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Understanding How Creative Thinking Skills, Attitudes and Behaviors Work Together: A Causal Process Model

ABSTRACT Managers (N = 112) from a large international consumer goods manufacturer participated in a field experiment in which they learned and applied the Simplex process of creative thinking to solve real management problems. The interrelationships among six attitudinal and behavioral skill variables learned during the training were measured to improve understanding of how these variables contribute to the process. Predicted relationships were tested and a best-fit causal model was developed. Behavioral skill in generating quantity of options was the most important variable overall: it was directly associated with behavioral skill in both generating quality options and evaluating options. The key attitudinal skill and the second most important variable overall was the preference for avoiding premature evaluation of options (deferral of judgment). The other attitude measured, the preference for active divergence, played only an indirect role in the process.

INTRODUCTION

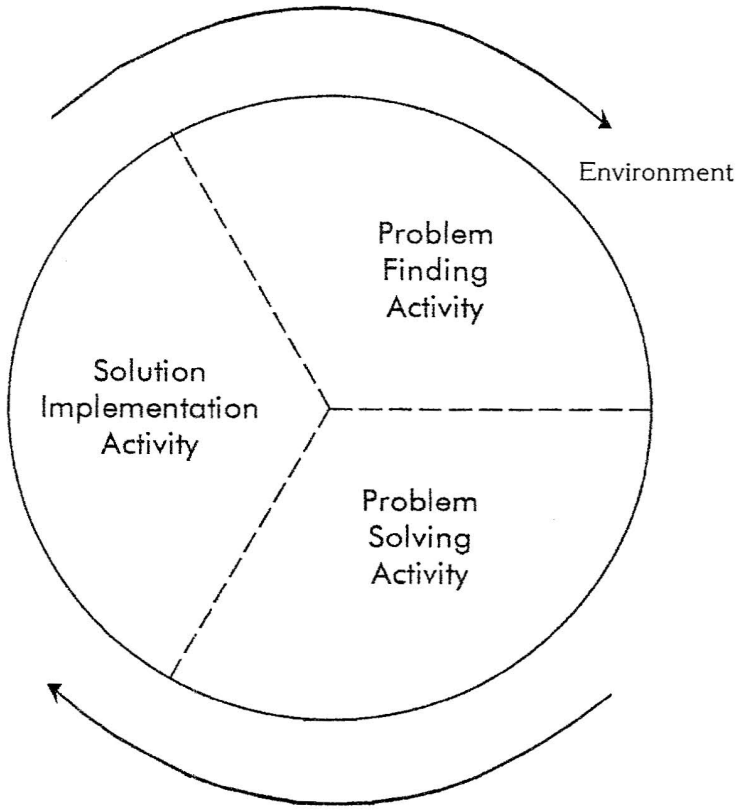
Attempts to categorize the study of creativity (e.g. Murdock & Puccio, 1993) frequently emphasize the four "Ps": *p*roduct, *p*erson, *p*ress (environment) and *p*rocess. Most research focuses on one category. O'Quin and Besemer (1989) and Jackson and Messick (1964), for example, focused on understanding and assessing the product of creative efforts. Meanwhile, one aspect of the "person" approach has been *identification*: the development of cognitive and personality tests capable of identifying more or less creative people. Dunnette (1976), Gough (1976), Roe (1976) and Torrance (1974) provide comprehensive reviews of this identification movement. Guilford's work (1968) is among the best-known

in the cognitive realm and MacKinnon's (1962, 1977) in the personality realm. Kirton (1976) and Myers (1962) addressed the relationship between personality and creative behavior, and Guilford (1968) addressed the cognitive aptitudes and abilities associated with various kinds of (potentially creative) thinking. The study of environmental "presses" has been pursued by Amabile and Gryskiewicz (1989), Andrews and Farris (1972), and Baker, Winkofsky, Langmeyer and Sweeney (1976), among others.

The Process Approach

The focus on the fourth "P" is apparent in research that models creativity as a *process*. For example, Basadur (1979, 1982, 1992) portrayed individual, team and organizational creativity as a continuous, dynamic, circular three-phase process of finding good problems, solving them and implementing good solutions (see Figure 1).

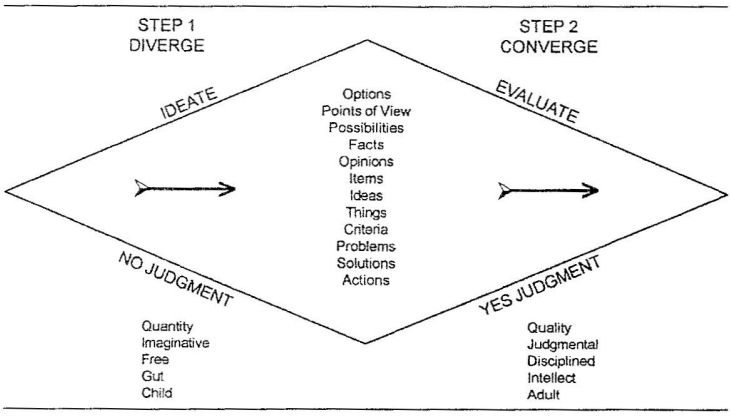
FIGURE 1. Organizational Creativity as a Process



Problem finding means continuously and deliberately discovering and formulating new and useful problems to be solved. In organizations, this includes generating new products or services by anticipating new customer needs, by discovering ways to improve existing products, services, procedures and processes, or by identifying opportunities to improve the satisfaction and well-being of organizational members and pertinent groups outside the organization. Problem finding also includes defining and conceptualizing such new problems and opportunities (regarding them as "fuzzy situations") accurately and creatively to clearly visualize the big picture and to identify more specific challenges and insights and relate them to one another. *Problem solving* means developing new, useful, imaginative solutions to these problems. *Solution implementing* means successfully implementing such new solutions. Each implemented solution leads to new, useful problems to be discovered — hence the circular process. Research shows that effective organizations do what it takes to mainstream such a process (make it an everyday habit among its members) for continuous innovation and for intrinsic motivation (Basadur, 1993, 1997). Research also shows that skills in such a process can be deliberately developed (Basadur, 1979, 1994).

