INVISIBLE ASSUMPTIONS AND THE UNINTENTIONAL USE OF KNOWLEDGE AND EXPERIENCES IN CREATIVE COGNITION

by
*Steven M. Smith**

Research on the cognitive processes involved in creative thinking sheds light on the nonobviousness of new ideas and inventions. An understanding of the conscious and unconscious use of prior knowledge and experiences is essential to the appreciation of the ways that new ideas come about and how those ideas should be evaluated. The creation of a guide for nonobviousness in patent law is proposed which would set out rigorous criteria for presenting and assessing evidence of nonobviousness that are as clear as those criteria that concern other aspects of patents. Such a guide would promote fairness in the consideration of patent evidence by describing practices and procedures that, if consistently applied, would tend to increase the fairness of patent evidence. Adherence to these procedures could conceivably decrease the number of wrongfully granted and wrongfully denied patents, and would help ensure that reliable procedures are included in the presentation and assessment of patent applications.

I. INTRODUCTION

Creative products are in part a function of cognitive structures and processes; that is, the mind.** Although there are many aspects of

* Texas A&M University, Department of Psychology. The author wishes to thank Jami Shah, Thomas Ward, and Nicholas Kohn for their contributions to the reported research studies.

** 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

creativity that have been studied, such as environmental, educational, and historic factors, it is clear that an understanding of some of the fundamental workings of the human mind is essential for an understanding of creativity. Whenever there has been a creative discovery or invention, it has always emerged as the result of human efforts or insights. The *KSR International Co. v. Teleflex Inc.*[1] case makes points that clearly relate to human cognition, and how thought gives rise to creative accomplishments. For example, the Supreme Court's opinion explicitly refers to issues such as "a person of ordinary creativity," and the "inferences and creative steps" that people make. Understanding how the human mind functions is indispensable in understanding the creative process.

In this Article, the roles of explicit (conscious) and implicit (unconscious) cognitive operations in creative design and invention are discussed. Experimental research on these two qualitatively different processes is described, and it will be shown how these two cognitive functions can produce cognitive illusions, and how people involuntarily use prior knowledge and experiences when they have creative ideas.

II. CREATIVITY

The term creativity has been defined in many ways, although there is no consensual definition of the concept. Cognitive psychologists, however, have settled on two main features of creativity, novelty and value. These two attributes are necessary, but may not be sufficient for an idea or product to be judged creative. Novelty, or newness, can occur at many levels, including the novelty of a cognitive or biological process, group and institutional novelty, novelty for a particular society, and historic novelty. Although the implications of novelty at these different levels are often quite different, it can also be the case that an "ordinary" set of cognitive processes can produce ideas that are novel at all of these levels. Novelty can arise as a creative element or object, it can emerge as a function of combinations of non-novel elements, and it can emerge as a function of novel contexts. Value, as an aspect of creativity, must be broadly determined. For example, even if value is not directly monetary in nature, it may nonetheless solve a problem, serve a function, or even satisfy an emotional need. Furthermore, value changes over time, rising and falling due to contextual changes. Ideas that may have no clear value during their inception may later take on great value, long after the life of idea's creator. Therefore, the value of creativity must include potential value.

Beyond novelty and value, creativity can be defined only in terms of a "family resemblance." That is, there is a set of characteristics shared by

a modified APA citation format, rather than the usual Bluebook citation format. We have added some pinpoint citations to aid the legal reader.

[1] 127 S. Ct. 1727 (2007).

creative things, and although these features are commonly seen in creative things, none is necessary or sufficient to label something as truly creative. Examples of these shared features include ambiguity, emergence, originality, insightfulness, incongruity, meaningfulness, surprise, flexibility, and divergence.[2]

