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Looking Inside the Fishbowl of Creativity: Verbal and Behavioral Predictors of Creative Performance

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ABSTRACT: This study set out to identify specific task behaviors that predict observable product creativity in three domains and to identify which of those behaviors mediate the well-established link between intrinsic motivation and creativity. One-hundred fifty-one undergraduate students completed a motivational measure and were later videotaped while engaging in tasks in three different domains: problem solving (a structure-building activity), art (collage making), and writing (an American Haiku poem). Behavioral coding and think-aloud protocol analysis yielded reliable measures that, when empirically combined to form task process indicators, strongly predicted judge-rated product creativity in each domain. One of the indicators, involvement in the task, served as a mediator of intrinsic motivation's positive influence on creativity. Other indicators reflect domain-relevant skills and creativity-relevant processes, lending support to the componential model of creativity. Theoretical and methodological implications for future creativity research are discussed.

Intrinsic motivation, the motivation to engage in an activity for its own sake, is conducive to creativity. Considerable research evidence on this point has accumulated over the past 20 years (e.g., Amabile, 1979, 1982b, 1985; Amabile & Gitomer, 1984; Amabile, Goldfarb, & Brackfield, 1990; Amabile, Hennessey, & Grossman, 1986; Amabile, Hill, Hennessey, & Tighe, 1994; Hennessey, 1989; Koestner, Ryan, Bernieri, & Holt, 1984; Kruglanski, Friedman, & Zeevi, 1971). This general finding holds whether intrinsic motivation is assessed as a personality trait or is influenced by social-environmental variables such as expected evaluation, contracted-for reward, restricted choice, or competition (Amabile et al., 1994). However, there is little evidence on the specific mechanisms by which intrinsic motivation might lead to creative outcomes. If creativity is a quality of products or ideas that leads them to be recognized as novel and appropriate by external observers (Amabile, 1982b), then what task behaviors stem from intrinsic motivation and result in those recognizably novel, appropriate outcomes? More generally, what task behaviors lead to creative products? The present study begins to address these questions.

Motivational Influences on Creative Performance

A preliminary conceptualization of motivational influences on creativity proposed an illustrative analogy where a task or problem is represented as a maze (Amabile, 1987, 1988, 1990). The maze has several exits, any of which represents finding a solution that is at least satisfactory. Some of these exits are easier to find than others. The most straightforward and well-practiced path out of the maze is the algorithmic solution (McGraw, 1978). This is the approach that can be expected of the least intrinsically motivated individuals, those who are less interested in the task than in finding an exit. Because it is so straightforward, the

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algorithmic exit is analogous to an end product that is low in creativity.

There are other exits available to those who are more inclined to investigate. This investigation is more likely in those who are motivated by their feelings of interest, involvement, enjoyment, curiosity, satisfaction, or positive challenge in the problem—in other words, by those who are intrinsically motivated (Amabile, 1996). These individuals are not simply interested in exiting the maze, because the very exploration of the maze provides them with pleasure. This exploration is the heuristic approach (McGraw, 1978). Exploring the maze is the only way to find the less obvious exits, which are analogous to end products high in creativity. Additional prospecting in the maze, or additional involvement in the task, is more likely to yield the payoff of higher creativity.

This conceptualization draws on several predictions suggested by previous theorists about the task-processing behaviors exhibited by intrinsically motivated individuals. Intrinsically motivated individuals should show deeper levels of involvement in the problem than individuals who are less strongly intrinsically motivated (Amabile, 1983a, 1983b, 1988, 1996). This involvement is fundamentally linked to interest in the problem and enjoyment of searching for its solution. Intrinsically motivated individuals should engage in more risk-taking strategies and behaviors (Condry & Chambers, 1978); because they are not single-mindedly focused on locating an exit to a maze, they should be more likely to take chances and pursue unorthodox approaches to solving a problem. Moreover, intrinsically motivated individuals should exhibit more exploratory or set-breaking behaviors (Condry, 1978) and greater persistence (Deci & Porac, 1978; Lepper & Greene, 1978). Finally, the problem solutions—the products—of intrinsically motivated individuals should be rated as more creative by judges who merely view the products, without knowledge about the intrinsic motivation or the task behaviors of the problem solvers (Amabile, 1983a, 1983b, 1988, 1996).

Assessing the Creative Process

Testing predictions generated through the maze analogy requires a method of assessing the creative process. There have been few empirical investigations of the creative process, and the predominant assessment devices (aside from creativity tests) have been post-task questionnaires and interviews (see Feist & Runco, 1993). This overwhelming reliance on retrospective, self-report measures of the creative process presents several limitations: biases in recall of information, questionable availability of relevant information, and preconceived categorizations of task behaviors. Although the degree of bias inherent in self-report measures is an open question, the potential for bias is clear.

The prototypical post-task questionnaire invites a number of recall biases. Retrospective data is far from perfect, and it is not clear that recalled information accurately reflects the experience of the individual at some previous point in time. Simple forgetting lowers the reliability of retrospective reports (Ericsson & Simon, 1984). Knowledge of an outcome (i.e., a self-assessment of the quality of one's own product) may color the recall of earlier experiences through a hindsight bias (Fischhoff, 1982). For example, the individual who has constructed what he or she thinks is an excellent collage might not recall outcome-incongruent early frustration with the task as readily as outcome-congruent later success. Alternatively, when using a self-presentational strategy to maintain self-esteem (e.g., Jones, Rhodewalt, Berglas, & Skelton, 1981) the individual might not want the researcher to know of the difficulty that he or she encountered with the task. This is by no means an exhaustive list of the potential biases of retrospective recall, but it serves to illustrate the nature of the problem with such techniques.

A second major limitation to self-report measures is the potential unavailability of accurate answers to the questions typically asked. Questions such as "How interested were you in the task?" inquire about internal states that may not be available to conscious awareness (Ericsson & Simon, 1984). Bem's (1972) self-perception theory asserts that one does not have privileged insights into the causes of one's own behavior, but must instead observe that behavior and draw conclusions. In order to answer this type of post-task question accurately, one must recall all of the relevant task behaviors and combine them to form an overall assessment. In addition to recall errors and biases, there are also severe limitations to people's ability to effectively combine information, especially information of multiple types, such as thoughts and behaviors (Dawes, 1979).

The third limitation to conventional post-task measures is their inflexibility. Paradoxically, researchers must know what the relevant processes are in order to construct questions, thereby forcing task behaviors into preconceived categories. Until the relevant processes have been identified, a more satisfactory approach would be to allow observed behaviors to guide the research.

One technique that addresses some of these problems is the use of verbal protocol analysis (Ericsson & Simon, 1984). Individuals are instructed to think aloud while engaged in a task, and their verbalizations are later coded as indices of task processing. This method eliminates retrospective recall biases, does not require individuals to combine information, and allows the researchers to empirically form processing categories according to observed verbalizations. To date, however, creativity researchers have not taken full advantage of verbal protocol analysis techniques.

One exploratory study of divergent thinking that utilized verbal protocols illustrates the richness of such data (Khandwalla, 1993). Participants engaged in a think-aloud procedure while completing a novel creativity task: listing as many green, funny, liquid objects as possible. Two independent coders analyzed the verbal protocols of the 21 participants into 5 categories and 23 subcategories of divergent thinking with an 85% agreement rate. Cluster analyses revealed that participants employed three distinct cognitive styles in performing the task, and an examination of transitions between categories allowed the researcher to test several theoretical models of creative problem solving. The present investigation expands on this preliminary creative process research by including both a larger sample size and a reliable assessment of product creativity to serve as an outcome measure in analyses of the verbal protocol categories.

Despite the utility of verbal protocol analysis, at least one problem remains. Actual task behaviors are only captured to the extent that participants choose to describe their behaviors and are able to do so accurately. One promising assessment strategy that targets this final obstacle is behavioral coding of videotapes of individuals' task performance. Videotape coding opens a window into actual task behaviors unfiltered through individuals' self-reports. However, the drawback to behavioral videotape assessment alone is that no index of thought processes is available. The research strategy undertaken here was to incorporate the complementary procedures of behavioral videotape coding and verbal protocol analysis to uncover task-specific manifestations of the underlying construct of task involvement.

