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On the Nature of Expertise in Visual Art

Sandra I. Kay

Moore and Murdock (1991) challenged researchers who study problem finding to answer several questions:

> What accounts do we have by problem finders of problem finding? What are their preferences for finding and forming questions and problems, and how do these preferences affect solving? What are the process pathways problem finders take as they explore the parameters of memory and knowledge? What pathways do they choose to arrive at their solutions? (p. 292)

The answers are critical to researchers who study creative thought and, therefore, to researchers interested in people who are gifted. Gleaned from the qualitative data collected during an empirical investigation of the thought processes of artists, some observations on the nature of expertise in these problem finders could offer potential for further investigation. This chapter reports unexpected findings regarding the nature of expertise (Kay, 1994) and explores the implications for explaining and nurturing creative giftedness. A brief description of the original investigation (Kay, 1989) precedes the focus on the qualitative differences that emerged among the various levels of expertise.

Experiment in Problem Definition

The purpose of the original investigation (Kay, 1989) was to explore the relationship between *problem solving* (the process of finding a solution to a stated problem) and *problem finding* (the formulation of a problem prior to the actions taken to solve the problem) in the manipulation of figural symbol systems by professional artists, semiprofessional artists, and nonartists. The possibility that these thought processes are qualitatively different for different people is supported in the literature by comparisons of experts and novices (Chi, Feltovich, & Glaser, 1981; deGroot, 1965; Schoenfeld & Herrmann, 1982). For example, deGroot (1965) concluded that the actual problem-solving process involved in chess mastery differs between expert

and novice both quantitatively and qualitatively. Variables that measure the speed of the performance on a task (latency) or the accuracy attained in the performance define the proficiency with which a task is completed. Analysis of these variables measures quantitative differences alone. Differences in the type or quality of the processes used in problem solving (Chi et al., 1981; Kanevsky, 1990) and in problem finding (Beittel & Burkhardt, 1963; Getzels & Csikszentmihalyi, 1976) have been observed through the analysis of dynamic process variables (Kay, 1991, p. 235).

The principal research question was this: Are there differences in the figural problem-solving and problem-finding behaviors of professional artists, semiprofessionals, and nonartists? Five hypotheses were advanced to address differences between the groups in their scores on spatial visualization measures; reaction time on a figural problem-solving task; and the reaction time, number of pauses, and number of completed ideas on a problem-finding task.

Sixty participants were selected for equal distribution into three independent groups. Each group consisted of 10 male and 10 female adults. Twenty visual artists—10 sculptors and 10 painters—who regularly exhibited their work in museums or galleries and earned their living solely through the production of art constituted the group of professional artists. The group of semiprofessional artists—10 painters and 10 sculptors—consisted of individuals who had formal art training beyond high school and produced ideas in art but did not earn their living producing their art work. The nonartists were graduate students who had not had formal art training since high school and who claimed they did not produce ideas in art under any circumstances.

The problem-finding task (the description of only one of the two tasks is necessary here) used a puzzle-type game available on the consumer market. PABLO, manufactured by Fox Spielverlag, is a construction toy that consists of 120 cardboard pieces of various sizes, shapes, colors, and patterns that can be used with small plastic connectors to build structures.

It was believed that a task other than the drawing task used in other studies of artists (Getzels & Csikszentmihalyi, 1976; Patrick, 1937) might offer a direct perspective on differences in cognitive processes without the confounding of extensive previous experience by one or more groups with the specific task. In other words, to compare the drawing procedure of those who draw and those who do not (nonartists) cannot help to address the issue at hand.

The use of play activities for analysis of cognitive behavior is suggested by the work of Welker (1961) in which the behavior mechanisms characteristic of exploratory and play behavior in animals have been theoretically proposed as being responsible for "the variable and dynamic acts which characterize exploration, play, adaptable problem solution and invention" (p. 226) in advanced animals. The playing with ideas often reported in accounts of the creative process within creative individuals (Ghiselin, 1952; Koestler, 1964) or the playful attitude describing noted scientists (Root-Bernstein, 1989) and artists (Klee, 1964) adds strength to the theory advanced by Welker (1961).