III. CREATIVITY AND THE MIND

Creative cognition[3] refers to the cognitive processes, structures, and operations that give rise to creative ideas. Examples of cognitive structures, which have fixed properties and capacities, include short-term memory, mental models, schemas, or episodic long-term memory. Cognitive processes mentally manipulate and transform knowledge and information within cognitive systems, and include pattern recognition, encoding, retrieval, visualization, or analogical reasoning. There is no unitary "creative process"; the science of creative cognition deals with the complex interacting components of creative thinking, as is done in other areas of cognitive experimental science, such as memory, language, or decision-making. Cognitive procedures that are frequently involved in creative cognition include combination, ideation, imagination, incremental work, ineffable processes, and logical reasoning. Each of these procedures involves complex interactions of basic cognitive processes. Combination involves synthesis, usually visual or conceptual, and the emergence of novel qualities that are not features of the constituent elements. Ideation, the process of generating ideas, includes divergent thinking and remote association. Imagination includes visualization, cognitive restructuring, or thinking about ideas from changing perspectives, and insight, the sudden realization of ideas or solutions. Some creative cognition involves simple incremental work, such as everyday sorts of learning, memory, or mental computation. Ineffable processes are those mental operations that cannot be easily expressed by words, and include intuition, or hunches about possible ideas, and incubation, the processes that can occur after an initially intractable problem is temporarily put aside. Finally, creative cognition often involves logic, such as analogical reasoning and transfer, inference, and induction. Operating alone, none of these cognitive processes is equivalent to creative thinking, just as a symphony cannot be reduced to a single instrument, or a painting reduced to a single brush stroke.

One of the most ubiquitous concerns in the creative process is the problem of implicit assumptions that are limiting or erroneous. Such implicit assumptions must be overcome for one to have successfully creative ideas. What is most maddening about this situation is that

[2] Finke, R. A., Ward, T. B., & Smith, S. M. (1992). *Creative Cognition: Theory, Research, and Applications*. Cambridge, Mass.: The MIT Press.

[3] Smith, S. M., Ward, T. B., & Finke, R. A. (1995). *The Creative Cognition Approach*. Cambridge, Mass.: The MIT Press.

implicit assumptions are, by definition, invisible, hidden from one's conscious mind. A common example of these implicit assumptions can be seen in the classic Nine-Dot Problem (Figure 1). In this problem, the problem-solver has nine dots arranged in a square, and must draw four straight lines without lifting the pen to connect all nine dots.

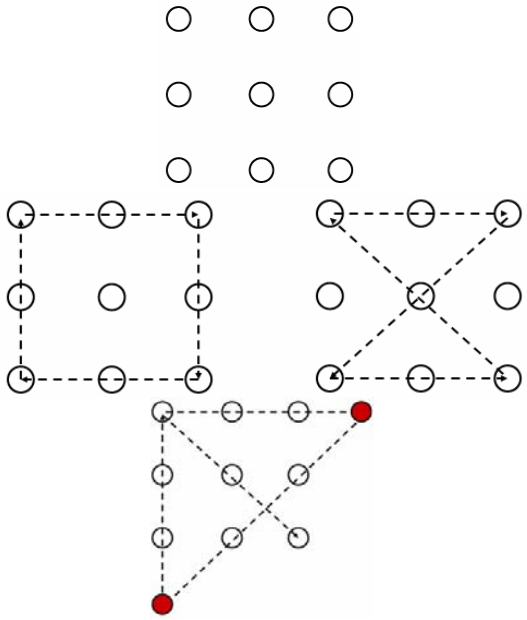

Figure 1. The Nine Dot Problem, shown at the top of the figure. The two failed solution attempts in the center of the figure do not go outside of the perceived square defined by the dots. The solution, shown at the bottom, goes outside of the "box" in two places (the shaded dots).

When people first try to solve this problem, they seem to impose implicit assumptions and rules that limit the scope of their solution attempts. For example, they might assume that each line must start and stop on a dot, or that their solution should not go outside of the "box" that is perceptually defined by the outer perimeter of dots. The solution, shown in Figure 1, violates both of these implicit assumptions.

To understand how implicit assumptions can occur, how they can impact the creative process, and how they can be overcome, one must understand the nature of implicit and explicit cognitive processes, and how these processes function, sometimes collaboratively, and sometimes independently.