The Present Study

The present study had three major aims. First, we sought to develop a systematic methodology that does not rely on retrospective reporting of internal states for empirically examining the creative process across different task domains. Our second goal was to use such a method to comprehensively identify task behaviors and verbalizations as possible predictors of creativity. Third, we sought to identify mediating process factors that might clarify the mechanisms by which intrinsic motivation exerts its positive impact on creativity.

The conceptual framework that was employed to test for these mediating effects is outlined in Figure 1. In keeping with the maze analogy, individuals higher in intrinsic motivation were expected to exhibit task process behaviors indicating heightened involvement in the task (such as interest, enjoyment, and satisfaction), consideration of more unusual strategies while engaged in the task (such as risk-tasking, curiosity, exploration, or set breaking), and greater persistence at the task. In other words, the effect of intrinsic motivation was hypothesized to be mediated by process factors conceptualized a priori, with any residual (direct) effect representing other, as yet undiscovered, mediators of the motivational impact on creativity. Additionally, task process behaviors unrelated to intrinsic motivation (and not depicted in the figure) may also predict creativity.

Given that this is the first study to tackle these questions, its methods were exploratory. To achieve the three outlined goals, the creative process was investigated in a laboratory study through the use of behavioral videotapes and think-aloud protocols of participants as they engaged in tasks in each of three separate domains: problem solving (a challenging structure-building activity), art (collage making), and writing (an American Haiku poem). We employed three creativity tasks in order to search for consistency in mechanisms across domains. Two of our tasks (the collage and the poem) were selected based on their previous utility in creativity research, and the third task (the structure) was developed through extensive pretesting in order to incorporate the domain of problem solving. Given the large number of significance tests conducted in an exploratory study of this type, the incorporation of three tasks allowed us to address the problem of a high experiment-wise Type I error rate by focusing our attention primarily on results that inter-

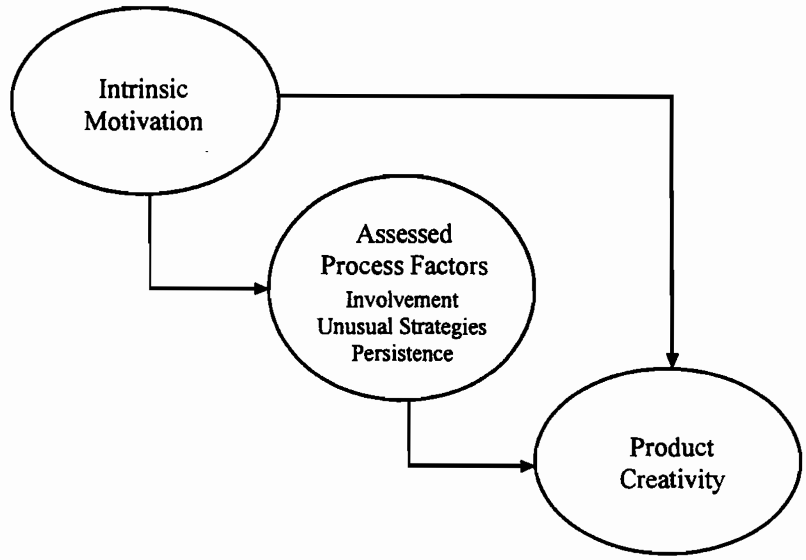

Figure 1. *Basic model of the mediational role of the creative process in intrinsic motivation's impact on creativity.*

nally replicated across tasks and treating unreplicated results in a more speculative manner.

Measures of participants' stable, domain-specific intrinsic motivation were obtained prior to the laboratory session. Task behaviors and verbalizations were coded to obtain empirical indices of the task process. Once reliably identified, the process measures were examined for relations to creativity. Strongly related measures were then analyzed for possible mediational roles in intrinsic motivation's impact on creativity, with the expectation that intrinsic motivation would predict measures such as involvement and set breaking, which would, in turn, predict creativity. The observation of influences such as these would constitute evidence of mechanisms by which intrinsic motivation has a positive impact on creativity.

Method

Overview

Participants' stable, domain-specific motivation was assessed several weeks or months prior to their laboratory session, during a group questionnaire administration in their classroom. The instrument was the Student Interest and Experience Questionnaire (SIEQ), which yields a domain-specific measure of intrinsic motivation in each of the spheres of problem solving, art, and writing (Amabile, 1989). Participants engaged in three tasks during the laboratory portion of the study: building a structure (problem solving), making a collage (art), and writing a short poem (writing). Judged creativity scores on the products in each domain, obtained in accordance with the consensual assessment technique (Amabile, 1982b), constituted the primary dependent measures of the study. To examine the creative process, participants were videotaped while working on each task and a subset was asked to think aloud as they worked. A behavioral coding scheme was developed, as was a verbal protocol coding scheme. The tapes were analyzed by independent coders with high reliability.

Participants

One hundred fifty-one Introductory Psychology students at Brandeis University were recruited for this study either through sign-up sheets or direct telephone solicitation. Participation was voluntary, and participants were compensated either by a payment of five dollars or by partial fulfillment of the requirements of their Introductory Psychology course.

Materials

Intrinsic motivation. The SIEQ, a highly face-valid questionnaire, was used to assess participants' levels of stable, domain-specific intrinsic motivation. SIEQ items ask participants about their level of interest in various activities on a five-point Likert scale ranging from X (*low*) to X (*high*). The 30 items have been factor analyzed (Amabile, 1989), yielding a three-factor solution that corresponds perfectly to the three intended domains: problem solving (e.g., "fixing complex machines," "solving logic problems"), art (e.g., "making collages," "expressing yourself through art"), and writing (e.g., "writing poetry," "playing with words"). The 10 items comprising each domain were averaged to yield a measure of interest, or intrinsic motivation, that encompasses a wide range of related activities in each of the three domains explored in the present study. Internal reliabilities (Cronbach's alphas) for the SIEQ in the three domains were: problem solving, .90; art, .89; writing, .88.

In addition to the high face validity of the SIEQ, the predictive validity of the art interest scale has been investigated in a laboratory study (Tighe, 1989). Art interest, assessed several weeks prior to the laboratory session, correlated significantly with self-rated interest in the study's collage-making activity. In addition, there was a positive correlation between SIEQ art interest and a free-choice measure of time spent on a collage activity.

Structure task. Participants were provided with scissors, masking tape, and a ruler, along with various common home and office supplies such as paper cups, straws, paper clips, and yarn, with which to create their structure. This task was extensively pretested to determine the most suitable materials, a reasonable time period for the task, and a height requirement that was challenging but attainable. Pretesting also revealed that participants usually attempted to build symmetric structures, and therefore odd numbers of the items were given, to increase the difficulty.

Collage task. Participants were provided with a 9″ × 11″ piece of cardboard on which to make their collage, a bottle of glue, a can of glitter, and 65 pieces of paper and felt in various sizes, shapes, and colors (all arranged identically for each participant). This task has been used extensively in previous creativity studies (e.g., Amabile, 1979, 1982a, 1982b).

Poem task. An *American Haiku* is a five-line, unrhymed verse that follows a fixed format: the first and last lines contain a given noun, the second line contains two adjectives related to the noun, the third line contains three verb forms related to the noun, and the fourth line contains a phrase or sentence about the noun. Participants write the second, third, and fourth lines. This task has also been used extensively in previous creativity studies (e.g., Amabile, 1985; Amabile et al., 1990). Participants were given scratch paper along with an instruction sheet containing details on how to write an American Haiku, a sample poem, and lines on which to write the final poem.

Procedure

The SIEQ was administered to all students in Introductory Psychology classes at the beginning of the semester, along with several other, unrelated questionnaires. Participants were then solicited to come into the laboratory from this pool of potential participants. Both the sign-up sheet and the telephone solicitation advertised this study as an "Activities Pre-Test" that involved participating in three fun activities that would take less than one hour. The students participated in individual sessions.