Although not a pure form of problem finding, the PABLO instructions required little direction, affording an opportunity for divergent capabilities in a task of figural transformations. The opportunity to define one's own problem was given to the 60 participants.

All participants received the same instructions. Upon arrival, an attempt was made to make the subject feel comfortable and relaxed. The purpose and procedure of the study were stated as follows (Kay, 1989):

> There will be two measures of spatial ability and three different tasks that I will ask you to complete. I will be videotaping so that I can play the tape back for you. At that time I will ask you to tell me what you were thinking about while you were playing. If you want to talk about what you are doing as you are doing it, please feel free to say anything at any time. Anything you say or think will help me to evaluate the usefulness of the two games as learning tools. (p. 115)

The oral instructions for the PABLO task were as follows (Kay, 1989): "This is a game that just came on the market. You can make anything you would like; just have fun with it" (p. 117).

Upon completion, the videotape was reviewed by the participant. Participants were asked to explain what they remembered thinking as they were working. Responses were audiotaped. All participants were unfamiliar with the task.

The identification of dynamic process variables was facilitated by the use of videotape and, in the manner of Kagan, Krathwohl, and Miller (1963), an audiotaped analysis by the participant immediately followed the activity. Based on H. E. Gruber's case-study approach (personal communication, March 7, 1988), protocols were analyzed for thematic structures.

When the three groups were given PABLO and asked to "do whatever you like with it," specific patterns emerged. The use of play activities did produce behaviors most similar to those found in the empirical studies that required drawing (Getzels & Csikszentmihalyi, 1976; Patrick, 1937). Like these other two studies that involved problem finding, two different behaviors were depicted during the process. The first stage, problem defining, resembled Patrick's (1937) "unorganized thought." It began from the moment the participant opened the box and ended when the first two pieces that remained in the final product were constructed. Once that occurred, a different stage was clearly depicted. The second stage, problem solving, began when those first two pieces that remained in the final product were assembled and ended when the participants stated that they were finished.

Within this two-stage structure, the professional artists demonstrated specific preferences when finding or defining their answers to the PABLO task. For example, a sculptor known for monochromatic, geometric forms constructed a form using squares and rectangles and then stated a desire to spray paint the structure black. This behavior was not demonstrated in the other two groups (semiprofessional artists and nonartists).

Expertise in the Visual Arts

According to the expert-versus-novice literature, the initial perception of a problem or the problem space seems to differ depending on the degree of expertise acquired. DeGroot (1965) found that expert chess players perceived the board positions in terms of broad arrangements or patterns; novices did not. DeGroot discussed the probability that the master, afforded a greater depth and breadth of experience, is less likely to make unsuccessful attempts or changes because of his or her knowledge of what will fail. This behavior was depicted in the professional artists engaged in this study (Kay, 1989). A concern for the fact that deGroot observed chess players, and these artists were also involved with a play activity, could lead one to assume that these behaviors are characteristic of play and not of creative thought. However, all of the artists volunteered an unsolicited comparison of this game playing to their own creative work.

In comparing the PABLO task with his creative thought process, Participant 50 offered this analogy:

> In the game PABLO with cardboard basically, by having those shapes that are there, to me they are like letters. Each shape is symbolizing a letter and by putting several of those letters together—it is like creating a word. Create an idea, a concept. Now, the way I work . . . is I will use existing shapes because that's what you are familiar with—that is what is available to us, and then I want to make these shapes into unique shapes—make them my own shapes. So what I am doing, in a sense, is changing a letter and then by having different changed letters, I create a new word that did not exist before, and I feel that is the difference—why I had little harder time with your things—because to me—they are already pre-conceived. Found objects that I put together as a grouping. While to make it more personal—I would rather create my own shapes which are derived—from shapes. So I am just taking these shapes, the potential of these shapes a little further . . . not that they're better . . . but just taking them into another direction and then putting them together and making them into a totally new thing. But I deal, in my sculpture, with very simple, basic form. Very simple dialogue . . . it's like haiku poetry. You use a few words and create a 5-hour movie, with six words. (Kay, 1989, p. 195)

