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ABSTRACT

This paper on the nature of expertise discusses implications of findings of an earlier study into the problem-solving, problem-finding and thought processes of 3 groups: 20 professional artists (experts), 20 semiprofessional artists (non-experts), and 20 non-artists (novices), each group consisting of 10 male and 10 female adults. Subjects were all given a "game" and instructed to "do whatever you like with it" and then asked later to verbally recount their mental processes as they observed a videotape of themselves. Results are discussed in terms of differing attitudes of experts versus non-experts and novices toward play, creative thought, personal aesthetic biases, and selected perception. Examples from the study are used in a discussion of the role of aesthetics in creative thought and sense of responsibility to the solution; i.e., knowing when a solution is "good," or "right," not simply when the task is "done." Implications considered include the possibility that aesthetic development may be critical to the development of creative thought and the need to reconsider the pedagogy involved in developmental approaches to defining or identifying exceptional ability in the visual arts. (Contains 38 references.) (DB)

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On the Nature of Expertise

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on the Psychological Development of Gifted Children

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ON THE NATURE OF EXPERTISE

In a recent commentary, Moore and Murdock (1991) challenge researchers involved in studying problem-finding to seek answers to questions such as

> 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 to these questions are critical to researchers studying creative thought and, therefore, to researchers interested in the 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 may offer fruitful potential for further investigation.

Statement of the Problem

The purpose of the original investigation (Kay, 1991) 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 may be qualitatively different for certain individuals 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 the expert and the novice chess player both quantitatively and qualitatively. Variables that measure (a) the speed of the performance on a task (latency)

> or (b) the accuracy attained in the performance define the proficiency in which a task is achieved. Analysis of these variables can only measure quantitative differences. Differences in the type or quality of the processes employed in problem-solving (Chi et al., 1981; Kanevsky, 1990) and problem-finding (Beittel & Burkhardt, 1963; Getzels & Csikszentmihalyi, 1976) situations have been observed through the analysis of dynamic process variables. (p. 235)

Although the empirical study is reported elsewhere (Kay, 1991), the purpose of this article is to report the unexpected findings that emerged regarding the nature of expertise. For clarification purposes, a brief description of the method employed in the original investigation is warranted.

In seeking to answer the research question: Are there differences in the figural problem-solving and problem-finding behaviors of professional, semi-professional, and non-artists? (Kay, 1989), five hypotheses were advanced. These hypotheses addressed differences between the groups in their scores on spatial visualization measures; the 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.

Method

Subjects. Sixty subjects 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 semi-professional 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 ideas in the field. The nonartists were graduate students at a major university who had not had formal art training since high school and claimed that they do not produce ideas in art under any circumstances.

Measures. The problem-finding task chosen for this study (the description of only one task is necessary here) was a puzzle-type game available on the consumer market. PABLO, manufactured by Fox Spielverlag, is a construction-type toy similar to LEGOS. However, PABLO includes approximately 120 cardboard pieces of various sizes, shapes, colors, and patterns that may be used with small plastic connectors to build a multitude of constructions.

It was felt 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 confound of extensive previous experience by one (or more) group(s) with the specific task. In other words, to compare the drawing procedure of those who draw and those who do not (non-artists) cannot help to address clearly 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 instructions to the PABLO task required little direction, affording an opportunity for divergent capabilities in a task of figural transformations. The opportunity to define one's own problem to solve was given to the 60 participants involved in the study.

Procedure

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:

> 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.

It is the patterns that emerged when the participants were given the PABLO game that are addressed here. The verbal instructions for the PABLO task were:

> This is a game that just came on the market. You can make anything you would like; just have fun with it.

Upon completion, the videotape was reviewed by the participant. Each participant was asked to "tell me what you remember thinking as you were working." These responses were audiotaped.

Scoring and Data Analysis

The identification of dynamic process variables was facilitated by the use of videotape, and, in the manner of Kagan (Kagan, Krathwohl, & Miller, 1963), an audiotaped analysis by the subject immediately followed the activity. Based on Gruber's (1990) case-study approach, protocols were analyzed for thematic structures.