On entering the laboratory, participants were told by a male experimenter that three activities were being pretested for use in future research, with no mention being made of creativity or any connection to the SIEQ. He further explained that, because the researchers were interested in how people went about engaging in these activities, participants would be videotaped. All participants then completed a consent form.

In addition, two-thirds of the participants were asked to think aloud while engaged in the activities (Ericsson & Simon, 1984), with the other third comprising a comparison group for assessing whether this procedure influenced performance. For the think-aloud participants, the experimenter explained exactly what was meant by "thinking out loud" and made every effort to assure the participant that this was neither difficult nor unusual. Because there was a wide range of comfort with this procedure, additional reassurance was provided as necessary, in an effort to ensure similar and high degrees of engagement in the think-aloud procedure as well as to prevent participants from reporting only socially desirable thoughts. The instructions given to think-aloud participants were as follows:

> While you work on each of these tasks, we would like you to think out loud. You often do this when you are alone and working on a problem. Just say the first thing that comes to mind, no matter what it may be. This will let us know what you are thinking while you are doing each task. To give you an idea of how this works, there are some warm-up exercises for you to do before you begin the actual tasks that you'll be doing.

Two warm-up exercises were utilized to prepare participants for thinking aloud while engaged in a task. First, two games of tick-tack-toe were played, with both the experimenter and the participant thinking aloud as they took their turns. Next, the experimenter modeled the technique by performing a simple task while thinking aloud. This task involved building a small tower from six blocks of wood. While building a standard tower, placing the same pieces in the same places in the same order for all participants, the experimenter "spontaneously verbalized" continuously from a fixed script. Comments ranged from task oriented ("This doesn't seem too hard"), to object oriented ("This block will make a sturdy base to build on"), to nontask ("I wonder what I'll be having for dinner?"). After observing this demonstration, participants were asked to build a small tower of their own from similar blocks while thinking aloud.

During all phases of the warm-up, the importance of thinking aloud the entire time, saying whatever comes to mind, was stressed. Participants were told not to concern themselves at all with the content of their verbalizations, but simply to maintain a steady report of their thoughts. In addition, participants were told that they need not speak in complete sentences, that their thoughts were best reported in whatever form came naturally to mind. On completion of the warm-up exercises, the experimenter gave the following concluding remarks regarding the think-aloud procedure:

> This should give you a pretty good feel for thinking aloud. Just a reminder: While you are doing each task do not feel that you have to explain what you are doing, or use complete sentences. Just say the first thing that comes to mind. Finally, you'll hear a soft beep every two minutes to remind you to keep talking. If you haven't said anything for a moment, the beep will get you going again.

This think-aloud procedure was extensively pretested, revealing that participants were able to provide verbalizations while performing the tasks. For participants not in the think-aloud condition, the experimenter still engaged in the warm-up activities, to maintain roughly the same level of interaction with the participant, but no mention was made of thinking aloud. Debriefing interviews revealed that participants did not find this procedure to be peculiar, whether they were asked to think aloud or not.

As soon as participants felt comfortable with the procedure, directions for the tasks were given. The order of the three tasks was counterbalanced across participants.

Structure. Participants received the following instructions:

> What I would like you to do now is to build an aesthetically appealing structure that's at least fifteen inches tall, using all of the materials you see in front of you. You can use this ruler to check the height of your structure; fifteen inches is marked at the top of the tape. Feel free to build higher; just make sure to go to at least fifteen inches. Please try to use as many pieces as possible, ideally using all of the pieces available. You will have fifteen minutes to build your structure. So, to sum up: strive for aesthetic appeal, build to at least fifteen inches, use all of the pieces, and finish the structure in fifteen minutes.

The experimenter answered any questions the participant had at that point. The materials were left in labeled sections of a piece of poster board that also summarized the instructions for the participant's reference. The experimenter turned on a video camera and left the room for fifteen minutes while the participant worked. On returning, the experimenter measured and recorded the structure height, counted and recorded the number of unused pieces remaining on the table, and took two pictures of the structure (one front view and the other 45 degrees off center, giving a front/side view) while the participant completed the post-task questionnaire at another table.[1]

Collage. Participants received the following instructions:

> What I would like you to do now is to make a collage out of the materials you see in front of you. You should construct your collage on the cardboard. Feel free to use any of the materials that you like, but you don't have to use any that you don't want to—it's entirely up to you. There is also a bottle of glue and some glitter available. Again, you are not required to use anything in particular; just make a collage that you find interesting. You will have 10 minutes to make your collage.

The experimenter answered any questions the participant had at that point. The materials were left in labeled sections of a piece of poster board. The experimenter turned on a video camera and left the room for 10 min while the participant worked. On returning, the experimenter carefully removed the collage from the room and affixed a numbered sticker to it in the lower-right corner, while the participant completed the post-task questionnaire at another table.

Poem. The experimenter gave the following instructions while pointing to the corresponding directions and the sample poem on the instruction sheet:

> What I would like you to do now is to write a short poem. The specific type of poem is called an "American Haiku," and it's a five-line poem. The first line simply contains a noun, in this case [points to the sample] "ocean." The second line contains two adjectives that describe the noun, in this case "wavy" and "foamy." The third line contains three verb forms that relate to the noun, in this case "roll," "tumble," and "crash." The fourth line contains a phrase or sentence of any length about the noun, in this case "all captured in this shell at my ear." The fifth and final line simply repeats the noun, in this case "ocean." For your poem, I'd like you to write about the noun "summer." There are five lines provided here for your poem, but you can work on some scratch paper before you write your final poem, if you like. Just be sure to write the poem you end up with on these five lines. You will have five minutes to write your poem.

The experimenter answered any questions the participant had at that point. The materials were left on the table, and the experimenter turned on a video camera and left the room for 5 min while the participant worked. On returning, the experimenter removed the poem from the table while the participant completed the post-task questionnaire at another table.

After all three tasks were completed, the participant was then thoroughly debriefed, paid or given credit toward the course requirement, thanked for his or her time, and excused.

Product Assessment

The judging process applied to participants' products followed the guidelines of the consensual assessment technique (Amabile, 1982b). Independent raters viewed all of the products in different randomized orders, subjectively assessing each on creativity relative to the other products. Judges utilized a 7-point Likert scale ranging from X (*Anchor*) to X (*Anchor*) for each participant's product. This procedure was performed separately on the products from each task, with separate sets of judges serving as experts in their respective domains.

Structure. As preparation to become judges, four psychology graduate students were given the instructions for the structure task and then built at least one structure of their own. After being familiarized in this way, these four judges were asked to independently rate

[1] Of the 151 participants, 8 did not successfully build a structure; they either could not combine the materials in any way, or their structure collapsed just before the end of the 15-min building period. No pictures were taken in these cases, and these participants' data were dropped from all structure-related analyses.

the participants' structures, using their own subjective definitions of creativity. The interjudge reliability coefficient (Cronbach's alpha) for this creativity rating was .87.

Collage. Ten artists (3 professional artists and 7 art graduate students) were given the instructions for the collage task as preparation to become judges. They then rated the participants' collages on creativity, with an interjudge reliability (Cronbach's alpha) of .80.

Poem. Four English graduate students were given the instructions for the poem task as preparation to become judges. They then rated typed copies of participants' poems (with spelling, capitalization, grammar, and punctuation left precisely as written) on creativity with an interjudge reliability (Cronbach's alpha) of .89.

Creativity scores. Because acceptable reliability was obtained for creativity on each task, mean scores across all judges were calculated for each product. This mean judge-rated creativity was used as the dependent variable for each task in all analyses. Although we did not design our study to examine cross-domain creativity, it is worth noting that creativity scores across the three domains were largely uncorrelated with one another. Structure and collage creativity scores were significantly correlated, $r(141) = .18$, $p = .033$, but the correlations between structure and poem scores and between collage and poem scores were not significant, $r(141) = -.02$, and $r(149) = .09$, respectively.