Play and Creative Thought

The spoken protocols show that all of the artists stated that much of what they were doing (the process) was in essence the same approach that they take in their studio work. Each artist described in various degrees of detail the difference between playing with this game and doing their own work. Where the other participants stated that they found the choices (color, shape, size) afforded by the PABLO game to be overwhelming, the professional artists felt hindered by its limitations. Some of the specific limitations cited were as follows:

- The size of the pieces was too small.
- The colors were not to their liking.
- The shapes were considered flat (cardboard art) by sculptors, but painters found them more three-dimensional, so it took less time to mentally imagine the different views because they could manipulate the pieces.
- The shapes were all the same thickness.
- Participants had to use structured, predetermined, rigid forms.
- Participants had to use "found objects" so the technical responsibilities were different from their work.
- The connectors limited one to constructing at right angles, which is static, rather than offering the dynamic possibilities of using different angles.
- The connectors were all the same so there were no variations possible (including ability for movement).

Other than these restrictions, the artists perceived their behaviors, when reviewed on the videotape, and their thought processes to be the same as when they were developing their own art. Participant 3 offered a good example:

> Oh my gosh—there's enough pieces in here. I may have to be a month on this . . . oh, oh, what do we have here . . . [starts humming] the thing is this is more my kind of thing. I don't think this is fair because this is what I'm doing all the time. [What do you mean? You play with puzzles?] Yes—making a sculpture you are taking these things . . . [selects pieces from large pile to build. Sounding disappointed he continues] . . . all of the catches are the same, huh? This isn't fair because this is what I do all the time [Have you seen this before?] No, not this particular puzzle—but I would imagine that a person who is using this . . . [gets back into his work]. The two things that are different from what I do all the time is that these are flat, flat cardboard pieces, and I make my own shapes from clay. I make my own shapes and thicknesses. These are two-dimensional, with the same thickness, and now I am concerned with the selection of the color which I do not normally do. You know, I may get hooked on playing this game all the time. . . . Want to see the way it looks? [Yes. Are you finished?] Yes, well, wait, I want to make it just a little bit better.

It was an elongated figure playing the guitar. His sculptures are elongated forms of action.

Personal Aesthetic Bias

A second phenomenon, not cited in the literature, appears to be supported by clinical observations and oral protocols. Unlike the other two groups, the professional artists exhibited behavior that has been called *personal aesthetic bias* or *personal aesthetic preference* (Kay, 1989, 1991). Based on

a personal set of conventions that is the basis of the language used in an artist's body of work, a personal aesthetic seems to evolve. The distinctive aesthetic that guides creative thought processes when producing ideas in art was reflected in the behaviors of a game task that does not purport to have any association with the complexity involved in producing art.

This personal aesthetic bias behaves like the engineering of a bridge, offering tensile strength to the pursuit of an idea. As in steel structures, this tensile strength supports the endeavor, yet it bends or flexes in response to the forces that act on it. The aesthetic appears to guide the search operation, providing a selective criterion within which one explores (Campbell, 1960). The literature describes an aesthetic characteristic of creative thought in determining the correct solution (Campbell, 1960; Perkins, 1981), but the idea of an aesthetic preference that controls the perception of new experiences has not been expressed in the literature.

It appears that this aesthetic preference could have altered the perception of this task into a problem-solving task rather than the problem-finding or problem-defining task it was originally designed to be. This is substantiated by most of the professional artists who, on opening the PABLO box, commented on the "predetermined nature" of the game. Finding no redeeming qualities to "pretty games," one artist wanted to "spray paint the forms black" (his language). Another artist, also involved in performance art, wished to set fire to the pieces to develop a metamorphosis of them. Restricted by my need to reuse the toy, she instead developed a collage (her language) using pearls and sawdust to temper the predetermined nature of the materials. Given that the professional artists began the task by imposing a particular set of conventions that had been a part of their own work, the application of these conventions to the task can be viewed as a problem to solve.