IV. IMPLICIT AND EXPLICIT COGNITION

There are two qualitatively different ways in which cognition acts to use or access prior knowledge and experiences: Explicit and implicit

memory. The term explicit memory refers to remembering deliberately and with conscious awareness, where the memory is the object of one's experience, and details of the original experience, such as the time or the setting, can be brought to mind. In contrast, implicit memory is involved when one automatically and involuntarily responds in a way that corresponds to prior experience; prior knowledge can be used unconsciously as a tool, such as identifying a partially obscured object because one has seen the object recently, or more easily solving a previously solved problem. Implicit memory involves a sense of familiarity that is not accompanied by awareness of the source of that familiarity. This familiarity may occur because the cognitive processes engaged in one event can be repeated more fluently (*i.e.*, more easily or more quickly). In contrast, explicit memory involves the conscious recollection of prior experiences that includes the source of the prior event, such as the context of the remembered event.

A clear anatomical basis of these two qualitatively different types of memory was explained in studies of brain-damaged patients whose hippocampal damage caused anterograde amnesia.[4] These patients are poor at recollecting recently experienced events. For example, they can recall few, if any words from a list read only minutes before the recall test, and, in fact, they may not even remember having read the list of words at all.

For example, if patients with anterograde amnesia read the following list of words, and were asked a few minutes later to recall the words, they would perform very poorly, and may recall none of the following:

ANALOGY
BRIGADE
TONIGHT

If, however, these amnesic patients are given word fragments, and are asked to fill in the missing letters to complete the words, they will perform much better for the word fragments that correspond to words from the list they read:

A_ _ L _ G Y
B_ _G A _ E
T _ N _ G _T

In contrast, amnesic patients would find it difficult to complete word fragments for words that were *not* recently read:

C _ T _ A _ E
H _ L S _ E _
V_ _ A G E _

The solutions for these last three fragments are *cottage*, *holster*, and *voyager*.

[4] Warrington, E. K., & Weiskrantz, L. (1970, November 14). Amnesic Syndrome: Consolidation or Retrieval? *Nature, 228*, 629–630.

Thus, although the words cannot be recalled explicitly by amnesics, there is nonetheless an effect on amnesics' implicit memory, as indicated by the patients' improved ability to complete word fragments that correspond to list words. Interestingly, people with anterograde amnesia can learn new facts, but when asked, they may claim always to have known the newly learned facts. That is, they may fail to explicitly recollect the implicitly remembered facts.

Non-amnesic control subjects also show corresponding improvements in word fragment completion, a phenomenon referred to as *repetition priming*, but, unlike amnesics, they can recall list words as well. Showing that amnesic patients retain only implicit memory establishes a clear distinction between these two different abilities.

Most people who do not suffer anterograde amnesia have intact explicit and implicit memory functioning, and these two types of memory typically work together. For example, implicit memory may cause a response to pop into mind, or it may trigger a sense of familiarity, and then explicit recollection can retrieve associated information, such as when the familiar idea had been seen or heard. Normal explicit recollection of events, however, is highly susceptible to forgetting. In many interesting situations, it is found that explicit recollection of an event is less reliable than implicit memory. This combination of a successful implicit response combined with a failure of explicit recollection has been shown to be the basis of several cognitive illusions that are commonly experienced by normal people.

V. INAPPROPRIATE USES OF KNOWLEDGE AND EXPERIENCES IN COGNITION

A cognitive illusion is a false or erroneous mental representation of reality. Optical illusions are commonly known even in the public domain, but other types of cognitive illusions, such as false memories, unconscious plagiarism, and hindsight bias, are less well known. Many of these illusions occur in situations in which implicit memory succeeds but explicit memory fails. That is, implicit memory can bring knowledge or memories to mind, but explicit recollection can fail to identify the source of the memory. In such situations, people may make inferences about the knowledge, and such inferences may be true or false. Cognitive illusions result when such inferences are false.

As previously noted, implicit memory can allow a repeated stimulus to be more fluently cognitively processed. For example, one may more fluently read a word or a name, solve a problem more easily, recognize a face, or generate a creative idea if one recently has encountered those stimuli or ideas. In these cases, one correctly attributes the subjective experience of fluency if recollection of the recently encountered word, name, problem, face, or idea is successful.