Behavioral Coding of Videotapes

In an attempt to capture the type and frequency of observable behaviors that participants engaged in, a videotape coding scheme was developed for the structure and collage tasks. (The 5-min videotapes of poem-writing did not contain enough behavioral information to warrant the development of a coding scheme.) The coding was conducted in an exploratory manner, with an attempt to include all behaviors that might conceivably relate to creative performance.

An initial list of nonverbal coding measures was compiled from the suggestions of a large research group whose members viewed a few tapes. From this starting point, two independent coders made use of 11 training tapes that were recorded during pilot testing to develop a coding scheme. The scheme was developed through an iterative process, in which the coders refined their initial coding categories, tried them out, and then refined them repeatedly until a set of behavioral measures was obtained that could be reliably identified. Coding was performed using both 7-point Likert scales and frequency counts, and the items comprising the coded behavioral elements were kept as similar as possible across tasks. A list of the mutually exclusive coding categories used, along with the definitions employed by the coders, appears in the Appendix.

Coders practiced rating the pilot test tapes in an iterative fashion, discussing disagreements and modifying categories, until they felt sufficiently trained to achieve reliability. They then coded a subset of actual participants' tapes completely independently of one another, aware of the general hypotheses under investigation, but with no knowledge of individual participants' intrinsic motivation or creativity scores. Cronbach's alpha was computed for each item on the coding sheet. The inter-coder reliability coefficients for 65 segments[2] of the structure task ranged from a low of .60 to a high of .97, with a median of .82. The inter-coder reliability coefficients for 30 segments of the collage task ranged from a low of .79 to a high of .99, with a median of .92.

Verbal Protocol Coding

Verbal protocol analysis was conducted in much the same way as the behavioral coding. An initial list of verbal coding measures was compiled from the suggestions of a large research group, whose members listened to a few participants. From this starting point, inde-

[2]All behavioral and verbal coding for the structure and collage tasks was performed by time segments. The poem task was only 5 min long, too short a time to meaningfully divide into segments. New coding sheets were begun every 3 min for the structure task (total of five segments) and every 3 min, 20 sec for the collage task (total of three segments). Reliabilities were calculated using the time segment as the unit of analysis. Due primarily to low frequencies of occurrences for individual time segment behaviors and verbalizations, all subsequent analyses were performed on averages (for Likert scale items) or sums (for frequency counts) across all segments for each participant on each task.

pendent coders again made use of the eleven training tapes that were recorded during pilot testing, to develop a coding scheme in an iterative process. Coding was again performed using both 7-point Likert scales and frequency counts. The coding sheets were designed to be as similar across tasks as possible. A list of the mutually exclusive coding categories used, along with the definitions employed by the coders, appears in the Appendix.

Coders practiced rating the pilot test tapes in an iterative fashion, discussing disagreements and modifying categories, until they felt sufficiently trained to achieve reliability. They then coded actual participants' tapes completely independently of one another. For the structure and collage tasks, coders listened to the videotapes without viewing them and coded the verbalizations without pausing between coding segments. However, because the short length of the poem task made written transcriptions feasible, coders operated from these transcripts in order to maximize their accuracy. Cronbach's alpha was computed for each item on the coding sheet. The inter-coder reliability coefficients for 50 segments of the structure task ranged from a low of .69 to a high of .98, with a median of .92. The inter-coder reliability coefficients for 30 segments of the collage task ranged from a low of .33[3] to a high of .98, with a median of .86. The inter-coder reliability for 20 segments of the poem task ranged from a low of .69 to a high of 1.00, with a median of .97.

Results

Overview

Data were collapsed across various groups of participants. As expected, there was no difference in creativity scores between the think-aloud and no think-aloud groups, between male and female participants, or between participants completing the three tasks in different orders. Analyses were performed separately for the three tasks (structure, collage, and poem) for two reasons. First, it was desirable to determine whether relations among key variables would be similar across domains. Second, the lack of strong correlations among the three creativity ratings prohibited multivariate analyses. Data were analyzed in the same manner for all tasks, for both behavioral and verbal coding.

Within each task and coding scheme, all coded measures were correlated with the judge-rated creativity for that task. Only the 10 most highly correlated measures were analyzed further because, due to the exploratory nature of this study, it was not expected that every measure would be strongly related to creativity. Rather, every effort was made in the development and implementation of the coding schemes to err on the side of inclusiveness to safeguard against missing important processes. After the selection of the measures most related to creativity, factor analysis—which imposes its own limitations on the number of variables that should be entered for a given number of cases (Kim & Mueller, 1978)—was carried out to further reduce the 10 measures to a more manageable set of composite variables that could then be used in regression analyses, predicting creativity from both intrinsic motivation and these process variables. An analysis of Eigenvalues as well as a scree plot for each factor analysis were used in determining the appropriate number of factors.

Those process factors—composite variables derived strictly from factor analysis—that had been found to be significantly related to creativity were examined in regression analyses for a potential mediational role in intrinsic motivation's impact on creativity. Testing for mediation involves three separate regression analyses to determine, in this case, that (a) intrinsic motivation predicts the process factor, (b) the process factor predicts creativity, and (c) intrinsic motivation, a significant predictor of creativity, is not significant when entered simultaneously with the process factor, which itself remains a significant predictor (see Baron & Kenny, 1986).

Finally, an overall regression analysis was performed for each task. This final regression included all behavioral and verbal process factors, in order to determine the total amount of creativity variance predictable by the process factors.

Data Combination

It was not expected that thinking aloud would have any impact on creativity scores (Ericsson & Simon, 1984). However, to allow a test of whether this was in

[3]This intercoder reliability was an outlier simply due to a very low frequency of occurrence. The next lowest intercoder reliability was .71.

fact the case, recall that one-third of all participants did not engage in the think-aloud procedure. Comparisons of creativity scores of participants in the think-aloud group with those of participants not thinking aloud yielded no significant differences on any of the three tasks (all $ts < 1$). Likewise, there were no effects of sex (all $ts < 1.35$, *ns*) or order (all $Fs < 1.83$, *ns*) on the creativity scores on any of the three tasks. Data for all participants were therefore combined for all analyses.

Structure-Building Task

Behavioral process measures. The 10 highest correlations between behaviorally coded measures and creativity are presented in Table 1. These 10 measures were factor analyzed into 5 process factors, also shown in Table 1. When entered simultaneously into a regression analysis, the 5 factors were highly significant predictors of judge-rated creativity, $R^2 = .19$, $R^2_{adj} = .17$, $F(5, 135) = 6.54$, $p < .001$. Two factors in particular were strong predictors of creativity. The first, a significant predictor ($\beta = .31$, $p < .001$) labeled *Involvement in the Task*, was composed of involvement, work on stability, set breaking, and pace. Work on stability may not appear to fit naturally into this factor, but it was clear from viewing the videotapes that the most challenging aspect of the structure-building task was simply to get the structure to stand up, and so those who concentrated more effort on stability were more focused on the heart of the problem-solving task. Alternatively, effort focused on stability may be related to expertise or experience, despite our attempts to select a task that requires no special domain-relevant skills. The other strong factor, a significant predictor ($\beta = -.27$, $p < .001$) labeled *Exhibited Uncertainty*, was composed of just a single item: self-initiated backtracks. Self-initiated backtracks appeared to indicate that the participant was hesitant or indecisive in building the structure. Complete regression results appear in Table 1.