Because the artists brought their personal aesthetic bias to the situation, the qualities of the task affected their response to the situation depending on their personal style. For example, Participant 37, a sculptor whose aesthetic preference is often represented through bronze forms of the human figure, responded to the task as follows:

> [The artist was just opening the box to the PABLO game] Oh, it looks like Frank Stella. . . . Oh, that's a nice shape . . . this isn't fair to artists because their own aesthetics get in the way . . . too bad you can't attach pieces from the middle of the shape . . . that's too red . . . that's too long . . . well, this is a Frank Stella aesthetic so I'm just going to have to work with his aesthetic . . . [and she did]. (Kay, 1989, p. 199)

To see her work is to know that she is involved with subtle shades and not color, that her forms have no flat areas, and that patterns are not intrinsic to her world of ideas. Exhibiting the sine qua non of flexibility, her final comment was "It's a great toy, actually. Let me add to it a little more." Rather than avoid premature closure (Perkins, 1981) or actively pursue fluent or flexible behavior (Guilford, 1967), the opposite characteristic seems to initiate response to the stimuli. Only when the behavior consistent with the inherent process is found to be an unacceptable strategy is flexibility used to resolve to a solution.

The semiprofessional artists, not having had the time to develop their own sets of conventions fully, viewed the multiplicity of choices as a problem-defining or discovered-problem situation (Getzels & Csikszentmihalyi, 1976), as did the nonartists, who had even more limited experience with transforming figural information.

Selected Perception

The differences detected between the semiprofessional and the professional artists in their response to the stimuli appear to be initiated by the selected perception of the professionals based on personal aesthetic preference. As in deGroot's (1965) study, "the primary task of the problem solver is TO GIVE SHAPE TO THE BOARD PROBLEM through an economically programmed series of questions, that is, to try to classify the position accurately enough to set up the first board goal hypothesis" (p. 406). As Sternberg (1982) hypothesized, classification could be based on the selective encoding of perceptual information.

With professional artists, the problem space, defined by an intrinsic aesthetic that is brought to the situation by the individual, alters the nature of the task. Therefore, the creative thought of artists does not appear to be totally free-spirited and structure-free. Although idiosyncratic, there is a discipline or responsibility based on the artist's individual aesthetic and the technical responsibilities of the materials. This quote from Participant 50 depicts that finding well:

> There are two things to creative art. One is technical responsibilities. Creativity is directly tied with some kind of technical responsibility. There is tremendous order to coming up with something very creative and beautiful.
>
> See, I go back and forth in my work—I actually flow between parts that are responsible, dogmatic, order/structure and then go try to work with that particular . . . and then you go back again. I very often do little doodles and then say "can it be done?" on two levels—one, a technical level and one on an emotional or aesthetic level. . . . I like the concept of interpretation. When I say green, different feelings are elicited in different people. With art, you have to explore all the options before you make a decision. With only one answer, you eliminate all the deviations, which in art, is the most interesting part.
>
> You want to see the opportunity within the structure.
>
> There is a kind of responsibility, an aesthetic.

The phenomenon appears to transcend personality, differences between male and female, and the medium (painting or sculpture). All of the professionals exhibited a personal aesthetic bias that "guides the product" (F. Gagné, personal communication, February 29, 1992); however, analysis of their working styles (or approach to studio problems) varied tremen-

dously. For example, where one sculptor spends an average of 6 months to design one piece, another sculptor works on several pieces simultaneously, stating that work on one piece informs him on the others. The working style of a particular artist might vary as well. Several artists commented on their belief that as the situation differs, so does their approach to problem finding.