A creativity process that incorporates divergent and convergent thinking within multiple phases or steps is a "complete" process. Basadur, Graen and Green (1982) identified a two-step mini-process called *ideation-evaluation* in which divergent and convergent thinking occur sequentially (see Figure 2). Osborn (1963), Parnes, Noller, and Biondi (1977), and

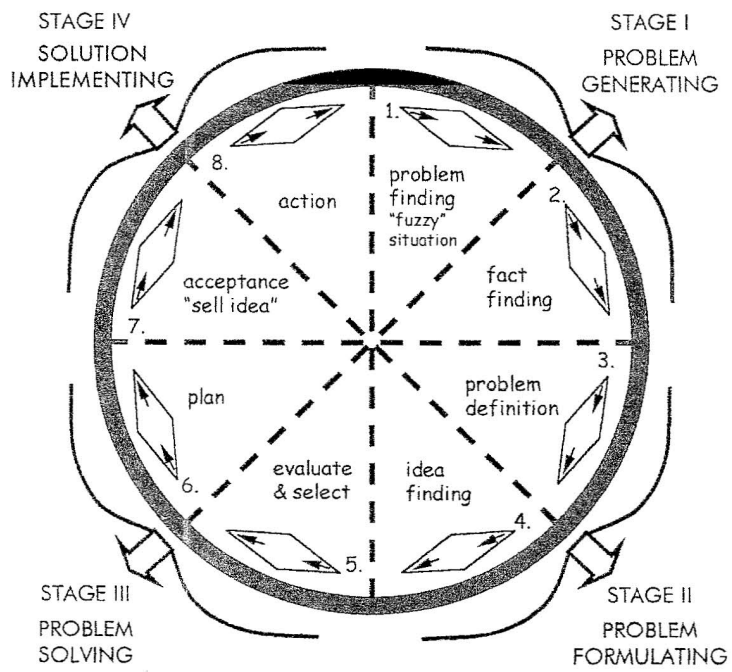
FIGURE 2. Ideation-Evaluation: A Sequential Two-Step Creative Thinking Mini-process.



Isaksen and Treffinger (1985) provided linear three-, five- and six-step models of a complete process. Basadur (1974, 1979, 1981, 1982, 1983, 1992) used real-world, organizational application experience and field research to extend the basic Osborn-Parnes three- and five-step models in two ways. The process can be represented as eight steps within the three phases of Figure 1. After the problem-finding phase has been divided into two stages — problem *generating* and problem *formulating* — the process can also be represented as a circular, continuous, four-stage process of generating, formulating, *solving* and *implementing*. Each of the eight steps consists of the two-step mini-process (see Figure 3); the entire process is called Simplex (Basadur, 1981).

Ideation-evaluation occurs within each of the eight steps of the Simplex process. *Ideation*, or active divergence, is the generation of options without evaluation (deferring judgment). *Evaluation*, or active convergence, is the application of judgment to the generated options to select the most significant options. Separating ideation from evaluation is a vital aspect of this two-step process. This mini-process must be executed

FIGURE 3. The Simplex Creative Process as a Whole.



skilfully. For example, Basadur (1995) suggested that, in order to achieve high-quality, innovative, creative results, an individual or a group requires not only the appropriate content (i.e., the knowledge or the *what*) but a creative, innovative process (the *how*) for working on that content, as well as sufficient skills in using the process. He identified four such process skills within the Simplex process:

- Active divergence – the ability to assertively generate a variety of options.
- Active convergence – the ability to evaluate and choose from among options and advance the process.
- Deferral of judgment – the ability to separate active divergence from active convergence.
- Vertical deferral of judgment – the ability to avoid unconsciously leapfrogging past steps, phases or stages of the process.

Basadur incorporated these three components into a Quality Results Equation:

Quality Results = Content + Process + Process Skills

These four process skills permit successful application of the ideation-evaluation mini-process within each step of the Simplex process, and from step to step or stage to stage (see Figure 3) throughout the process. Mastering the skills and the process enables individuals or groups to move about the process in different sequences as situations require. Synchronizing these skills is especially vital for group members attempting to work creatively together.

Basadur and Finkbeiner (1985) identified specific attitudes that *enhance* these process skills. They suggested that, unless the ideation-evaluation process is *accepted* attitudinally, then the process will not likely occur. Thus, the process skills have both attitudinal and behavioral components.

Basadur and Finkbeiner established a 14-item questionnaire to measure two specific attitudes that make up acceptance of ideation-evaluation: the preference for ideation (active divergence) and the tendency to (not) evaluate prematurely (preference for deferral of judgment). They suggested that these two attitudes enhance and encourage the practice of the two related behavioral skills. Encouraging active divergence leads to generation of more options and deliberate development of many points of view. Encouraging avoidance of premature convergence reduces the urge to prematurely judge or

analyze a fledgling thought. Basadur and Finkbeiner also suggested that a low tendency toward premature convergence would trigger a high preference for active divergence. That is, the former, more passive attitude is a prerequisite trigger for the latter, more active attitude. When people become skilled in reducing premature convergence and increasing active divergence, they create more, higher-quality options. These two measures of the acceptance attitudes are used in the research reported in this paper as explained later. Measures of the behavioral skill (practice of the ideation-evaluation process) are also described later.