Results

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

Within this 2-stage structure, the professional artists demonstrated specific preferences when finding or defining their answers

to the PABLO task. This behavior was not demonstrated by the other two groups (semi-professional artists and non-artists).

The Nature of Expertise in the Visual Arts

According to the expert vs. novice literature, the initial perception of a problem or the problem space seems to differ depending on the level of expertise acquired. In chess, deGroot (1965) found that expert chess players perceived the board positions in terms of broad arrangements or patterns, whereas the novice players did not.

DeGroot (1965) discusses the probability that the expert chess master, afforded a greater depth and breadth of experience, is less likely to make unsuccessful attempts or changes due to his or her knowledge of what would fail. This behavior was depicted in the professional artists that engaged in this study (Kay, 1991). 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 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 to his creative thought process, participant #50 offers an eloquent 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.

Play and Creative Thought

Surveying the verbal protocols, 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 (of color, shape, size, etc.) afforded by the PABLO game to be overwhelming, the professional artists felt hindered by its limitations. Some of the specific limitations cited were:

1. the size of the pieces (they were too small).
2. the colors were not of their liking.
3. the shapes were considered flat (cardboard art) by sculptors, painters found it more 3-D which took less time to mentally imagine the different views because they could manipulate the pieces.
4. shapes were all the same thickness.
5. had to use very structured, pre-determined, rigid forms.

6. had to use "found objects"--so the technical responsibilities were different from their own work.

7. the connectors limited one to constructing at right angles which is static--not dynamic possibilities using different angles.

8. the connectors were all the same--no variations (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 are developing their own art.

Participant #3 offers a good example. To quote:

> 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 to . . . because you know . . . the thing is, you know--this is what I'm doing all the time. [I asked 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 [do you play with this puzzle? 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.

A Personal Aesthetic

Hint of a second phenomenon, not cited in the literature, appears to be supported by the clinical observations and verbal protocols. Unlike the other two groups, the professional artists who participated in this study exhibited a behavior that has been labeled a "personal aesthetic bias" (Kay, 1991). Based on a personal set of conventions that is the basis of the language used in a artist's body of work, a personal aesthetic seems to evolve. The distinctive aesthetic that guides their 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 the creative thought processes involved in producing art.

This personal aesthetic bias behaves like the engineering of a fine 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 upon it. This 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 located in the literature.

It appears that this aesthetic preference may have altered the perception of this task into a problem-solving task rather than the problem-defining task it was originally designed to be. This is substantiated by the large majority of professional artists who, upon

opening the PABLO box, commented on the "pre-determined nature" of the game. Finding no redeeming qualities to "pretty games," one artist wanted to spraypaint the forms black (his language). Another artist, also involved in performance art, wished to set fire to the pieces to develop a metamorphosis of the pieces. Restricted by my need to reuse the task, she developed a collage (her language) using pearls and sawdust to temper the pre-determined nature of the materials. In that the professional artists begin the task with a particular set of conventions that have emerged from their own work, the application of these conventions to the task can be viewed as a problem to solve.

Because the artists brought to the situation their personal aesthetic bias, the qualities of the game task affected their response to the situation depending on their personal style. For example, one female sculptor, whose aesthetic preference is often represented through bronze forms of the human figure, responded to the PABLO 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 gets 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]. (Participant #37)

To see her work is to know that she is involved with subtle shades, not color, that her forms know no flatness, 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," and she did. Rather than avoiding premature

closure (Perkins, 1981) or actively pursuing 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 employed to resolve to a solution.

The semi-professional 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 non-artists due to their even more limited experience with transforming figural information.

Selected Perception

The differences detected between the semi-professional and the professional artists in their response to the stimuli appear to be initiated by the selected perception employed by the professionals and based on their personal aesthetic bias. As in deGroot's (1965) study of chess experts, "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 may 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 artists' individual aesthetic and the technical responsibilities of the materials. This last quote depicts this 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. [He goes on to say] 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.

