participants were given insight problems without the irrelevant information; the path to solution was obvious.

In explaining hindsight bias and other cognitive illusions, Smith (2008) makes an important distinction between conscious and unconscious cognitive processes. Conscious processes are effortful, explicit, and executed sequentially. Unconscious ones, in contrast, are automatic, executed in parallel, and implicit. Hindsight bias, according to Smith, occurs when initial judgments cannot be explicitly retrieved from conscious memory. Instead, implicit memories about the outcome create a familiarity that is misattributed to always knowing something. This cognitive illusion allows individuals consciously to make sense of events that deviate from their original expectations.

Hindsight bias is poisonous for the nonobviousness requirement in patent law. Even though the Supreme Court thinks it sufficient for patent examiners and courts simply to be aware of, and cautious about, hindsight bias, research presents a compelling case that this bias is impervious to change. Smith and Seifert cite a variety of examples illustrating how hindsight bias exists despite efforts to prevent it. In an empirical study specifically related to patent law, Gregory Mandel (2006) found a significant hindsight effect for determinations of nonobviousness; this bias was not drastically reduced by instructions to avoid it. For example, three groups of mock jurors were given a scenario based on a litigated patent about baseball instruction. The foresight group received information about the prior art and was told that a particular individual was attempting to solve the identified problem. Only twenty-four percent of these jurors believed the solution was obvious. The hindsight group was given the same information but also told about the invention. Seventy-six percent of this group considered the creation to be obvious. Finally, mock jurors in the de-biasing condition received identical information to the hindsight group, plus material based on Model Patent Jury Instructions that explained hindsight bias and urged them to avoid it. Sixty-six percent of these individuals determined that the inventor's solution was obvious. These and other results lead Mandel to conclude that patent law, as it is currently constructed, is unjust.

Seifert (2008) ends her paper with an intriguing solution to the hindsight problem: ask student engineers, who have ordinary skill in the art, to produce an innovation based on the same information that was available to the original inventor. This method would remove the opportunity for hindsight bias and, consequently, allow a fair assessment of nonobviousness. Another option is to take Mandel's advice and conduct further research on how hindsight bias affects different types of patent decisions and decisionmakers. These results would then be used to improve patent law. His reasoning is that effective patent reform cannot occur until the bias is fully understood.

## VI. CONCLUSIONS

Psychologists do not typically have ordinary skill in the prior art of patent law. However, we do know that some forms of problem solving yield less obvious solutions than others. We also understand that hindsight bias can be insidious. Given that the Supreme Court Justices are not psychologists, there are aspects of human behavior that they, to some extent, appear to misunderstand. In addition, there are relevant characteristics of creative behavior that current patent law does not take into account. These commissions and omissions will briefly be reviewed, followed by suggestions for how psychologists can help reform section 103 of the Patent Act.

### *A. Misunderstandings*

There are at least three aspects of human behavior that the Supreme Court seems to overestimate. These aspects involve individuals' ability to (a) avoid hindsight bias, (b) use familiar items in new ways, and (c) have extraordinary creativity that is qualitatively different from the day-to-day form. In other words, the Court assumes that humans are more rational and creative than we actually are under most circumstances.

#### *1. Hindsight Revisited*

As noted earlier, hindsight bias is perhaps the most troubling flaw in section 103 of the Patent Act. Telling people about the bias and warning them to avoid it, as the Supreme Court recommends, is usually pointless. The bottom line is that inventions seem more obvious in hindsight than in foresight. Perhaps, as Mandel (2006) suggests, there are individual differences that should be studied and taken into account. Some decision makers might be immune to the bias. This seems unlikely, however, because the original inventor is solving (and even finding) a different problem than the one other people reconstruct after seeing the invention. Hindsight does not involve impasses, selective encoding, restructuring of one's mental representation of the problem, or the other concepts described here.