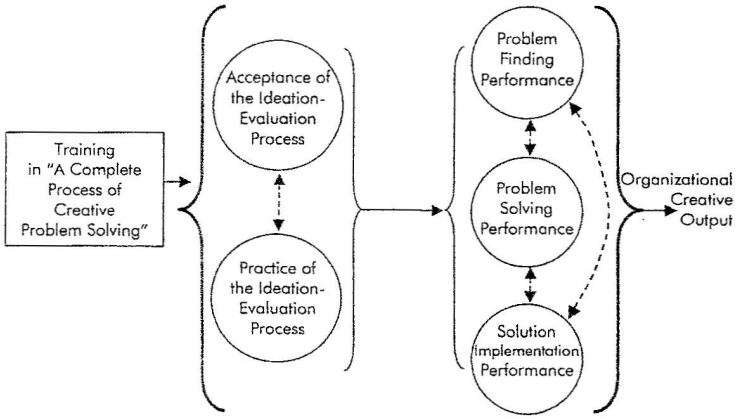
Basadur, Graen and Green (1982) and Basadur (1979, 1994) reported research that indicated that one's preference for and skill in applying the ideation-evaluation mini-process might differ in each of the three phases of the complete process. For example, someone might prefer to defer judgment and actively diverge in the solution-finding phase rather than in the problem-finding phase, or vice versa. Basadur suggested there might be different optimal ratios of ideation and evaluation in each of the phases for different fields of endeavor, and later (1995) provided supporting evidence.

Skills, Behaviors And Attitudes Are Needed to Make The Process Work

Basadur, Graen and Green (1982) reported a field experiment which tested the effects of training the complete Simplex process in an applied setting. They expected that the training would improve five variables: (a) acceptance of the ideation-evaluation thinking mini-process; (b) deliberate practice of the ideation-evaluation thinking mini-process; (c) problem-finding performance; (d) problem-solving performance; and (e) solution implementation performance. The first of these five variables is attitudinal and the second is behavioral. Basadur et al suggested that these two attitudinal and behavioral variables were necessary antecedents of the three performance variables. They believed that, unless a positive change in attitudes and behaviors occurred — motivating participants to separate divergent and convergent thinking and to deliberately apply divergent thinking — training would not improve ideation performance. The expected training effects are modeled in Figure 4.

This belief was based on Basadur's (1979, 1994) analysis of previous laboratory and field experiments on the value of providing creativity training. For example, Basadur found that most of the research had tested the brainstorming technique. Although brainstorming is a divergent thinking technique based on the *use* of ideation-evaluation, none of the brainstorming

FIGURE 4. Effects of Simplex Training on Attitudes, Behaviors and Performance.



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research had attempted to measure to what extent the subjects *accepted* the value of and *employed* any skills in ideation-evaluation during the particular experiment (or more permanently back in the real-world setting). To what extent brainstorming performance correlated with the willingness to accept ideation-evaluation and the skill in using it was never tested. In other words, many earlier research studies provided no more training than "giving brainstorming instructions" (as if this were sufficient to effect sudden changes in brainstorming attitudes and behaviors). For participants to say they *understand* brainstorming rules is entirely different from *using* the brainstorming rules skilfully, especially on real-world problems and meaningful issues.

For example, several laboratory experiments indicated that inhibitory influences make "training" (giving brainstorming instructions) of *groups* less valuable than training of *individuals* (Bouchard, 1972; Bouchard & Hare, 1977; Dunnette, Campbell & Jaastad, 1963; Shaw, 1971; Taylor, Berry & Block, 1958). However, none of these experiments measured intermediate attitudinal or behavioral effects of such "training". Not only is it unlikely that simple brainstorming instructions qualify as sufficient training, but it is unlikely that many group participants would truly *accept* and *use* those instructions. They were more likely inhibited within the group and collectively lacked sufficient attitudes and skills in the ideation-

evaluation mechanism. These groups should be called *untrained*, *undertrained*, or *underdeveloped groups*. Unless trainees significantly increase their acceptance of and skill in ideation-evaluation, neither they nor their groups should be expected to improve their creative performance compared to untrained individuals or untrained or nominal groups. In other words, the process modeled in Figure 4 strongly suggests that training in creative problem solving must be of sufficient quality, impact, and duration to effect *real* improvements in acceptance of the validity of the skill in the mini-process of ideation-evaluation and in the skill itself. This line of thinking explains why so few new management techniques become permanent and why many earn the ironic label of "flavor of the month" (see Basadur & Robinson, 1993).

Measuring the Needed Skills, Attitudes and Behaviors

Basadur et al. (1982) systematically measured for the first time the impact of creative problem-solving training on individuals both immediately after training and after their return to work. They expected that the three performance variables would be improved only if the antecedent variables — the acceptance and practice of the ideation-evaluation process – were improved. These expectations are consistent with Kraut's (1976) traditional industrial/organizational psychology training model: Training must go beyond *understanding* to change *attitudes* and to change *behaviors* in order to achieve superior *results*. Basadur et al stressed that essentially none of the previous research in creativity training had addressed the intermediate steps in Kraut's model. Their research attempted to measure and understand to what extent changes in acceptance of (attitude) and practice of (behavior) ideation-evaluation might *actually* result from training and accompany changes in performance (results). In previous research, this link between training and changes in acceptance and practice of the fundamental ideation-evaluation process had simply been *assumed* to occur.