The false fame illusion,[5] for example, can be induced by having someone read a long list of names that are clearly designated as names of non-famous people, such as *Douglass Shaw*. After time has passed, the non-famous name is included on a list that includes both famous (*e.g.*, *John Adams*) and non-famous names. If a recently encountered non-famous name, such as *Douglass Shaw*, seems familiar, but the rememberer cannot explicitly recollect reading the name, then the familiarity might be incorrectly attributed to fame. That is, if implicit memory finds the name is familiar, and explicit recollection of the name having been read on the non-famous list fails, then one might falsely infer that the familiar name must be the name of a famous person. A similar memory illusion called *unconscious transference* can occur when a familiar face is recollected to have been seen in the wrong context, an illusion that can be quite consequential when it happens to an eyewitness to a crime. Yet another memory illusion is called *cryptomnesia* or *unconscious plagiarism*.

Another such illusion is found when one judges the difficulty of puzzle problems. If the puzzle is new to the problem solver, then the time needed to solve the puzzle is used to estimate the puzzle's difficulty. If, however, the solution is given along with the puzzle, then it will be judged to be easier than it actually is.[6] In this case, one's subjective experience has been spoiled or tainted by seeing the solution, because that experience makes the puzzle solved more fluently, and that fluency is incorrectly inferred to mean that the puzzle is easy to solve.

This same pattern of cognitive processes explains hindsight bias. When people estimate what someone would, should, or could have done in a situation, their judgment can be clouded by hindsight.[7] Once people know something, they find it difficult to ignore their new knowledge and recognize their own prior state of ignorance, nor can they easily comprehend other people's ignorance. *Creeping determinism* refers to a tendency to judge events in hindsight as more inevitable or foreseeable than in foresight. Implicit familiarity of new knowledge is falsely attributed to having known something all along. Learning the solution to a problem can produce implicit familiarity that might be incorrectly interpreted to mean that the problem was easy, or the solution was obvious. Likewise, learning something about a new creative invention or idea before observing and judging the creative value might produce implicit familiarity, creating a cognitive illusion that the idea or invention is not creative or novel.

[5] Jacoby, L. L., Kelley, C. M., & Dywan, J. (1989). Memory attributions. In H. L. Roediger, III, & Fergus I. M. Craik (Eds.), *Varieties of Memory and Consciousness* (pp. 391–422). Hillsdale, NJ: Erlbaum.

[6] *Id.*

[7] Fischhoff, B. (1975). Hindsight • foresight: The effect of outcome knowledge on judgment under uncertainty. *Journal of Experimental Psychology: Human Perception and Performance, 1*, 288–299.

VI. RESEARCH IN CREATIVE COGNITION

Experimental research on aspects of creative thinking demonstrates the ways that implicit cognitive processes can be causally linked with behavioral outcomes across a broad range of tasks that vary in complexity, from tightly controlled artificial experimental settings to ecologically valid situations involving real world design and invention. This research strategy of conceptually linking experiments at many levels of complexity has been referred to as an *alignment* process,[8] and is useful for establishing generality and relevance from controlled experiments to naturalistic design and invention situations.

Studies of implicit memory processes using indirect measures, such as word fragment completion, set the stage for showing that cognitive blocks, or impasses, can also be caused by implicit memory processes. Although implicit memory can facilitate the subsequent use of recently encountered information, it can block or impede performance on tasks for which the original information is similar but inappropriate. For example, seeing the word ANALOGY helps with subsequent completion of the word fragment A_ _L_GY, but impedes completion of the similar word fragment A_L_ _GY.[9] Studies using this implicit memory task, word fragment completion, indicate that the same factors that influence the positive uses of implicit memory can influence implicit impediments in exactly the same ways. These experiments demonstrate that prior experiences (*e.g.*, reading the implicit blocking words; see more examples in Figure 2) unconsciously can influence and obstruct performance on simple tasks. Furthermore, even when experiment participants were warned to avoid remembering the misleading words from the list they had read, they could not avoid or diminish the negative effect of the previously seen blocker words, which were involuntarily and unconsciously brought to mind by the orthographically similar word fragments.

[8] Shah, J. J., et al., *Empirical Studies of Design Ideation: Alignment of Design Experiments with Laboratory Experiments* (Proceedings of the American Society of Mechanical Engineering) (2003).

[9] Smith, S. M., & Tindell, D. R. (1997). Memory blocks in word fragment completion caused by involuntary retrieval of orthographically similar primes. *Journal of Experimental Psychology: Learning, Memory and Cognition*, *23*, 355–370.