Aesthetics in Creative Thought

A characteristic cited as important to the solving of a creative problem is an aesthetic sensitivity to elegant solutions. Campbell (1960) described an editing talent in creative individuals that includes this sensitivity to the aesthetic. This ability to appreciate the beauty of a solution has been noted in scientists (Gruber, 1978; Mansfield & Busse, 1981; Root-Bernstein, 1985) and mathematicians (Campbell, 1960; Hadamard, 1949; Polya, 1945), as often as in artists (Arnheim, 1969; Gardner, 1982; Perkins, 1981; Winner, 1982). There appears to be a sensitivity to the aesthetic qualities of an elegant solution that serves as a selective criterion in the search operation. Campbell (1960) quoted Poincaré, who eloquently captured a record of this sensitivity as well as a hint of its importance in defining problems:

> The useful combinations are precisely the most beautiful, I mean those best able to charm this special sensibility that all mathematicians know, but of which the profane are so ignorant as often to be tempted to smile at it. . . .
>
> When a sudden illumination seizes upon the mind of the mathematician, it usually happens that it does not deceive him, but it also sometimes happens, as I have said, that it does not stand the test of verification; well, we almost always notice that this false idea, had it been true, would have gratified our natural feeling for mathematical elegance. Thus, it is this special esthetic sensibility which plays the role of the delicate sieve of which I spoke, and that sufficiently explains why the one lacking it will never be a real creator. (pp. 387–388)

The selective criterion of aesthetic sensibility is suggested by both Poincaré and Campbell.

Responsibility to the Solution

Although not described as a cognitive characteristic, the executive power proposed by Poincaré (cited in Campbell, 1960) tends to support the belief that the emotional response of the individual is a cognitive one (Scheffler, 1977). The feeling of being finished with a task without knowing the qualities of completeness required until it is achieved appears to be a characteristic unique to creative thought. It does appear to be guided by an aesthetic sensing of completion. Every participant in this study (Kay, 1989, 1991) knew when what he or she wanted was achieved. The desire to strive for the correct solution was more intrinsically motivated than expected in a presented task situation. Satisfying the task of the experiment was the original motivating force, but personal interest or concern dominated the processes involved in the game task. This quality is exemplified in the response of a nonartist: "There came a point in time when I was finished with the wall, I finished with the floor, but didn't feel finished and that's when I went into the Art phase. . ." (Kay, 1989, p. 202). An excerpt from the conversation with a professional artist also illustrates this point:

> [Participant 42] You couldn't let go just because of some silly games. It isn't mine and it isn't yours . . . it wasn't mine, it was more your game, but suddenly I found myself taking it seriously, it mattered if I ended up with something good not for you, but for me, because I just needed to know this felt satisfying.
>
> [Researcher] And yet you knew that only you and I were going to see it. . . .
>
> [Participant] Right. But the best pieces I've ever made, I made for me. Actually the first pieces I made after my operation last year were only for me. I never thought about this show and there . . . the first ones I made when I was in pain and could barely move, they are the best. At the time it didn't matter about anyone else. No one else existed. Maybe that's one of the things about artists. . . . I was a maid for a friend of mine, and I was the best maid anybody could have because the same perfection I used in those . . . like in those detail pieces was exactly the same kind of detail I did in cleaning. . . . In life everything matters.

Knowing when a solution is "good" or "right" in an ill-defined problem (J. Wakefield, personal communication, February 28, 1992) or when something is "done" are issues constantly addressed in actions that demand creative thought. Although all of the participants felt the need to arrive at a good solution, the behaviors (Kay, 1989, 1991) and oral protocols imply that different strategies were used by the groups to reach the "right" solution.

Whereas most of the nonartists stated that first they reduced the number of choices by limiting themselves to using only one color or making a flat arrangement, the semiprofessional artists stated their need to explore the possibilities (similar to the discovery-oriented behavior described in the 1976 study by Getzels and Csikszentmihalyi). However, the experts differed from the other two groups in their ability to use a personally defined aesthetic style to efficiently and decidedly arrive at this state of "doneness." In defining their problem-finding procedures by grounding their decisions in their personal set of conventions or personal aesthetic style, the professional artists seemed to have had much less difficulty arriving at a "good" solution.