Basadur et al. (1982) extended the previous research in several other ways. One way was to attempt to understand problem *finding* and solution *implementation* as well as *problem solving*. (Virtually all previous organizational research had focused only on *problem solving*.) Another way was to focus primarily on effects and mechanisms concerning *individual* attitudes, behaviors, and performance in a *real-world* setting (rather than in a laboratory setting). What little previous research had occurred in relatively real-world settings had been limited to group variables. It was also suggested that,

compared to simple brainstorming, a complete process such as Simplex would prove more useful and more credible (and less subject to the skepticism that often plagues creativity training) among participants from real-world business and other organizations (Basadur, 1997; Basadur, Graen, & Scandura, 1986). Unlike earlier research in which participants were asked merely to apply brainstorming rules without training, Basadur, Wakabayashi, and Graen (1990) stressed the importance of building skills through at least two days of hands-on practice using real-world problems.

Thus, Figure 4 offers the starting point of a theoretical model to explain how training increases organizational creativity and innovation. This model postulates that, in order to achieve meaningful increases in problem finding, problem solving, or solution implementation performance and organizational results, the impact of training must be sufficient to increase acceptance and practice of the ideation-evaluation process. For simplicity's sake, the model excludes various organizational, group and individual work-related factors that also affect creativity. The results of Basadur et al's research supported the model in Figure 4. Compared to a control group, the experimental training group achieved significant increases in the acceptance and practice of ideation-evaluation and significant increases in the performance variables measured. Potential interrelationships among the constructs (indicated in dashed lines) were left for future research. The model is useful primarily for identifying the key constructs that must be affected in order for training to succeed. The purpose of this paper is to investigate the relationships between the two antecedent variables of Figure 4 in the problem-solving phase of the Simplex creative problem-solving process.

While Basadur et al. (1982) restricted their measures to diverging variables, Runco and Basadur (1993) extended this work to include converging variables. They demonstrated that Simplex training participants significantly improved their evaluative skill, and that evaluative skill correlated positively with their ideational skill. This result is consistent with Runco and Vega's (1990) suggestion that individuals with high ideational abilities have more opportunity to exercise evaluative skills. In summary, participants given appropriate training have improved their evaluative skills, ideational skills and ideational attitudes, which are associated with ideational skills.

The main objective of this study is to advance the research reported in Basadur et al. (1982), Runco and Basadur (1993),

and Basadur (1994) by field testing and modelling the interrelationships among the various attitudinal and skill variables discussed above. The testing and modelling is restricted to the problem-solving phase of the complete Simplex process.

HYPOTHESES

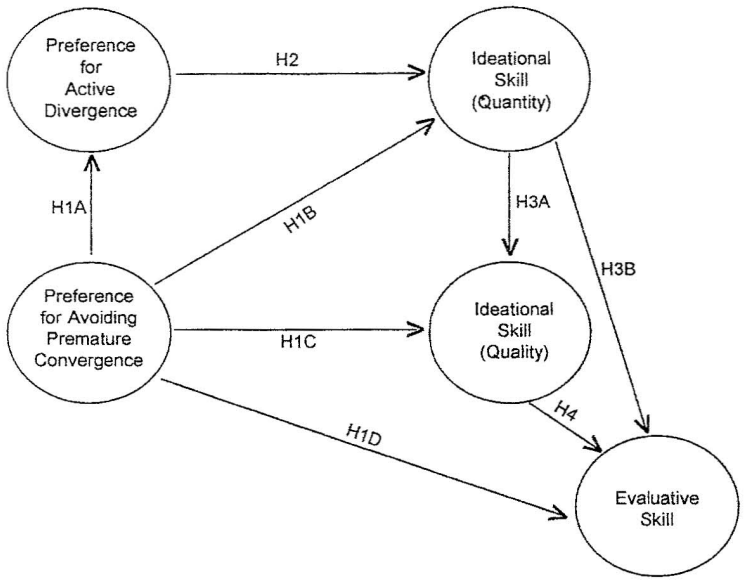
The model in Figure 5 predicts the expected relationships among these variables. It is expected that ideational skill will be associated with evaluative skill for the following reasons. First, generating more, and better, criteria for evaluation should lead to better evaluation. Second, the preference for avoiding premature convergence should be associated with evaluative skill, as the evaluation will be less hasty. Finally, ideational skill includes skill in conducting the two-step, ideation-evaluation mini-process (discussed under "Training" in the "Method" section). This skill includes the ability to separate ideation from evaluation. Just as practicing evaluation during the ideation step produces poor options, so practicing ideation during the evaluation step produces poor choices and decisions. Thus, better evaluation should result from better ideation. A set of hypotheses consistent with these predictions follows:

- H1: improvements in the attitude of preference for (avoiding) premature convergence will be associated with improvements in (a) the attitude of preference for active divergence (H1A); (b) ideational skill (quantity) (H1B); (c) ideational skill (quality) (H1C); and (d) evaluative skill (H1D); .
- H2: improvements in the attitude of preference for active divergence will be associated with improvements in ideational skill (quantity) (H2);
- H3: improvements in ideational skill (quantity) will be associated with improvements in ideational skill (quality) (H3A) and evaluative skill (H3B);
- H4: improvements in ideational skill (quality) will be associated with improvements in evaluative skill.

METHOD

Before and after training, participants were measured on the variables contained in the hypotheses. As a procedural check, their gains after training were checked against previous research, using multivariate analysis of variance. This was done to ensure that a normal "take" had occurred consistent with previous research and that a control group was unnecessary. Then the hypothesized relationships among the variables as portrayed in Figure 5 were tested using a special causal analysis model (Bollen, 1989).

FIGURE 5. Predicted Causal Model From Theory and Previous Research.



Participants

The participants ($N = 112$) were lower- through upper-middle managers employed by a large international consumer goods manufacturer. They represented a wide range of functions, including finance, manufacturing, operations, employee relations and distribution. Most participants had marketing and sales responsibilities. The organization was keenly interested in enhancing its members' creative problem-solving process skills to help them respond to a dynamic environment including changing marketing channels, customer needs and new technology.