The most reasonable solution to the hindsight bias problem would be to avoid it altogether. Seifert's (2008) suggestion to give graduate student engineers relevant resources and the task of producing an innovation is an objective test of whether a person having ordinary skill in the art would replicate the inventor's solution. However, as noted earlier, the problem solving cycle for problem-finding creativity is typically at least a year and graduate students might not be available that long. In these cases, it might be necessary to monitor the problem solving processes (e.g., selective encoding, combination, and comparison) students use and the impasses they reach, rather than wait for the final product. Another solution would be to analyze the obviousness of inventions using Sawyer's (2008) empirically based guidelines for the four core processes of creativity: conceptual combination, conceptual transfer, conceptual elaboration, and conceptual creation. For example, a combination of dissimilar concepts would be deemed less obvious that a combination of similar ones; changing a central property of a concept would be judged as less obvious than modifying a peripheral feature.

*2. Fixation*

Many non-routine problems, on the surface, appear to be routine ones. Unfortunately, applying routine procedures leads to obvious, but incorrect, solutions. Even when problem solvers realize that their old strategies are irrelevant to the current situation, they often cannot break their focus on this approach in order to develop a more productive plan for solution. In other words, fixation causes individuals to try the same problem solving strategies over and over, even when they know this is fruitless. Similarly, functional fixedness often prevents problem solvers from using well-known objects in unfamiliar ways. The Supreme Court should recognize that (a) it is difficult to ignore irrelevant information and (b) familiar items generally do not have obvious uses beyond their primary purposes. In general, fixation is a common barrier to creativity and it automatically means that effective solutions are nonobvious.

*3. The Ordinary Nature of Creativity*

Sawyer (2008) notes that the Supreme Court essentially makes a distinction between creativity that is ordinary and un-patentable and creativity that is real and patentable. It is common to believe in a "true" creativity that is extraordinary and qualitatively different from other forms of thinking. However, current theoretical models and empirical research do not support this belief. Instead, the creative cognition approach (Finke, Ward, & Smith, 1992) and other psychological models of creativity propose that individuals use the same mental processes for both routine and non-routine problem solving. The differences between these two types of problem solving reside not in the processes themselves but in how they collaborate and shape mental representations of a problem. Relevant research in support of these views suggests that individuals with ordinary skill in the prior art can use ordinary processes to produce nonobvious innovations. Creativity is not trivial nor is it as unique and mysterious as is often believed.

### B. *Omissions*

Given the rapidly changing workplace, future assessment of nonobviousness might benefit from incorporating additional aspects of the creative process. Current patent law seems primarily to focus on individuals' conceptual combinations that address known problems in a domain. Sawyer, Seifert, and Smith nicely demonstrate that creativity involves so much more than this: conceptual transfer, conceptual elaboration, unconscious processing, problem finding, collaboration, and other processes also play a role. Some of these processes, such as problem finding, seem likely to lend themselves to nonobvious innovations. In addition, legal issues will most likely surround these innovations if they involve collaborations between companies or if one person discovers a problem that another person solves. Revising patent law to include a more complete portrayal of the creative process will help clarify decisions about who has the legal right to a patent.

### C. *How Psychologists Can Help*

This Article is not intended to be critical of the Supreme Court or of patent law. The assessment of nonobviousness is a non-routine problem that no heuristic or formula will be able to solve. Psychologists are continually struggling with their own non-routine problems, such as how to understand creativity. Insightful solutions might well result if patent lawyers and cognitive psychologists form a collaborative web. A partnership between these two domains could help resolve patent issues surrounding nonobviousness and advance what is known about innovative problem solving.

As part of this collaboration, psychologists would need to move their research agendas beyond puzzle problems, college student participants, and laboratory settings. Some researchers (Dunbar, 2001; Sawyer, 2007) have already begun this movement by examining creativity in the workplace. This type of research and the recent Supreme Court decision in *KSR v. Teleflex* (2007) bode well for a productive collaborative web of knowledgeable parties from more than one domain. In short, a partnership between patent lawyers and cognitive psychologists seems like an obvious solution to the non-routine problem of nonobviousness.

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