Contrast to Perkins's Schemata

It might be suspected that this personal aesthetic bias is similar to what Perkins (1981) described as "schemata." Perkins defined *schema* as "a

mental structure that allows a person to perceive or act effectively by anticipating the organization of what the person apprehends or does, so the person needn't function as much from scratch" (p. 173). However, the parallel Perkins drew is the way knowing the rules of English grammar guides the spoken language. The rules are the rules of a discipline or field of study. The rules are extrinsic to the creative individual—boundaries to work in or to break, but boundaries outside the individual's personal aesthetic. No doubt, the creative person must be well-informed and well-versed in the discipline in which he or she performs. But within the realm of the discipline it appears that the artist brings a personal, subjective aesthetic—intrinsic to that individual—that works within and often beyond the aesthetic of the field or discipline.

In describing a computer program with an aesthetic, Perkins (1988) claimed the difference between that program and human creative efforts is that humans "from time to time challenge their operating rules as such and revise them" (p. 371). The example given is one of Einstein's observations of the lack of a symmetrical pattern in electrodynamics. The apparent asymmetry of the discipline disturbed him, provoking the search which, according to Perkins, led to his work on relativity. Again, the concept of schemata seems to represent the ability that creative individuals have to be sensitive to the patterns that make up a particular field of study. That aesthetic sense, although perceived by him or her, lies outside of the individual. The intrinsic quality that characterizes the personal aesthetic bias exists in addition to the schemata of a field.

Constraining Effect of Aesthetic Style

The personal aesthetic preferences or style exhibited by the professional artists raises a major issue, namely, the balance between freedom and constraint in the creative process (Johnson-Laird, 1988; Mansfield & Busse, 1981). Instead of establishing rules to organize the given information, artists choose the information to attend to.

> The parameters of the rule are constructed by the objects that you have not eliminated. These are your biased preferences. One does not have to arrange them, for these are your choices and they could essentially form the sides of a road and the road is what allows you to perform. Because you can't be an artist if you don't do anything. (Kay, 1989, pp. 195–196)

The development of an aesthetic style can be seen as the creation of "perceptual templates" (F. Gagné, personal communication, February 29, 1992) that guide artists during the initial problem-defining phase of their creative endeavor. Perceptual templates accelerate the process of defining a first draft or direction to follow, providing a shorter, more efficient procedure to delineate the basic form of the final product. But this increased efficiency also can have a price. It could act as a procrustean bed to the

creative process in the same way that well-worn trails reduce the degree of exploration for hikers in the forest: Keeping to the trails requires less effort than heading into the bush. This homeostatic drive could be at work in the creative process through reliance on one's aesthetic style as a guide toward outlining the final work.

This phenomenon does resemble the description given by Cattell (1968) of an "Ideational Inertia or Rigidity Factor" (p. 412). Tentatively describing this factor as an energy directed toward inflexible or consistent behavior, he explained that many examples of rigidity are "operationally simple character stability" (p. 413). He put aside the negative connotations associated with rigidity; indeed, he asserted that the creative process needs such a balance between flexibility and consistency in behavior.

The problem-finding process that is often depicted as one of total freedom is actually constrained by a well-developed aesthetic perception that guides the task-defining process toward realization of the artist's aesthetic style. Perhaps the fondness for children's art mentioned by many professional artists (Klee, 1964) reflects their admiration for the absence of self-imposed constraints in such work.

Developmental Differences

Could the progressive development of artistic expertise generate qualitative differences in process? Before directly answering that question, let me show how the results from my study (Kay, 1989) provide a possible explanation for contradictions found on the creative processes of artists at different levels of expertise. The contradiction concerns especially two studies. In the first, Patrick (1937) watched 50 professional artists and 50 nonartists sketch pictures based on a poem they were given. A detailed analysis of the process, enlisting spoken feedback, formed the core of the research procedure. The major results were as follows: (a) No difference was observed between the artists and the nonartists in the amount of time spent before engaging in the actual drawing or for the total amount of time spent on the entire task (but major differences were seen in the quality of the results); (b) in contrast to the nonartists, the artists did not change the essential structure of their work but revised only the surface structure; and (c) the problem-solving process for both groups was described as consisting of periods of unorganized and organized thought.