Training

Participants underwent 20 hours of intensive training in the Simplex creative process over two days. This training was primarily hands-on and experiential, with exercises and diverse tasks that encouraged participants to discover for themselves such concepts as the value of ideation-evaluation. Using their chosen real-world problems, the participants practised ideation-evaluation in completing all three phases of the process: finding and defining their own problems, solving those problems, and preparing to implement their own solutions (implementation would occur after the training).

Various tools and techniques of ideation and evaluation were practiced in each of the eight steps and three phases of the process (see Basadur, 1995). The participants frequently

reviewed their experiences, learnings and insights. One goal of the training is to induce participants to become skilled in synchronizing divergent and convergent thinking within and among each of the eight steps and the three phases of the process. Another goal is to encourage participants to value concrete experience as well as abstract thinking, and to appreciate how attitudinal processes enhance cognitive processes in creative thinking and problem solving.

Instrumentation and Procedure

Two ideational attitudes, "preference for active divergence" and "preference for (avoiding) premature convergence," were measured using the Basadur 14-item Ideation-Evaluation Preference Scale (Basadur & Finkbeiner, 1985). Participants rated their level of agreement or disagreement with each of the 14 statements on a five-point Likert scale before and after the training. The minimum/maximum range for "preference for active divergence" was 6 to 30, and for preference for (avoiding) premature convergence, 8 to 40.

This study also employed measures of ideational skill and evaluative skill. The two ideational skill measures included quantity and quality (originality) of ideas generated to solve real-world managerial problems. The measure of evaluative skill assessed managers' ability to recognize creative and original ideas. The measures were applied to responses to four open-ended tasks (two tasks performed before training and two training). Participants were randomly assigned to two subgroups. Each subgroup took two minutes to write down as many ideas as possible to solve each of two work-related problems. All four problems were selected in consultation with senior managers to ensure that the problems were relevant to the participants. The instructions for these problems were as follows: "Work alone. Remember that these are not `tests'. They do not receive grades nor are there `incorrect' answers. In addition, your responses are completely confidential."

The tasks were ordered so that one subgroup received two of the four tasks *before* training and the other subgroup received the same two tasks *after* training, and vice versa. This added precaution was taken to minimize the potential effects of pre- and post-task differences, even though great care was taken to ensure that all the problems were equally open-ended and meaningful.

The four tasks were:

A: How might we install our vending equipment accounts faster?

B: How might we get into and out of our markets faster?

C: How might we make better decisions as a team?

D: How might we communicate better among ourselves?

Tasks A and B were considered to be equivalent technical problems, and tasks C and D were considered equivalent organizational or behavioral problems. One subgroup received tasks A and C before training and tasks B and D after training, and the other subgroup did the reverse. Ensuring a minimum of content overlap between tasks A and C and tasks B and D avoided the possibility that similarity of content made the after-training task easier than the before-training task.

The responses to these four problems were scored for quantity and quality. Quantity scores were derived by counting the number of ideas given. Quality scores were derived from the number of original or unique ideas (ideas given by only one participant). Quantity scores therefore represent ideational fluency, and quality scores represent ideational originality (Guilford, 1968; Runco & Albert, 1985; Torrance, 1974).

Evaluative skill was assessed by asking each participant to rate his or her own ideas on a seven-level scale (1 = entirely unoriginal; 7 = highly original). Rather than calculate correlational scores between ratings and actual originality as in Runco and Vega (1990), a simplified scoring technique was used. The evaluative scores were determined by calculating the number of original ideas that were accurately rated. A second score reflected the number of unoriginal ideas correctly identified.

This evaluative measure was used previously with managers in Runco and Basadur (1993), and is analogous to that used with satisfactory reliability with parents, teachers and children in Runco (1991) and in Runco and Vega (1990). Because significant cognitive differences exist between intra-personal evaluations and interpersonal evaluations (Runco & Chand, 1994; Runco & Smith, 1992), this measure is important. Because participants know so much about the "associative history" of their own ideas, intra-personal evaluations are generally much easier to make than interpersonal evaluations. Conversely, because individuals tend to judge their own ideas either extremely strictly or extremely leniently, they may find it easier to remain objective about someone else's ideas.

Analysis

Two procedural checks were made. The first was to ensure that the responses to the two task sets (AC and BD) were not significantly different. A simple t-test analysis compared task set means both before and after the training.

The second procedural check was to ensure that before- and after-training effects were similar to previous training research results in several controlled field experiments, ensuring that a "take" had been achieved and removing the necessity for a control group. These before- and after-training effects were analyzed through multivariate analysis of variance (MANOVA). The causal modelling analysis was performed using Lisrel 8 (Joreskog & Sorbom, 1993).

RESULTS

Both procedural checks were successful. There were no significant differences ($p \leq .05$) between mean task set scores on any of the ideational or evaluational skill measures, either pre-test or post-test (see Table 1). As demonstrated in the multivariate and univariate analysis results in Table 2, the training produced the intended results for all but evaluation of non-original solution ideas. The quantity of ideas produced increased significantly from a mean of 9.1 to a mean of 13.4 ideas ($p \leq .001$). There was also a significant increase in the

TABLE 1. Comparison of Responses to the Two Different Task Sets.

