



IDENTIFYING ATTITUDINAL FACTORS RELATED TO IDEATION IN CREATIVE PROBLEM SOLVING

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ABSTRACT

Identifying Attitudinal Factors Related to Ideation in Creative Problem Solving

Innovation and creative problem solving training are increasingly important topics in organizations facing accelerating change and environmental volatility. This report first surveys how the literature characterizes creative problem solving, suggests how the various approaches to training or explaining creative problem solving may be categorized, and investigates the empirical research concerning such training. Second, it reports new field research focussing on one particular training approach previously indicated as useful. Four attitudinal constructs related to ideation, the primary cognitive construct of this training approach, are identified. The implications for future theory-building and training policy alternatives are discussed. A speculative model is presented differentiating between "ideation" and "deferral of judgment". A method of categorizing Osborn's brainstorming rules accordingly is suggested.

Creativity, problem solving, and innovation are becoming increasingly important topics in organizations in these times of rapidly accelerating change and instability. To innovate and adapt to change is considered by some researchers as the most important performance attribute of managers, engineers, scientists and other professionals and organizational members. Some major corporations have created a separate "department of corporate innovation" to stimulate and manage creativity organization-wide. Increasing numbers of organizations are interested in learning about individual, group and organizational factors influencing creativity. Some are developing creative problem solving training to try to increase innovation performance and degree of organic, participative management style (Basadur, Graen and Green, 1982).

This paper first describes how the literature characterizes creative problem solving, suggests how the various approaches to training or explaining creative problem solving may be categorized, and investigates the empirical research concerning if and how such training is useful. A new model linking training to performance is presented. Second it reports new field research deepening understanding of one particular training approach previously found useful. It then suggests implications for future research and organizations contemplating developing creative problem solving training. Many people believe that creative problem solving performance and innovation can be increased by training (e.g., Simon, 1960; Joyner & Tunstall, 1970; Basadur, Graen & Green, 1982). While this belief has spawned some research into understanding and testing creative problem solving processes, much of the training effort instead has been put into developing training programs by practitioner-oriented people based on relatively unproven and unresearched concepts, techniques and theories (Basadur, Graen & Green, 1982; Mackinnon, 1977).

The literature describes creative problem solving in various ways. Simon, Newell and Shaw (1962) consider creative activity as a special class of problem solving characterized by novel and unconventional thinking, persistence, and problems which are vague and undefined initially (such that part of the task is to formulate the problem itself). Others emphasize that creative problem solving involves not only the solving of problems, but also the finding or initiation of problems. Basadur (1979) and Basadur, Graen & Green (1982) summarize the literature on this line of thought. Simon (1960) distinguishes between programmed and non-programmed decision making. The latter concerns novel and unstructured problems requiring creativity and the former repetitive and routine problems which have predetermined solution procedures worked out. Guilford (1967) distinguishes between convergent thinking and divergent thinking. The latter involves the use of the imagination to generate ideas to solve problems which may have many possible correct but different answers; the former involves logical, mathematical thinking to solve "single correct answer" problems. Guilford suggests that the need for divergent thinking is characteristic of creative problem solving. Similarly, de Bono (1971) distinguishes between vertical and lateral thinking. Many other writers present various descriptions of creative problem solving (Rothenberg and Hausman, 1976).

In the literature explaining creative problem solving or suggesting training approaches, most writers describe specific processes which tap the imagination to create novel solutions to problems or facilitate the discovery of problems and the implementation of solutions (Osborn 1963; de Bono, 1971; Prince 1970; Gordon 1971; Parnes, Noller & Biondi, 1977; Leavitt, 1975; Mackworth, 1965; Getzels, 1975; Basadur, 1982). Some writers advocate the deliberate separation and sequencing of "idea producing" thinking processes from "idea selecting" thinking processes (Simon, 1960; Simon, Newell & Shaw,