Verbal process measures. The 10 highest correlations between verbally coded measures and creativity are presented in Table 2. These 10 measures were factor-analyzed into four process factors, also shown in Table 2. When entered simultaneously into a regression

Table 1. *Structure Task Behavioral Coding: Correlations With Creativity, Factor Analysis, and Regression (N = 141)*

		Factor Loadings				
Measure	Correlation With Creativity	Involvement in the Task	Exploration	Efficiency	Height Concern	Exhibited Uncertainty
Involvement[a]	.22***	.76	.15	.21	–.13	–.02
Work on Stability[a]	.13	.76	–.17	–.04	.02	.22
Set-Breaking[a]	.36****	.60	.52	.14	–.11	–.14
Pace[a]	.17**	.57	–.11	.55	.29	–.03
Experimentation[a]	.13	.29	.85	.11	–.09	.12
Planning[a]	–.09	.34	–.81	.02	–.04	–.01
Progress[a]	.16*	–.06	.18	.90	.00	–.02
Not Working[a]	–.12	–.32	.04	–.67	.23	–.11
Checks Height[b]	–.17**	–.05	–.04	–.08	.96	.00
Self-Initiated Backtracks[b]	–.23***	.08	.07	.04	.00	.97
Percentage of Variance		28.2	17.1	11.5	10.4	9.7
Correlation With Creativity		.31****	.12	.15*	–.17**	–.23***
B		.58	.11	.00	–.07	–.12
SE B		.16	.10	.06	.04	.03
β		.31****	.09	.00	–.13	–.27****

Note: B = regression coefficient; $SE\ B$ = standard error of B; and β = standardized regression coefficient. Loadings shown above were obtained with a varimax rotation. The factors captured a total of 76.9% of the variance in the process measures. Creativity regressed simultaneously on all behavioral coding process factors was significant, $R^2 = .19$, $R^2_{adj} = .17$, $F(5, 135) = 6.54$, $p < .001$.
[a]Likert scale. [b]Frequency count.
*$p < .10$. **$p < .05$. ***$p < .01$. ****$p < .001$.

Table 2. *Structure Task Verbal Coding: Correlations With Creativity, Factor Analysis, and Regression (N = 97)*

Measure	Correlation With Creativity	Factor Loadings: Nervousness	Thinking Ahead	Hesitance	Concrete Focus
Problem With Task	.17	.78	.19	.05	–.12
Negative Exclamation	.15	.74	–.14	–.35	–.05
Open Question	.13	.51	.37	–.08	.10
Laugh	.16	.51	.00	.42	.42
Goal Statement	.18*	.05	.80	.03	.09
Mention Time	.12	.44	.50	.03	–.08
Analogy	.12	.03	.12	.77	.05
Strength in Self	.23**	.19	.11	–.69	.13
Talks About Task	–.20*	–.06	.39	–.09	.80
Describes Materials	.18*	.07	.48	.00	–.68
Percentage of Variance		22.8	14.7	12.9	10.9
Correlation With Creativity		.22**	.19*	.05	–.21**
B		.06	.08	.06	–.14
SE B		.04	.07	.12	.08
β		.16	.11	.05	–.18*

Note: B = regression coefficient; $SE\ B$ = standard error of B; β = standardized regression coefficient. All measures were coded as frequency counts. Loadings shown above were obtained with a varimax rotation. The factors captured a total of 61.3% of the variance in the process measures. Creativity regressed simultaneously on all behavioral coding process factors was significant, $R^2 = .10$, $R^2_{adj} = .06$, $F(4, 92) = 2.50$, $p = .048$.
$^*p < .10$. $^{**}p < .05$.

analysis, the four factors were significant predictors of judge-rated creativity, $R^2 = .10$, $R^2_{adj} = .06$, $F(4, 92) = 2.50$, $p = .048$. A factor labeled *Concrete Focus* was composed of talking about the task and not describing the materials (that is, describing the materials loaded negatively on the factor). This concrete focus was a marginal predictor of creativity (β = –.18, $p = .070$). Complete regression results appear in Table 2.

Mediation analyses. Stable intrinsic motivation in the problem-solving domain, assessed by the SIEQ, was significantly correlated with creativity, $r = .19$, $p = .038$. One process factor, Involvement in the Task, satisfied the criteria for mediation outlined earlier: intrinsic motivation marginally predicted Involvement in the Task, $r = .18$, $p = .083$; Involvement in the Task predicted creativity, β = .31, $p < .001$; when creativity was regressed simultaneously on both, intrinsic motivation was not a significant predictor, β = .13, *ns*, whereas Involvement in the Task was a significant predictor, β = .26, $p = .004$.

Overall regression. The final analysis performed on the structure task data determined how well both the behavioral and the verbal process factors predicted creativity. The simultaneous regression equation significantly predicted creativity, $R^2 = .23$, $R^2_{adj} = .15$, $F(9, 87) = 2.83$, $p = .006$.

Collage Task

Behavioral process measures. The 10 highest correlations between behaviorally coded measures and creativity can be seen in Table 3. These 10 measures were factor-analyzed into four process factors, also shown in Table 3. When entered simultaneously into a regression analysis, the four factors were highly significant predictors of judge-rated creativity, $R^2 = .26$, $R^2_{adj} = .25$, $F(4, 145) = 12.50$, $p < .001$. Two factors in particular were strong predictors of creativity. One, a significant predictor (β = .35, $p < .001$) labeled *Involvement in the Task*, was composed of involvement, planning, and playfulness. This behavioral process factor closely resembled the behavioral factor of the same name derived in the structure task, again strongly reflecting our conceptualization of task involvement. Another significant predictor (β = .32, $p < .001$), labeled

Table 3. *Collage Task Behavioral Coding: Correlations With Creativity, Factor Analysis, and Regression (N = 150)*

		Factor Loadings			
Measure	Correlation With Creativity	Assuredness	Involvement in the Task	Pleasure	Uncertainty
Difficulty[a]	−.15*	−.87	.15	−.04	.05
Confidence[a]	.31****	.82	.07	.25	−.21
Pace[a]	.33****	.78	−.02	.13	.17
Planning[a]	.15*	−.21	.84	−.04	.03
Involvement[a]	.36****	.21	.69	.11	.04
Playfulness[a]	.28***	−.35	.67	.33	−.30
Enjoyment[a]	.21**	.13	.08	.83	−.20
Negative affect[a]	−.24***	−.22	−.10	−.82	−.12
Look at What Done[b]	−.19**	−.18	.27	.14	.81
Sloppiness[a]	−.13	.13	.27	−.25	.67
Percentage of Variance		26.5	21.5	12.7	11.2
Correlation With Creativity		.30****	.34****	.25***	−.21**
B		.36	.41	.09	−.04
SE B		.09	.09	.09	.03
β		.32****	.35****	.07	−.11

Note: B = regression coefficient; $SE\ B$ = standard error of B; β = standardized regression coefficient. Loadings shown above were obtained with a varimax rotation. The factors captured a total of 71.8% of the variance in the process measures. Creativity regressed simultaneously on all behavioral coding process factors was significant, $R^2 = .27$, $R^2_{adj} = .25$, $F(4, 145) = 12.50$, p .001.
[a]Likert scale. [b]Frequency count.
*$p < .10$. **$p < .05$. ***$p < .01$. ****$p < .001$.

Assuredness, was composed of confidence, pace, and not encountering difficulty (that is, difficulty loaded negatively). Complete regression results appear in Table 3.

Verbal process measures. The 10 highest correlations between verbally coded measures and creativity are presented in Table 4. These 10 measures were factor-analyzed into four process factors, also shown in Table 4. When entered simultaneously into a regression analysis, the four factors were highly significant predictors of judge-rated creativity, $R^2 = .19$, $R^2_{adj} = .16$, $F(4, 96) = 5.75$, $p < .001$. Three factors in particular were strong predictors of creativity. One, a significant predictor (β = .25, $p = .011$) labeled *Concept Identification,* was composed of analogies, "ahas," and transitions. Unexpected changes in thought and sudden inspirations characterized this aspect of the process. Another factor, a significant predictor (β = −.22, $p = .023$) labeled *Difficulty,* was composed of problems with self and negative exclamations, characterizing individuals who said negative things both about their own abilities and about the task in general. The other strong factor, a significant predictor (β = .26, $p = .008$) labeled *Wide Focus,* was composed of goal statements and irrelevant-to-task comments. Talking in this way was not constrained, but rather diverse in scope. Complete regression results appear in Table 4.

Mediation analyses. Stable, domain-specific intrinsic motivation, assessed by the SIEQ, was not significantly correlated with creativity, $r = .03$, *ns.* Therefore, mediation analyses could not be carried out for this task.