Blocker	Fragment	Target
ANALOGY	A _ L _ _ G Y	ALLERGY
BRIGADE	B _ G _ A _ E	BAGGAGE
COTTAGE	C _ T A _ _ G	CATALOG
CHARTER	C H _ R _ T _	CHARITY
CLUSTER	C _ U _ T R _	COUNTRY
CRUMPET	C U _ P _ _ T	CULPRIT
DESTINY	D _ _ N I T Y	DIGNITY
FIXTURE	F _ I _ U R E	FAILURE
HOLSTER	H _ S T _ R _	HISTORY
TONIGHT	T _ N G _ _ T	TANGENT
TRILOGY	T R _ G _ _ Y	TRAGEDY
VOYAGER	V O _ _ A G _	VOLTAGE

Figure 2. Blocker words, word fragments, and fragment solutions used by Smith & Tindell (1997).

The blocking effect was again demonstrated for experimental subjects trying to solve Remote Associates Test (RAT) problems, a task that was developed to test cognitive abilities thought to be at the heart of creative thinking.[10] In RAT problems three test words are given, and the solution is a single word that is closely associated with each of the three test words. For example, for the RAT problem APPLE-HOUSE-FAMILY the solution is *tree*, which makes the phrases *apple tree*, *tree house*, and *family tree*. If blocker words (*i.e.*, words that resemble solutions, but that do not solve the RAT problems) are seen just before the test, they have the effect of blocking or impeding performance on RAT problems. For example, the blocker word *green* makes a two-word phrase with two of the test words in the APPLE-HOUSE-FAMILY problem, *green apple* and *green house*, but it does not fit for the third test word, *family*. Subjects who have seen the blocker words are considerably worse at solving RAT problems than subjects who have not recently seen blocker words.[11] People involuntarily use recently encountered words, implicitly bringing them to mind, which has the effect of blocking access to the correct solutions. More examples of RAT problems with blocker and solution words are shown in Figure 3.

[10] Mednick, M.T., et al. (1964). Incubation of Creative Performance and Specific Associative Priming. *Journal of Abnormal and Social Psychology, 69*, 84–88.

[11] Smith, S. M., & Blankenship, S. E. (1991). Incubation and the persistence of fixation in problem solving. *American Journal of Psychology, 104*, 61–87.

Remote Associates Test Problems			Blockers	Solutions
SALAD	HEAD	GOOSE	lettuce	egg
BED	DUSTER	WEIGHT	room	feather
APPLE	HOUSE	FAMILY	green	tree
CAT	SLEEP	BOARD	black	walk
WATER	SKATE	CUBE	sugar	ice
ARM	COAL	STOP	rest	pit

Figure 3. Remote Associates Test words, blocker words, and solutions used by Smith & Blankenship (1991).

The involuntary use of implicit knowledge affects not only creative problem solving, but also creative ideation; that is, the process of generating new ideas in open-ended creativity tasks. For example, one experimental task asks subjects to create and diagram imaginary life forms that might evolve on an Earth-like planet, a task not unlike the activities of the creators of science fiction books, movies, and video games. Students given this creative ideation task often produce novel ideas. If, however, subjects are first shown examples of ideas for such imaginary creatures, their subsequent sketches often incorporate the features of the example ideas.[12] For example, after seeing the examples shown in Figure 4—all of which have antennae, four legs, and a tail—subjects are much more likely to include those features in their creative ideas. For example, the imaginary creature on the top of Figure 5, which incorporates all three of the example features, was sketched by a subject who had just viewed the examples, whereas the sketch on the bottom, which contains none of those features, was done by a subject who saw no examples. These conformity effects occur even when subjects are asked to make their ideas as different as possible from the examples they have been shown, indicating that the effects are, indeed, involuntary.

[12] Smith, S. M., et al. (1993). Constraining Effects of Examples in a Creative Generation Task. *Memory & Cognition, 21*, 837–845.