	Pre-test Means Task Set BD	AC	t	
Ideational Skill (Quantity)	9.2	9.2	0.1	(n.s.)
Ideational Skill (Quality)	3.5	3.5	0	(n.s.)
Evaluational Skill (Original Ideas)	1.2	0.8	1.6	(n.s.)
Evaluational Skill (Non-Original Ideas)	1.8	2.1	0.2	(n.s.)
	Post-test Means Task Set BD	**AC**	**t**	
Ideational Skill (Quantity)	13.6	14.3	0.4	(n.s.)
Ideational Skill (Quality)	5.3	5.9	0.6	(n.s.)
Evaluational Skill (Original Ideas)	2.6	2.3	0.4	(n.s.)
Evaluational Skill (Non-Original Ideas)	2.1	1.9	0.4	(n.s.)

Note: n.s. means that the difference was not significant at $p < .05$.

TABLE 2. Multivariate Analysis of Variance for the Pre- and Post-Training Test Scores.

MULTIVARIATE:		Wilks' Criterion: $F(6,78) = 21.75$, $p < .001$					
UNIVARIATE:		PRE	POST	t-Value	F-Value	D.F.	Rc
Ideation Skill (Quantity)	M (SD)	9.1 (4.2)	13.4*** (6.5)	6.7	45.1	(1,83)	0.57
Ideation Skill (Quality)	M (SD)	3.1 (3.1)	5.4*** (4.1)	5.6	31.8	(1,83)	0.48
Evaluation Skill (Originality)	M (SD)	1.0 (1.3)	2.5*** (3.1)	4.7	22.4	(1,83)	0.40
Evaluation Skill (Non-originality)	M (SD)	2.1 (1.8)	2.0 n.s. (1.9)	-0.5	0.3	(1,83)	-0.04
Preference for Premature Convergence[1]	M (SD)	3.1 (0.5)	2.4*** (0.7)	-9.4	87.6	(1,83)	-0.79
Preference for Active Divergence	M (SD)	3.8 (0.6)	4.0** (0.7)	2.9	8.3	(1,83)	0.25

Note: ** $p < .01$
*** $p < .001$
n.s. $p > .05$

[1] *Special Note*: In this table, a lower score on the attitude of preference for premature convergence indicates a stronger attitude of preference for (avoiding) premature convergence.

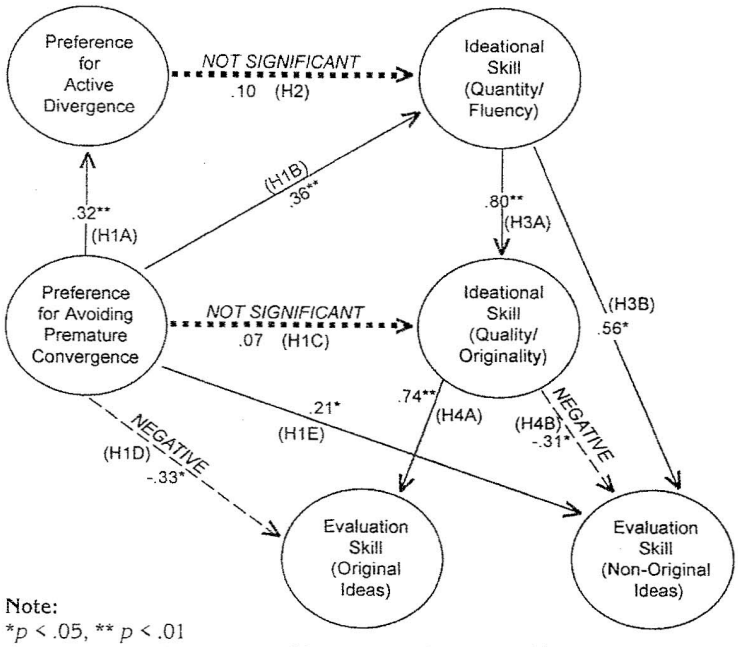
quality of ideas produced from a mean of 3.1 to a mean of 5.4 original ideas ($p \leq .001$). This increase may partly reflect the participants' improved evaluative skills. After training, they recognized significantly more accurately which of their ideas were original (an increase to a mean of 2.5 original ideas accurately evaluated from a mean of 1.0). It is somewhat surprising that participants failed to improve their recognition of unoriginal ideas, but, practically speaking, this may not be a critical point. Even with a drop in this index, the production of original ideas improved. Both ideational attitude means increased significantly after training. (Note that the preference for premature convergence attitude change score is negative in Table 2 as expected and must be reversed to represent the preference for *avoiding* premature convergence attitude.)

The results of the causal model using Lisrel 8 are shown in Figure 6. The fit indices show that the data fit the hypothesized

model of Figure 5 quite well, although two of the hypothesized relationships were not supported and the direction of two others was reversed. The fit of the model was evaluated using different criteria (e.g., Bollen, 1989): the chi-square goodness of fit statistic (in which a non-significant chi-square indicates excellent model fit) and the chi-square/degrees of freedom ratio (generally, values below 2.0 are viewed as acceptable); the Goodness of Fit Index (GFI); and the Adjusted Goodness of Fit Index (AGFI) (values over .90 are viewed as indicating good fit) (Joreskog & Sorbom, 1989). The AGFI adjusts for the degrees of freedom of a model relative to the number of variables; as a result, the AGFI rewards simpler models with fewer parameters (Bollen, 1989). These indices for the model were $X^2 = 22.37$ ($p = .498$), X^2/df (22.37/23 = .98), GFI = .975, and AGFI = .870, all indicating excellent fit.

Figure 6 presents the standardized solution to the model. The values in each path are the structural coefficients and can be interpreted in the same manner as standardized weights in

FIGURE 6. Results of Testing the Predicted Model.