Overall regression. The final analysis performed on the collage task data determined how well both the behavioral and the verbal process factors predicted creativity. The simultaneous regression equation significantly predicted creativity, $R^2 = .42$, $R^2_{adj} = .37$, $F(8, 91) = 8.23$, $p < .001$.

Poem Task

Verbal process measures. The 10 highest correlations between verbally coded measures and creativity are presented in Table 5. These 10 measures were

Table 4. *Collage Task Verbal Coding: Correlations With Creativity, Factor Analysis, and Regression (N = 101)*

		Factor Loadings			
Measure	Correlation With Creativity	Confidence	Concept Identification	Difficulty	Wide Focus
Describes Collage	.12	.75	.12	–.17	–.09
Strength With Self	.16	.73	–.08	.10	–.04
Talks About Materials	.19*	.58	.04	–.06	.25
Analogy	.14	.09	.80	–.15	.09
Aha	.21**	–.18	.73	.16	.06
Transition	.20**	.25	.43	.18	–.01
Problem With Self	–.30***	.04	–.09	.86	–.01
Negative Exclamation	–.14	–.16	.35	.69	–.01
Goal Statement	.34***	–.18	.05	.06	.81
Irrelevant to Task	.25**	.39	.09	–.09	.72
Percentage of Variance		18.9	17.2	12.0	10.7
Correlation With Creativity		.21**	.24**	–.20**	.31***
B		.03	.10	–.16	.05
SE B		.05	.04	.07	.02
β		.05	.25**	–.22**	.26***

Note: *B* = regression coefficient; *SE B* = standard error of *B*; β = standardized regression coefficient. All measures were coded as frequency counts. Loadings shown above were obtained with a varimax rotation. The factors captured a total of 58.9% of the variance in the process measures. Creativity regressed simultaneously on all behavioral coding process factors was significant, $R^2 = .19$, $R^2_{adj} = .16$, $F(4, 96) = 5.75$, $p < .001$.
*$p < .10$. **$p < .05$. ***$p < .01$.

Table 5. *Poem Task Verbal Coding: Correlations With Creativity, Factor Analysis, and Regression (N = 101)*

		Factor Loadings		
Measure	Correlation With Creativity	Involvement in the Task	Striving	Anxiety
Exploration[a]	.33***	.86	.05	.08
Enjoyment[a]	.24**	.79	–.20	.06
Concentration[a]	.39****	.76	.31	–.01
Difficulty[a]	.26**	–.01	.81	–.15
Transition[b]	.11	.01	.76	.10
Question How[b]	.14	.06	.54	.15
Repeat Something[b]	.21**	.50	.51	.03
Exclamation[b]	.13	.09	.47	.07
Mention Time[b]	–.11	–.01	.03	.93
Evaluation[b]	.19*	.39	.33	.45
Percentage of Variance		29.8	17.3	10.7
Correlation With Creativity		.39****	.26**	.06
B		.61	.41	–.17
SE B		.16	.20	.17
β		.36****	.19*	–.10

Note: *B* = regression coefficient; *SE B* = standard error of *B*; β = standardized regression coefficient. Loadings shown above were obtained with a varimax rotation. The factors captured a total of 57.8% of the variance in the process measures. Creativity regressed simultaneously on all behavioral coding process factors was significant, $R^2 = .19$, $R^2_{adj} = .16$, $F(3, 97) = 7.36$, $p < .001$.
[a]Likert scale. [b]Frequency count.
*$p < .10$. **$p < .05$. ***$p < .01$. ****$p < .001$.

factor-analyzed into three process factors, also shown in Table 5. When entered simultaneously into a regression analysis, the three factors were highly significant predictors of judge-rated creativity, $R^2 = .19$, $R^2_{adj} = .16$, $F(3, 97) = 7.36$, $p < .001$. Two factors in particular were strong predictors of creativity. One, a significant predictor ($\beta = .36$, $p < .001$) labeled *Involvement in the Task*, was composed of exploration, enjoyment, and concentration. This label was used again due to the similarity of the factor with like-named factors on the other two tasks and its correspondence to our a priori conceptualization of task involvement. The next strongest factor, a predictor ($\beta = .19$, $p = .050$) labeled *Striving*, was composed of difficulty, transitions, questioning how to do something, repeating something, and exclamations (both positive and negative). This factor characterized individuals who asked themselves how to do something, stated that they were having trouble, and repeated the instructions or words or phrases from their poems. Complete regression results appear in Table 5.

Mediation analyses. Stable intrinsic motivation in the writing domain, assessed by the SIEQ, significantly predicted creativity, $r = .34$, $p < .001$. Both process factors that predicted creativity were then tested for a mediational role in intrinsic motivation's impact on creativity, as previously described. Only involvement in the task satisfied these criteria for mediation: intrinsic motivation predicts Involvement in the Task, $r = .31$, $p = .003$; Involvement in the Task predicts creativity, $\beta = .36$, $p < .001$; when creativity was regressed simultaneously on both, intrinsic motivation was no longer a significant predictor, $\beta = .17$, *ns*, whereas involvement in the task was a significant predictor, $\beta = .30$, $p = .006$.

Discussion

This study yielded information not previously available in the literature on human performance: the first detailed specification of particular task behaviors that strongly predict observable creativity in actual products made by participants, and the first account of the role of those behaviors in mediating the impact of motivation on creativity. The methods of behavioral observation and verbal protocol analysis used in this study uncovered many factors that were strongly related to creativity. These process factors significantly predicted substantial proportions of creativity variance in regression analyses for all three tasks (R^2_{adj} ranged from .15 to .37). As hypothesized, intrinsic motivation had a significant impact on creativity in two of the three task domains, with one of the process factors—Involvement in the Task—mediating the influence of intrinsic motivation as well. These results support the basic model of the influence of both intrinsic motivation and task behaviors on creativity (see Figure 1).

Basic Model Testing

The positive impact of intrinsic motivation on creativity was observed as hypothesized in two of the three task domains. Stable, domain-specific intrinsic motivation, assessed by the SIEQ, was a significant predictor of creativity in the structure and poem tasks. Although this relation between intrinsic motivation and creativity was observed, task behaviors were even more impressive predictors of judge-rated creativity. Process factors were reliably obtained through both behavioral and verbal coding, and although not all significantly predicted creativity on their own, utilizing them together yielded highly significant predictions of creativity in each task domain. Several of these factors appeared to be particularly important in understanding the creative process, predicting creativity on their own and in one case mediating the effect of intrinsic motivation on creativity.

Involvement in the Task was not only a strong predictor of creativity in each domain, but it also mediated the effect of intrinsic motivation on creativity in the two tasks where such an effect was observed. Although this measure was composed of somewhat different elements in each task domain, they were conceptually related; thus, the mediation results represent the type of internal replication sought in the use of multiple tasks. Involvement in the Task consisted of involvement, work on stability, set breaking, and pace in the structure task and exploration, enjoyment, and concentration in the poem task. These types of behaviors, all consistent with predictions derived from the maze analogy and previous theoretical work, indicate several ways in which intrinsic motivation manifests itself in the creative process.

An Elaborated Mediation Model

Several other process factors also predicted creativity in each domain, but they were not mediators of the relation between intrinsic motivation and creativity. These factors may well stem from two sources other than intrinsic motivation that are critical in the generation of a creative product: domain-relevant skills and creativity-relevant processes (Amabile, 1983a, 1983b, 1988, 1996).

Domain-relevant skills comprise the individual's complete set of response possibilities from which a new response is to be synthesized and information against which the new response is to be judged. These skills include familiarity with and factual knowledge of the domain in question: facts, principles, opinions about various questions in the domain, knowledge of paradigms, performance "scripts" (Schank & Abelson, 1977) for solving problems in the domain, and aesthetic criteria.