In their innovative work on problem finding, Getzels and Csikszentmihalyi (1976) proposed to 31 male art students an open-ended or discovered problem situation in which 27 objects were provided for consideration for a still-life drawing. Among their results, they found that the more creative art students took more time before engaging in the actual drawing and spent more time on the entire task than did the less creative students. The art students identified as more creative also were more willing to change the entire product. Students who approached the task with a predetermined way of working toward a solution were considered less creative.

The results of the latter study (Kay, 1989, 1991) allow for a possible reconciliation of these apparently conflicting results. This reconciliation requires understanding that the operational definitions for group membership of Patrick's (1937) two groups were used to determine membership for my extreme groups, whereas Getzels and Csikszentmihalyi's (1976) two groups are assumed to be more closely related to the semiprofessional artists. By comparing the problem-defining processes among the three groups with varying degrees of expertise, a more complete picture emerges. I assumed that the semiprofessionals spent less time and practice making art because they had other full-time work commitments. Amount of practice as key to the development of expertise is supported in the literature (Ericsson & Smith, 1991).

Like Patrick (1937), I found no differences between the artists and nonartists in the amount of time spent in the actual building and in the total amount of time taken to complete the entire task (Kay, 1989, 1991). Yet qualitative differences were clearly observed (see Kay, 1989, for a discriminant analysis and discussion). Also in keeping with the behaviors of Patrick's artists, the professionals did not change the essential structure of their work but revised only the surface structure.

Among Getzels and Csikszentmihalyi's (1976) art students, behavioral differences in the approach to the discovered problem situation implied a crucial difference between those students seeking "to maximize the discovered nature of the task" (creative) and those (less creative) students who behaved as though they were in a "presented problem situation" (1976, p. 90). However, semiprofessional artists in the latter study (Kay, 1989) maximized the open nature of the task, as they took almost twice as long as the other two groups did to finish. In fact, the behavior pattern of the semiprofessional artists was most similar to the pattern of behavior describing the more creative art students in the earlier study. For example, the Problem Solution Stage (scored from the time a student began to draw to completion of the task) was marked by three types of observed behavior: "openness of the problem structure, discovery-oriented behavior, and changes in problem structure and content" (Getzels & Csikszentmihalyi, 1976, p. 98). The percentage of total drawing time that elapsed before the final structure of the drawing contained its essential elements was calculated to determine the score for openness to the problem structure. The greater the amount of time, the higher the score. For discovery-oriented behavior, a low score was given if the student drew without interruption. Changes in the medium or paper used or the rearrangement, substitution, or manipulation of objects during the drawing phase were considered reflective of discovery-oriented behavior and consequently received a high score. Changes in the problem structure and content received higher ratings. Indeed, if the student was willing to revise or eliminate elements of the drawing when evaluating the final product, an extra point was given toward the total problem-finding score. A low score was given if the student drew without interruption. Lack of changes or rearrangements also resulted in a low score.

Although the semiprofessionals in my study (Kay, 1989, 1991) took twice as long as the other two groups to complete the task, the final structure was not apparent until they were close to completion. In contrast, the professional artists took the least amount of time, had the fewest pauses, and changed or rearranged their work less than did the other two groups. The professional artists would have scored the lowest in all three behaviors observed in the more creative art students (Getzels & Csikszentmihalyi, 1976).