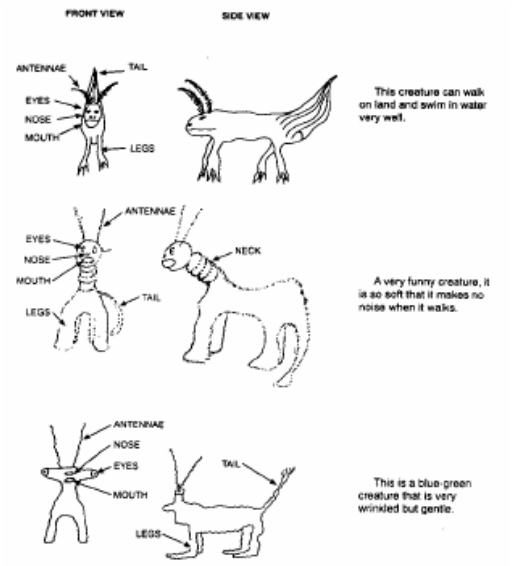

Figure 4. Example ideas shown to subjects in Smith et al. (1993), all of which have antennae, four legs, and a tail.

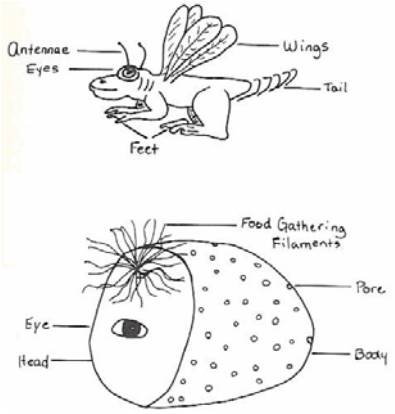

Figure 5. Sketches of ideas by subjects in Smith et al. (1993). The subject who drew the top figure had seen the examples in Figure 4 with antennae, four legs, and a tail, whereas the figure on the bottom was drawn by a subject who saw no examples.

These conformity effects occur not only for ideas that are completely fanciful, as in life on another planet, but also for ideas that are better rooted in real experience. When asked to design and sketch new toys that they had never encountered before, college students came up with a number of creative ideas. If, however, students were first shown three examples (Figure 6), all of which included a ball, a high level of physical activity, and electronics, then their creative new toys also tended to incorporate the features of the examples (Figure 7). Again, this

conformity effect occurs even when students are told to diverge from the examples as much as they can.[13]

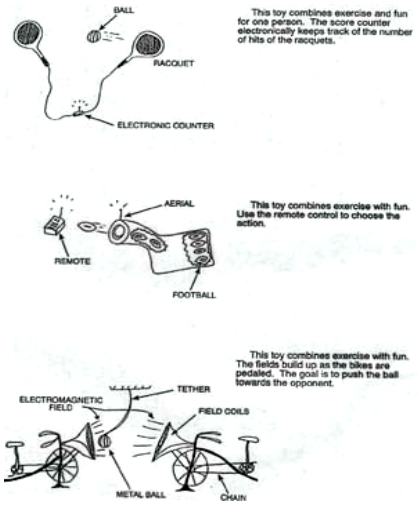

Figure 6. Example ideas shown to some subjects in Smith et al. (1993). The examples all included a ball, a high level of physical activity, and electronics.

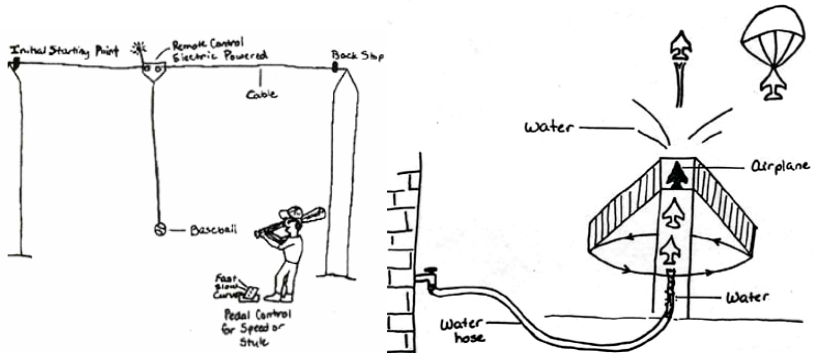

Figure 7. Sketches of ideas by subjects in Smith et al. (1993). The toy idea on the left was done by someone who saw the examples shown in Figure y, which included a ball, a high level of physical activity, and electronics, whereas the water jets toy on the right was drawn by someone who saw no examples.