Creativity-relevant processes are personality and individual difference variables that facilitate creative performance across a broad range of domains. Several specific aspects of cognitive style, including a number of distinct abilities, appear to be relevant to creative performance. For example, individuals who can break perceptual set (Boring, 1950; Katona, 1940), avoid "functional fixedness" (Duncker, 1945), abandon an old set of unsuccessful problem-solving strategies in order to explore new cognitive pathways (Newell, Shaw, & Simon, 1962), and occasionally break out of well-used performance scripts rather than proceeding through them uncritically (Langer, 1978; Langer, Hatem, Joss, & Howell, 1989; Langer & Imber, 1979) are able to solve problems creatively.

The componential model of creativity proposes that, together with intrinsic motivation, these two components combine to yield highly creative products (Amabile, 1983a, 1983b, 1988, 1996). Thus, certain process factors identified in this study may not necessarily originate from intrinsic motivation, but may instead reflect either domain-relevant skills or creativity-relevant processes.

Domain-relevant skills. Assuredness (high confidence, fast pace, and a lack of difficulty) was a predictor of creativity in the collage task. Participants with high domain-relevant skills would be expected to behave in such an assured manner. Difficulty (problems with self and negative exclamations) was a predictor of creativity in the collage task, and Exhibited Uncertainty (self-initiated backtracks) was a predictor of creativity in the structure task. While these do not directly measure types of skills, it may be that participants with low domain skills encountered more difficulty and were forced to backtrack more frequently, thereby reducing the creativity levels of their collages and structures.

Creativity-relevant processes. Concrete Focus (talking about the task and not describing the materials) also predicted creativity in the structure task. It may be difficult to avoid functional fixedness and break set—two important creativity-relevant processes—while focused so concretely on the task at hand. Concept Identification (analogies, "ahas", and transitions) and Wide Focus (goal statements and utterances irrelevant to the task), each of which predicted creativity in the collage task, also appear to describe creativity-relevant processes.

Striving (difficulty, transitions, questioning how to do something, repeating something, and exclamations) was a predictor of creativity in the poem task. While apparently similar to Difficulty (a predictor in the collage task), Striving may reflect a response to challenge, a type of perseverance that may constitute a creativity-relevant process. Viewed in this light, its relation to creativity no longer contradicts that of Difficulty, for the two processes may originate from different sources and serve different purposes.

Figure 2 presents an elaborated model of the creative process, taking into account all three creativity components. This preliminary identification of process factors that appear to stem from sources other than intrinsic motivation may lend support to the componential conceptualization of creativity that includes domain-relevant skills and creativity-relevant processes. Unfortunately, this study did not include measures of these constructs. We therefore offer these speculations for their heuristic value in guiding future research.

Behavioral Manifestations of Intrinsic Motivation

Aside from contributions to theories of creativity, this study contributes to theories of intrinsic motivation as well. Because it addresses influences on voluntary behavior, the study of intrinsic motivation has played an important role in social and personality psychology over the past 3 decades. The vast majority of all theory

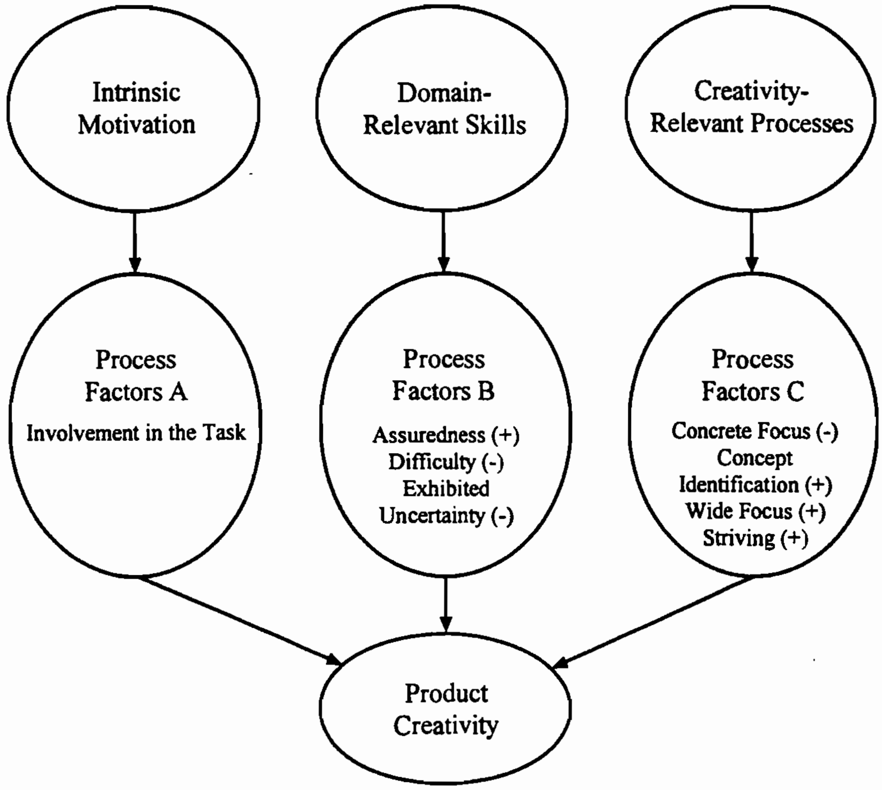

Figure 2. *Elaborated model of process factors mediating the impact of intrinsic motivation, domain-relevant skills, and creativity-relevant processes on creativity, with the direction of each factor's impact on creativity denoted as positive (+) or negative (–). Note that each of the three components could also have a residual (direct) effect on creativity not mediated by the particular process factors assessed in any given study.*

and research on the subject, however, has focused on some version of the same question: What influences people's voluntary behavioral choices between activities? Although the influences uncovered have often been complex, the primary focal point has generally been activity choice (e.g., Deci, 1971; Lepper & Greene, 1978; Lepper, Greene, & Nisbett, 1973; Ross, 1975). In addition, some theorists and researchers have considered a second important question: What is the impact of intrinsic motivation on the outcomes of activities? This work has examined outcomes such as learning, creativity, and work quality (e.g., Amabile, 1979; Greene & Lepper, 1974; Koestner et al., 1984; Kruglanski et al., 1971; McGraw & McCullers, 1979).

Few, however, have considered the conceptual space between activity choice and activity outcome: the actual task behaviors that result from higher or lower levels of intrinsic motivation. Some theoretical treatments have suggested that people higher in intrinsic motivation will be more likely to engage in flexible, deeply involved task behaviors (Deci & Ryan, 1985; McGraw, 1978). A few rare studies have collected data on task-engagement differences between subjects differing in intrinsic motivation. For example, in an early study, Garbarino (1975) found that children who were offered incentives in a cross-age tutoring task treated their "pupils" in a more negative, controlling, and inflexible fashion, leading to outcomes of poorer learning. Using a problem-solving task, Condry and Chambers (1978) found that subjects offered a reward for problems solved were more "answer oriented" in their task behavior than subjects not offered a reward: they started guessing the answers sooner, with less information; they made more redundant choices; and they were generally less efficient in solving the problems. The present study, however, was the first to examine the specific behavioral impact of intrinsic motivation on behaviors and the outcomes of those behaviors in a creativity task. Thus, this research begins to address important, unanswered questions about the behavioral manifestations of intrinsic motivation. With the methodology developed here, researchers should be able to further unravel the issue, with potentially significant implications for theories of human performance and for practical applications as well.

Methodological Implications

The most important methodological contribution of this study is the demonstration that task processing can be studied effectively using behavioral observation techniques and verbal protocol analysis. Through the use of videotape coding procedures, behaviors were identified and quantified that strongly predicted creativity. In addition, the analysis of verbal protocols—both in audio form in the structure and collage tasks and through written transcripts in the poem task—yielded process measures that were strongly related to creativity.

Although in this study these methods were used to examine the creative process, they lend themselves equally well as reliable research tools to any psychological researcher interested in relating social-psychological, personality, or other types of variables to actual task behaviors and verbalizations or relating task behaviors and verbalizations to observable performance outcomes. These methods offer decided advantages over the use of retrospective, paper-and-pencil assessments of task engagement. Behavioral coding may uncover variables that a participant simply cannot report accurately, for any number of reasons. Likewise, verbal protocol analysis of concurrent verbalizations can identify thought processes that the participant may hardly have been aware of and would easily have forgotten or distorted if not reporting them concurrently (Ericsson & Simon, 1984).