Note:
*$p < .05$, ** $p < .01$
Chi-square with 23 degrees of freedom 22.37 ($p = .498$)
Goodness of fit index = .975
Adjusted goodness of fit index = .870
Root Mean Square Residual = 1.16

multiple regression. As can be seen in Figure 6, Hypothesis H2, which stated that increased preference for active divergence would be associated with increased ideational skill (quantity), was not supported (i.e., .10, $p > .05$). Nor was Hypothesis H1C, which stated that increased preference for avoiding premature convergence would be associated with increased ideational skill (quality/originality), (i.e., .07, $p > .05$).

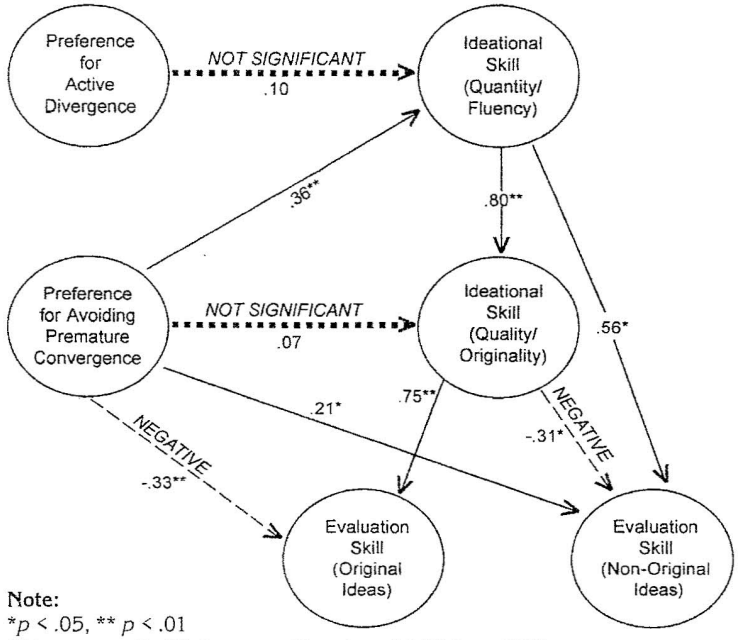
Also, Hypothesis H3B, associating increase in ideational skill (quantity) with increases in evaluative skill, was supported directly only in terms of the evaluation of non-original ideas. The corresponding association with evaluation of original ideas turned out to be an indirect one via pathway H3A, then followed by new pathway H4A (explained below).

All other associations in the hypotheses were supported. Although the association for Hypothesis H1D (preference for avoiding premature convergence with evaluative skill) was positive for non-original ideas (+.21), it was negative for original ideas (-.33). Similarly, while the association for Hypothesis H4 (ideational skill (quality) with evaluative skill) was positive for evaluating original ideas (.74), it was negative for evaluating non-original ideas (-.31). Accordingly in Figure 6, Hypothesis H1D has been split into two components: a revised Hypothesis H1D (-.33) and a new Hypothesis H1E (.21); and Hypothesis H4 has been split into new Hypothesis H4A (.74) and, H4B (-.31). Paths H3A and H4A were shown to be very strong, associating ideational skill (quantity) with ideational skill (quality/originality) (.80) and ideational skill (quality/originality) with evaluative skill (original ideas) (.74).

It is interesting that the active divergence attitude was associated only with the (avoiding) premature convergence attitude (H1A, .32), and not with any skills, contrary to the prediction of H2. Thus, although this research supported Basadur and Finkbeiner's (1985) suggestion that the ideational attitude of preference for (avoiding) premature convergence is necessary for the ideational attitude of preference for active divergence, the usefulness of including the divergence attitude in the overall causal model relationships is questionable. To test this suggestion, an alternative model omitting this path (H1A) was created. Figure 7 displays the results. The fit is not as good ($p = .075$) as the model in Figure 6, in which that path (H1A) was included ($p = .498$).

Several alternative models proved poorer than that of Figure 6. For example, when the pathway H3B is dropped from Figure 6, the model is rejected ($p = .035$). The results of

FIGURE 7. Results of Testing Alternative Model #1.



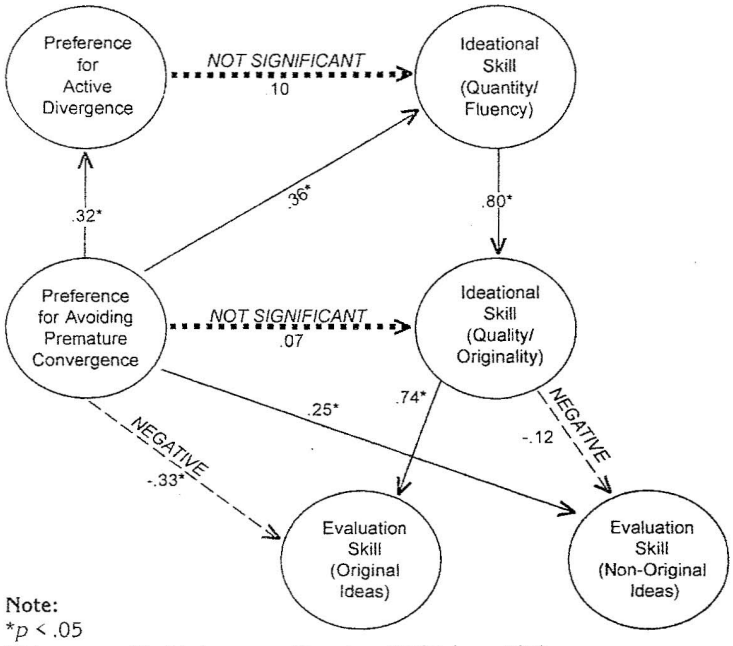
Note:
*$p < .05$, ** $p < .01$
Chi-square with 24 degrees of freedom 34.55 ($p = .075$)
Goodness of fit index = .962
Adjusted goodness of fit index = .809
Root Mean Square Residual = 1.16

testing this second alternative example are shown in Figure 8. No other alternative model was found to test as well as the model of Figure 6.