Students in an engineering design class have considerably more expertise than the participants in the Smith et al. (1993) study, who were non-expert students from introductory psychology classes. Nonetheless, these more expert student designers show the same involuntary conformity effects, referred to as *design fixation* effects, as do non-expert subjects. For example, when design students were given the task of designing new measuring devices to be used by visually impaired people,

[13] *Id.*

half were first shown the example in Figure 8. The flaws in this design include that it lacks an overflow mechanism and that it does not measure infinitely variable amounts, although these flaws were not explicitly identified to the design students. Those who had seen the example design in Figure 8 were far more likely than others to design a device with the same flaws.[14]

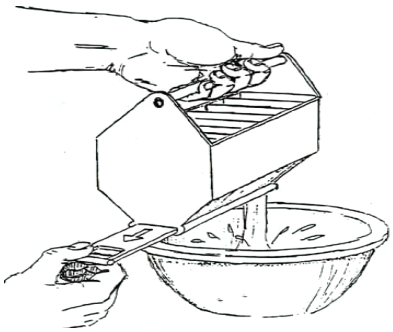

Figure 8. Example design shown to some subjects in Jansson & Smith's (1991) study. The example measures only non-infinitely variable amounts and lacks a much-needed overflow device, two design flaws.

In another experiment by Jansson & Smith (1991), engineering design students were asked to invent a spill-proof coffee cup, and they were explicitly forbidden from using straws or mouthpieces in their designs. Half of the design students saw the flawed example shown in Figure 9, which has both a straw and a mouthpiece. Those who first saw the example were usually unable to think of ways of designing a cup without the explicitly forbidden flaws, another case of involuntary design fixation. In this case, relative experts were susceptible to the effect.

[14] Jansson, D. G., & Smith, S. M. (1991). Design fixation. *Design Studies, 12*, 3–11.

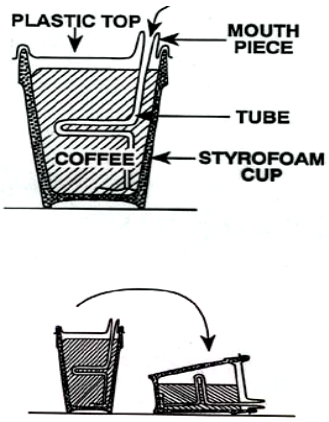

Figure 9. Example spill-proof coffee cup, shown to some subjects in Jansson & Smith's (1991) study. The example uses a mouthpiece, which would make one's mouth susceptible to scalding, and a straw that would leak, two design flaws that were explicitly forbidden in the task instructions.

These experiments also tested professional engineering designers to see if they were susceptible to involuntary design fixation. These engineers were expert designers. They were given the task of designing a device that would be placed inside a patient's intestine, and would take samples and measurements along the way. Half were shown the flawed example in Figure 10, and half saw no examples. The flawed example included a cord (rather than a radio or ultrasonic signal), a control box (which was superfluous), and an opening on only one end of the internal sensor (rather than on all sides), three major design flaws. The professional designers who saw this example were strongly influenced by it, incorporating far more of these flaws in their designs than did designers who did not see the example. Thus, design fixation, an involuntary process in which previous experiences are implicitly used in the invention process, influences experts as well as non-experts in creative thinking.

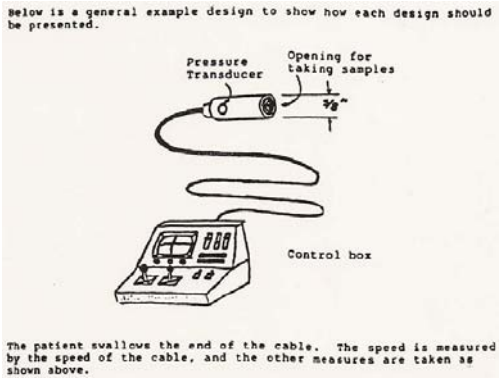

Figure 10. Example design of a biomechanical device for taking measurements inside a patient's intestine, shown to professional engineers in Jansson & Smith's (1991) study. The example has a cord, a front opening, and a control box, three design flaws.

An historic example of the use of prior experience in invention concerns the design of the earliest railroad passenger cars. These trains were constructed to look like a series of stagecoaches strung together, with doors opening on the sides of each car rather than the central aisles and doors that now connect railcars on most trains. In hindsight, the idea of cars connected by doors seems quite obvious, yet the involuntary use of stagecoach features brought along with it the flawed idea of side-opening doors. Not until many conductors were killed by falling off the outsides of the vehicles did people realize that a different solution was needed.