Most interestingly, the phenomenon appears to transcend personality, gender differences, and the nature of the art work produced (painter or sculptor). Intriguingly, all of the professionals exhibited a personal aesthetic bias that "guides the product" (Gagné, 1992); however, analysis of their working styles (or approach to studio problems) varied tremendously . For example, where one male sculptor spends an average of six months to design one piece, another male sculptor works on several pieces simultaneously, stating that work on one piece informs him on the others. The working style within a particular artist may vary as well. Several artists commented on their belief that, as the situation differs, so does their approach to problem finding.

The Role of Aesthetics in Creative Thought

A characteristic cited as important to the solving of a creative problem is an aesthetic sensitivity to the elegant solution (Campbell, 1960). Campbell 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 & Bussé, 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), in quoting Poincaré, eloquently captures a record of this sensitivity as well as a hint of the role played by this characteristic in defining of a problem:

> 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; emphasis mine)

Thus, 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 (Campbell, 1960) tends to support the belief that the emotional response of the individual is cognitive in nature (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 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 non-artist: "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 . . . ." An excerpt from the conversation of 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. . . .
>
> *#42*: 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 (Wakefield, 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, 1991) and verbal protocols imply that different strategies were employed by the groups to reach the "right" solution. Whereas most of the nonartists stated that first they reduced the amount of choices by limiting themselves to using only one color or making a flat arrangement, the semi-professional 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 difference between the "experts" or professional artists appears to involve their ability to employ a personally defined aesthetic style to efficiently and decidedly arrive at this state of "doneness." In defining the parameters of 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.

Discussion

The notion that this personal aesthetic bias is that which Perkins (1981) describes as "schemata" must be addressed. Perkins defines 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). This does sound similar to the descriptions given in the present study. However, the parallel drawn by Perkins is one of knowing the rules of English grammar which guide our spontaneous speech. These rules, then, are the rules of a discipline or field of study. The rules are extrinsic to the creative individual--boundaries in which to work or break, but boundaries outside of 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 with him or her 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) claims 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." The example given is one of Einstein's observations of the lack of a symmetrical pattern in electrodynamics. The apparent asymmetry of the <u>discipline</u> 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.

The issue of freedom and constraint (Johnson-Laird, 1988; Mansfield & Bussé, 1981) is raised by the personal aesthetic bias exhibited in these professional artists. 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 explains that many examples of rigidity are "operationally simple character stability" (Cattell, 1968, p. 413). Eschewing the negative connotations associated with rigidity, Cattell describes a balance between flexible and consistent behavior as important to the creative process.

An artist's personal style is guided by his/her aesthetic sensitivity. It is an aesthetic sense that is often described as characteristic of the creative individual (Campbell, 1960; Hadamard, 1945; Perkins, 1981). It appears that the problem-finding process that is often depicted as one of total freedom is actually quite constrained by a well-developed aesthetic perception. Perhaps the fondness for children's art work described by many professional artists (e.g., Klee, 1964) reflects an admiration for that freedom attained without constraints.

Implications

The purpose of this paper is to raise issues, not resolve them. From these preliminary and very sketchy findings, it would seem important that we (as researchers) look closer at the role of aesthetic development in gifted producers of ideas (Tannenbaum, 1983).

These findings suggest that aesthetic development may be critical to the development of creative thought. The fact that all three groups involved in this study sensed a rightness or goodness-of-fit to their design solutions deserves further investigation. Further, Root-Bernstein (1989), in researching creative scientists of the 19th and 20th centuries, has listed 180 eminent scientists and inventors with artistic proclivities in the visual arts.

Secondly, these findings point to a need for analysis or re-analysis of the pedagogy involved in developmental approaches to defining or identifying exceptional ability in the visual arts. From the ten-year-old who refuses to include color in his investigations of drawings or renderings, to the fact that the sculptor Auguste Rodin was for so long and so often rejected by The Academy (Frisch, 1939), the notion of educational assistance in the development of artistic talent must be reviewed. Further research in these directions may address some of the initial questions raised by Moore & Murdock (1991) and quoted at the onset of this article.

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