DISCUSSION

This study suggests how training in a complete creativity process increases a manager's ideation and evaluation skills. The training increases the acceptance of (preference for) avoiding premature evaluation (convergence) of new solution ideas. This probably increases the acceptance of (preference for) active divergence — the free-wheeling generation of options without judging their quality or analyzing their relevance. Precisely why the preference for active divergence increases is unclear, but increasing the preference for avoiding premature convergence seems to encourage skill in ideational fluency (quantity of solution ideas generated). It also appears to enhance the skill of evaluation in accurately recognizing non-original solution ideas. Meanwhile, increasing skill in ideational fluency (quantity of solution ideas generated) apparently translates directly

FIGURE 8. Results of Testing Alternative Model #2.



Note:
*$p < .05$
Chi-square with 24 degrees of freedom 37.94 ($p = .035$)
Goodness of fit index = .959
Adjusted goodness of fit index = .796
Root Mean Square Residual = 1.215

into increased skills in both ideation (quality [originality] of solution ideas) and evaluation (recognizing non-original solution ideas more accurately). Increases in evaluation skill apparently emerge both directly from the attitude of preferring to avoid premature convergence and indirectly from greater ideational skill in generating more solution ideas.

Greater ideational skill in generating higher-quality, more original solution ideas appears to be directly associated with greater evaluation skill in recognizing original, high-quality ideas. This skill is also apparently required to offset the negative, but smaller, effects of a higher preference for avoiding premature convergence on the skill of evaluating high-quality, original ideas. Similarly, although increased ideational skill in generating high-quality, original ideas has a negative effect on the skill of evaluating lower-quality, non-original ideas, this is apparently offset by the greater impact of higher ideational skill in fluency (quantity) of ideas generated.

Thus, the key appears to be ideational skill in generating a quantity of ideas. This skill is directly and strongly related to ideational skill in quality of ideas generated (.80) and to evaluation skill in recognizing lower-quality ideas (.56). In turn, the skill of ideation (quality/originality) is strongly associated with evaluation skill in recognizing more original, higher quality ideas (.74). This key set of mechanisms tends to offset the milder negative impacts on evaluative skills of the attitude of avoiding premature convergence for recognizing higher-quality, more original ideas (–.33) and of the ideation skill (quality/originality) for recognizing lower-quality, less original ideas (–.31). Overall, with respect to evaluation skills, it appears that the positive impacts of increasing ideational skills and attitudes substantially outweigh the negative impacts.

One might speculate that the mechanism by which the preference for avoiding premature convergence may interfere with evaluative skill in recognizing original high-quality ideas may be a reluctance to judge ideas too quickly. The individual or group might continue to consider options even as they are running out of time for making a sound judgment. Similarly, increased skill in creating high-quality, original ideas may interfere with identifying non-original, low-quality ideas: individuals who can improve ideas might be reluctant to drop a low-quality idea in the hope that they can somehow salvage it.

The training emphasizes the positive approach to idea generation: suspending judgment in order to improve ideas. This may best explain the lack of improvement after training in recognizing non-original ideas. For managers and others, improving skill in recognizing a few, original high-quality ideas might be a far higher priority in solving problems than improving skill in recognizing non-original, and thus less useful ideas, that they are unlikely to use.

It also appears that increases in preference for avoiding premature convergence do not directly impact skill in ideational quality, but rather *indirectly* through increasing skill in ideational quantity. It is well known that attitudes do not always translate directly into behaviors. Thus, the attitude of avoiding premature convergence may have been related directly to ideational quantity skill but only indirectly to ideational quality skill. Osborn's prediction (1963) that "quantity breeds quality" (a primary rule for the brainstorming process) comes immediately to mind as an example. This would explain the indirect effect in our final causal model of the avoidance of premature convergence attitude on ideational quality skill. The

intermediate step of increasing ideational quantity skill in order to increase ideational quality skill fits the causal model and lends credibility to Osborn's belief. It is also consistent with Mednick's (1962) theory about remote associations being found only after obvious responses, and with laboratory and field research supporting this belief as described earlier in this paper.

Furthermore, perhaps the increased preference for active divergence, which is apparently triggered by the increased preference for avoiding premature convergence, *indirectly* enhances the increased ideational skills in quantity/fluency and/or quality/originality. This raises the possibility of a moderating relationship that could be explored in further research.

CONCLUSIONS AND FUTURE RESEARCH

It appears that during the problem-solving phase of a complete process of creativity, an attitude of preference for active divergence is triggered by an attitude of preference for avoiding premature evaluation of options as predicted by Basadur and Finkbeiner (1985). However, the latter attitude — the acceptance of the value of deferring judgment — is the more powerful attitude as it is the only one significantly associated with any of the divergent and convergent thinking skill variables. The former attitude — the preference for active divergence — seems to merely accompany the development of divergent and convergent behavioral skills. It also appears that evaluative skills for non-original and original ideas may be different skills that are related in different ways to ideational attitudes and skills. This raises the possibility that various kinds of evaluation tasks may work best under a different set of attitudes and behaviors.

The causal model of Figure 6 should now be tested as a predictive model with a larger base size. Because of sample size limitations in this research, the models are offered as preliminary and tentative until this work is replicated with a larger sample. Additional measures of personality traits and different cognitive aptitudes and abilities associated with creativity could be added to test for moderating effects on the model and on training.

There are additional opportunities for extending this research. For example, replication with different samples and different tasks and perhaps additional measures would be one major avenue. Another path would be to investigate the other phases or stages of a complete process of creativity and innovation such as the Simplex process of Figure 3.

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