VII. A PROPOSED GUIDE FOR NONOBVIOUSNESS IN PATENT LAW

In 1999, U.S. Attorney General Janet Reno and the National Institute of Justice published a set of procedures for collecting and preserving eyewitness evidence within the criminal justice system.[15] The eyewitness evidence guide was motivated by an increasing number of cases of DNA exonerations of people convicted of serious crimes; clearly, eyewitness evidence was being tainted and misused in some cases. Although the guide does not carry the weight of law, it nonetheless has been used by law enforcement officials to improve the collection and preservation of eyewitness evidence, and by courts in assessing the credibility of eyewitness' memories. The guide was developed by a group of cognitive and social scientists, law enforcement officials, and attorneys who established a relevant set of principles, policies, and procedures for collecting and preserving eyewitness evidence, as well as summary

[15] U.S. Department of Justice. (1999). *Eyewitness Evidence: A Guide for Law Enforcement.* Retrieved March 20, 2008, from http://www.ncjrs.gov/pdffiles1/nij/178240.pdf.

statements to explain the justification and importance of the prescribed procedures.

It is proposed that a similar effort could establish a guide for the collection and preservation of evidence of nonobviousness in relation to patent law. Such a guide could steer the patent applicant towards collecting and presenting historical evidence related to the problems solved by the patent, and towards documenting the creative processes involved in the discovery and invention process. The guide could also direct patent application and assessment procedures in ways so as to avoid or minimize cognitive illusions, such as hindsight bias.

It would be important for such a guide to be supported by cognitive, economic, and social science research. Research psychologists have produced substantial findings regarding creative thinking and the way that people assess obviousness. In addition, economic research shows the implications of different types of errors that can occur in the assessment of nonobviousness in patents. Such a guide should make use of psychological and economic findings by including them in the recommended procedures. A guide could combine research and practical perspectives. Cognitive and social science research on innovation and the creative process has been increasing. At the same time, important legal decisions have been made that have important implications for the judged nonobviousness of inventions that are candidates for patents. The group that develops a guide for nonobviousness in patent law should include cognitive, social, and economics researchers, patent lawyers, inventors, and directors of research & development from organizations of all sizes.

This proposed guide could consider developing procedures in relation to the following issues, among others:

- The Scope & Content of Prior Art
- The Invention
- The Inventor
- The Examiner
- Differences Between Prior Art and Claims at Issue
- Level of Ordinary Skill in the Pertinent Art
- Commercial Success
- Long Felt but Unsolved Needs
- Failures of Other Inventors Working on the Same Problem
- Teaching, Suggestion, or Motivation Test (TSM Test)
- Combining Familiar Elements According to Known Methods

Research has shown that hindsight bias can cause an involuntary illusion that can influence perceptions of nonobviousness. A guide could develop procedures to take into account factors such as the length of time a problem has existed, and the number of other inventors who *failed* to solve a problem that is solved by a particular patent. A guide could also give statements of principle citing what is accomplished by prescribed procedures, statements of policy to applicants and reviewers explaining

how to conduct various procedures, procedures for performing various tasks related to the patent process, and summary statements explaining the justification for each procedure.

VIII.CONCLUSION

Creativity derives from and depends upon implicit and explicit cognitive processes. The interplay of these two processes can lead to accurate outcomes, but it can also lead to cognitive illusions, such as hindsight bias and unconscious plagiarism. In order to understand what "a person of ordinary creativity" is, what makes ideas seem obvious or nonobvious, how "inferences and creative steps" are taken in the creative process, and particularly the role of prior knowledge in creative thinking, one must consider the way that cognitive processes operate. It is proposed that a group of cognitive and social scientists, economists, business managers in research and development, inventors, patent examiners, and patent law experts convene to discuss and codify methods of protecting and preserving evidence of nonobviousness in the patent process. Methods must be determined to provide evidence of the history of the problems solved by an invention, to document the events surrounding the discovery and invention process, and to manage the patent application and evaluation to avoid cognitive illusions, such as hindsight bias.