It is also worthy of note that, although the use of behavioral coding and verbal protocol analysis methodologies to study the creative process does have advantages, there are limitations as well. Developing inclusive, reliable coding schemes and training coders is very challenging and time consuming. The data obtained through these techniques can also be difficult to analyze. Whereas the distributions of traditional questionnaire items tend to be normal and homogeneous, the distributions of behaviors or verbalizations may be highly skewed or heterogeneous. Additionally, it is easier to generate questionnaire items that form desired composites than to imagine the range of possible task behaviors or verbalizations and how they may cluster together.

Future Research

There are many opportunities for future research to build on and expand the findings of the present study. Previous research consistently demonstrated that more intrinsically motivated individuals produced more highly creative works of art, written products, and solutions to problems. The present study, and the maze analogy underlying it, provide a preliminary description of the process by which intrinsic motivation affects creativity. Empirically, it was found that involvement in the task mediated some, but not all, of the effect of intrinsic motivation on creativity. Thus, the question still remains: What else mediates motivational effects on creativity? Research should now be directed toward replicating these findings with other subject populations and task domains and uncovering additional behavioral manifestations of intrinsic motivation.

Extrinsic motivation can play an important role in creative performance. This study restricted its attention to intrinsic motivation as a first step, using methodology that is novel to creativity research. However, extrinsic motivation can coexist with intrinsic motivation and may be a fruitful construct to incorporate into future investigations of this kind.

Given the findings of this investigation, methodological techniques can be expanded and developed more thoroughly. Further behavioral coding and verbal protocol analysis can avoid the biases of retrospective self-report data while continuing to become more specific in targeting elements of the creative process. By constructing more detailed behavioral categories based on the significant process factors that have been uncovered, a richer description of the creative process could be obtained. For example, a behavioral category such as involvement or set breaking can be broken down into its constituent parts. In addition, behaviors or verbalizations may indicate task processes that are particularly important at certain stages of task engagement or in certain sequences. These potential timing or sequence effects could be investigated through behavioral or verbal coding methodology. Finally, an exploration into novel tasks—whether problem solving, artistic, verbal, or from an entirely different domain—would likely bring to light additional process factors that may not have been strongly manifested in the three tasks investigated here.

The identification of process factors that did not mediate the relation between intrinsic motivation and creativity lends some support to the componential model of creativity that includes domain-relevant skills and creativity-relevant processes (Amabile, 1983a, 1983b, 1988, 1996). Process factors related to Assuredness, Difficulty, and Exhibited Uncertainty were hypothesized to reflect domain-relevant skills, while factors such as Concrete Focus, Concept Identification, Wide Focus, and Striving were hypothesized to reflect creativity-relevant processes. However, these suggestions are highly speculative, because no measures of domain-relevant skills or creativity-relevant processes were obtained in this study. Investigations that expand on the present one by assessing these factors in addition to intrinsic motivation could more thoroughly test for behavioral mediation of all three components of creativity.

Finally, this study makes a more general point about future research directions. Contemporary psychological research, particularly in the realms of social and personality psychology, is often criticized as being too focused on self-report measures of impressions, attributions, attitudes, affect, and motivation, and insufficiently focused on actual behavior. The present study attempted to draw links between self-report measures (in this case, motivation), specific behaviors exhibited in three different tasks, and performance outcomes (in this case, creativity). If researchers are to better understand the workings of social-psychological and personality processes, and more confidently suggest implications for applied fields such as organizational psychology, the field must move toward drawing such links with real-world performance and real-world outcomes.

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Appendix: Coding Dictionary: Behavioral and Verbal Definitions for Each Task

Presented here are the coding categories and definitions employed in the behavioral and verbal coding of all three tasks. Due to space limitations, only the 10 categories that were most strongly related to creativity within each type of task and coding appear here. (See Results section for further information on this point). Items marked with *L* were coded on 7-point Likert scales, while items marked with *F* were coded as frequency counts.

Structure Task, Behavioral

Involvement: Focus is on solving the problem; minimal distraction; absorbed in work (*L*).

Work on stability: Amount of work committed to structural integrity and stability (*L*).

Set breaking: Manipulates materials; uses or attaches them in new, unusual, or unconventional ways (*L*).

Pace: Speed at which participant works; a slow to fast gradient of working rate (*L*).

Experimentation: Curious, playful behavior toward materials or structure; trying out different ideas (*L*).

Planning: Organizes material; establishes an idea, order to build in, steps to take (*L*).

Progress: Advances made toward structure and meeting requirements of task (*L*).

Not working: No work being done on either aesthetics, stability, or height (not a direct rating, but rather computed by subtracting other work measures from the total possible if working steadily the whole time).

Checks height: Uses ruler to measure actual or unbuilt, hypothetical height of structure (*F*).

Self-initiated backtrack: Intentionally removes or disassembles piece(s) from structure (*F*).

Collage Task, Behavioral

Difficulty: Problems encountered, trouble creating collage or working with materials (*L*).

Confidence: Certainty of ability to complete task; assuredness in going about the task; not doubtful, timid, or anxious (*L*).

Pace: See entry for structure task.

Planning: See entry for structure task.

Involvement: See entry for structure task.

Playfulness: Engaging in task in curious manner; trying out ideas in a carefree way (*L*).

Enjoyment: Having a good time, finding pleasure in the task; smiling, not distressed (*L*).

Negative affect: Irritable, jittery, nervous, upset, frustrated, angry, plodding, annoyed (*L*).

Look at what done: Picks up collage, stands up, or takes a step back to look at collage (*F*).

Sloppiness: Has messy work space; not cleaning up; materials scattered (*L*).

Structure Task, Verbal

Problem with task: Notice something not working right; notice task-related problems (*F*).

Negative exclamation: Usually one word, can be two or three; curses or otherwise sharply negative (*F*).

Open question: Question about what to do in the future; general open-ended question of what to do (*F*).

Laugh: Sound of amusement; nervous, joyful, or otherwise (*F*).

Goal statement: Something that cannot be done in one step, future oriented; restatement of problem given, self-imposed goal, statement dealing with desired final goal, etc. (*F*).

Mention time: Any statement making a reference to time (*F*).

Analogy: Description or statement containing an analogy or metaphor (*F*).

Strength in self: Positive statements about ability or mood; feels good at task (*F*).

Talks about task: Statement of like or dislike of task (*F*).

Describes materials: Statement about texture, color, or other attribute of a material; naming a material (*F*).

Collage Task, Verbal

Describes collage: Statement that just describes collage, not a like or dislike (*F*).

Strength with self: See entry for structure task.

Talks about materials: Describes materials; likes or dislikes materials (*F*).

Analogy: See entry for structure task.

Aha: Eureka-type statements; abrupt change in activity (*F*).

Transition: Statement or fragment of movement to new topic or area of discussion or action; includes place holding fragments if utterance stands alone and is separated from others by 1 sec or more (*F*).

Problem with self: Uncertainty, self-doubt, negative statements about ability or mood (*F*).

Negative exclamation: See entry for structure task.

Goal statement: See entry for structure task.

Irrelevant to task: Anything not related to performing the task (*F*).

Poem Task, Verbal

Exploration: Curious or playful testing out of ideas (*L*).

Enjoyment: Having a good time; finding pleasure in the task (*L*).

Concentration: Focused on the task; not distracted (*L*).

Difficulty: Encountering problems or obstacles to completing some or all of the task (*L*).

Transition: See entry for collage task.

Question how: Questioning how or what to do; what is currently being done, present tense only (*F*).

Repeat something: Repeats instructions, the word summer, entire poem, or word(s) (*F*).

Exclamation: Usually one word, can be two or three; positive or negative outburst (*F*).

Mention time: See entry for structure task

Evaluation: Positive, negative, or questioning assessment of a word or idea (*F*).