These findings suggest that expertise in creative problem finding develops along a continuum from the layperson to the expert (Patel & Groen, 1991), but that it elicits qualitatively different behaviors depending on the individual's position on this competence continuum. It is possible that the discovery-oriented behaviors as described by Getzels and Csikszentmihalyi (1976) could be a set of strategies or skills used by those whose performance falls within the middle range of a hypothetical normal distribution of competence (Salthouse, 1991). Various scholars have suggested that different principles or processes operate at different phases in the acquisition of expertise (Charness, 1991; Patel & Groen, 1991; Salthouse, 1991; Subotnik & Moore, 1988). It is possible that the personal aesthetic preferences guiding the behaviors of professional artists constitute a process used at the highest level of competence. Efficiency is key to identifying an expert's approach to problem-solving tasks that have a best or correct solution (deGroot, 1965; Ericsson & Smith, 1991).

It is possible that an efficiency criterion is also important in open-ended, problem-defining tasks. Where the nonartists determined the parameters of the task by eliminating choices, the professional artists selected meaningful possibilities as defined by their aesthetic preferences (Kay, 1989, 1991). The experts seem to rely on internal interests to guide their problem-finding pathways, manipulating or circumventing external constraints when necessary to their internal structure (e.g., spray painting the bright colors on PABLO with black paint). In this way, they use equal time for unequal results.

Implications

From these preliminary findings, it would seem important that researchers look more closely at the role of aesthetic development in creative producers of ideas (Tannenbaum, 1983). These findings suggest that aesthetic development might be critical to the development of creative thought. The fact that all three groups involved in the study (Kay, 1991) sensed a rightness or goodness of fit to their design solutions deserves further investigation.

Although the results of an investigation of an adult population cannot be applied to the behaviors of children, questions can be framed regarding developmental issues surrounding the education of creatively gifted children. The flexibility of working on an intrinsic agenda within a given set of external constraints was inherent in the behaviors and verbal protocols of the professional artists. Is the behavior depicting aesthetic preferences evident as a result of developed expertise as adults, or is it inherent to the creative process, thus also evident in the explorations of creatively

gifted children? Are there developmental stages to the creative process? Are some strategies or skills, such as personal-aesthetic-guiding principles, more prominent in decision making at different stages, or does this characteristic generally differentiate the creative from the technically competent?

Perhaps during the expansion of a knowledge base, the proficient or competent producer of ideas experiences a waning period in the aesthetic development of a personal voice. Preferences might recess to explore more possibilities. On the other hand, a well-developed intrinsic agenda can be observed in a precocious 5-year-old (Kay, 1999). The former hypothesis is challenged when one observes a preschooler with strong preferences with regard to subject matter, direction of learning experiences within the variations of theme, and materials (e.g., which of three white pencils provides the correct shade of white). The lack of attending to this need could contribute to the negative associations with elementary art experiences reported in Bloom's (1985) study of sculptors. Attending to this need might have been the catalyst to the recorded memorable moment when one artist's elementary art teacher gave him the keys to the supply room (Brown & Korzsenik, 1993). Perhaps protecting the formation of these personal-aesthetic-guiding principles contributed to the motivation behind the home-tutoring approach adopted by the parents of Pablo Picasso (Rubin, 1980) and Wang Yani (Goldsmith, 1992).

If the development of personal aesthetic preferences or a set of guiding principles is intrinsic to an individual's creative process, recognition and respect for the development of this personal agenda would encourage expertise in creative thought. The sculptor Auguste Rodin pursued his own agenda even though he was rejected by the Academy until he was 62 (Frisch, 1939). If strong preferences for finding and forming problems affect problem solving, then a different understanding of the behaviors of a 10-year-old who refuses to include color in his investigations would provide direction for curriculum modifications (Passow, 1979) that enhance creative talent. Aesthetic development might be integral to all creative thought and not domain specific. Root-Bernstein (1989), in researching creative scientists of the 19th and 20th centuries, listed 180 eminent scientists and inventors with proclivities in the visual arts. Some scientists openly discuss the aesthetic preferences within a particular research facility (Subotnik, 1992). Aesthetic preferences might be a domain-general habit of mind requisite to developed expertise (Pelletier & Shore, 2000). Or the sensitivity to aesthetic considerations might distinguish the creative producer in a field from other experts. Further research in these directions should address some of the questions raised by Moore and Murdock (1991).

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