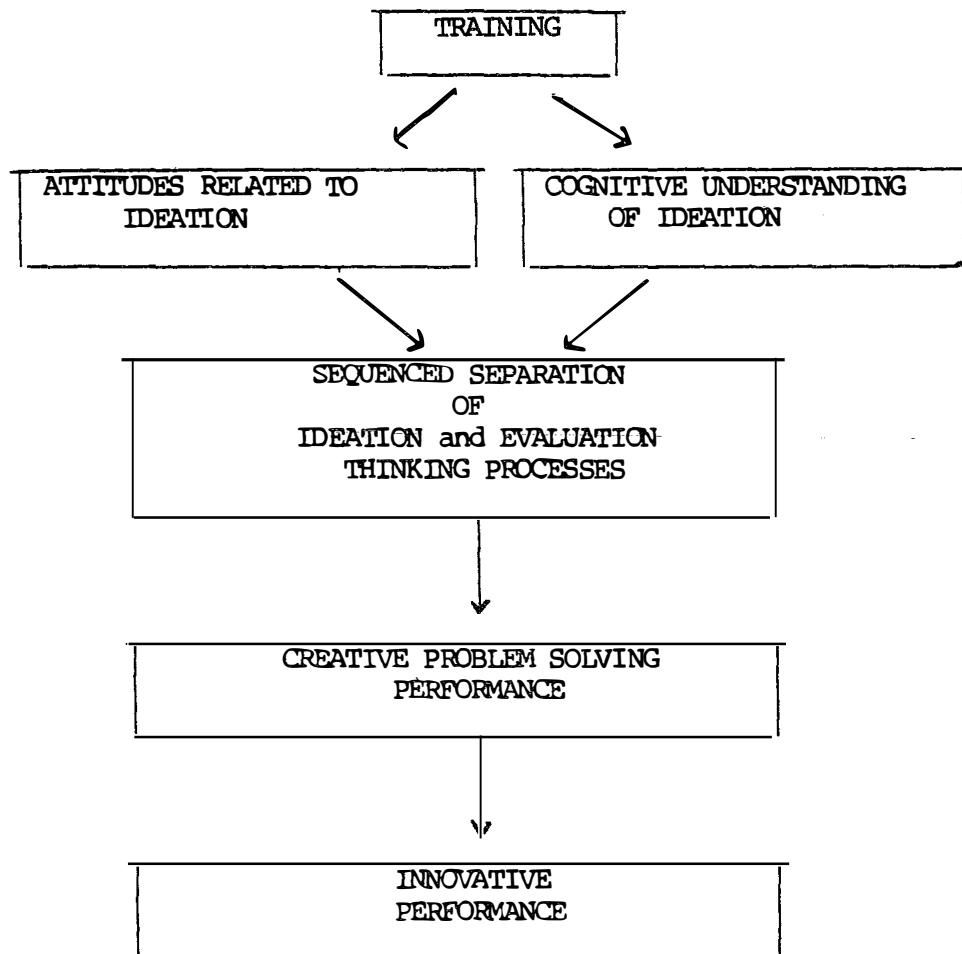
1962; Maier, 1967; Joyner & Tunstall, 1970). Within this basic approach there are two different schools of thought. One allows for the use of judgmental, convergent thinking processes during idea production such as trial and error searches (Simon et al, 1962). The other does not. It expressly prohibits judgmental, convergent thinking during idea production, deferring such thinking until later. The object is to proliferate options with full use of the imagination without regard to judgment or rules of logic. All evaluation of ideas is delayed until after ideas are produced to the limit of the time available. This is sometimes called the principle of deferred judgment. Some of the advocates of this approach include Osborn (1963); Parnes, Noller & Biondi (1977); Prince (1970;1976); Parnes (1961); Parnes & Meadow (1959); and de Bono (1971).

Based on this principle, Basadur, Graen & Green (1982) identify a separated, sequenced two-step thinking process called "Ideation-Evaluation". "Ideation" is defined as the generation of ideas without evaluation. "Evaluation" is defined as the application of judgment to the ideas so generated. Basadur et al present a model of a "complete process of creative problem solving" in which the ideation-evaluation process is repeated in multiple, sequenced and separate stages including problem finding, problem solving and solution implementation. Basadur (1982) and Parnes, Noller and Biondi (1977) describe other conceptually related multi-stage "complete process" models. Thus, within this particular school of thought, both kinds of thinking, ideation and evaluation, are valued but their separation is believed important. There is a large variety of specific ideation techniques available, the best known being brainstorming (Osborn, 1963).

While some empirical research that has been carried out supports both the general approach of separating idea production from idea selection and the more specific ideation-evaluation process, (Joyner & Tunstall, 1970; Parnes,

Noller & Biondi, 1977; Basadur, Graen & Green, 1982), relatively little has been done on understanding and measuring the attitudes and behaviors that may be related to and facilitative of such thinking processes (Basadur, 1979; Basadur, Graen & Green, 1982). Perhaps certain attitudes may be required to permit participants to truly "let loose", to use their imaginations "unencumbered". Thus when training is provided, perhaps it must be of sufficient impact to increase such attitudes significantly. Figure 1 shows a tentative model of how such training may lead to increased innovative performance.

FIGURE 1
Modelling Creative Problem Solving Training
Emphasizing Ideation



The research reported in this paper explores the question "what attitudes may be associated with the "ideation" process of thinking?" Basadur, Graen & Green (1982) have already identified one such attitudinal construct called "preference for ideation" and provide a seven item scale to measure it (Appendix 1). Our research attempts to identify additional attitudes related to ideation. Such additional attitudinal constructs may provide the basis for further understanding and research and new insights into training.

METHOD

A group of 36 middle managers and professionals drawn from across all the functions of a large industrial company and known to be familiar with ideation, deferral of judgment and other creative problem solving concepts (through training) were asked to add potential scale items concerning attitudes relating to ideation to the two strong items provided from the original preference for ideation scale (Appendix 1). A total of 101 potential items were thus added to the original two. Next, a questionnaire including the 103 items was sent out to a broad cross-section of 186 middle managers and professionals from several companies to answer on a five point scale, from "strongly agree" to "strongly disagree." This sample included both people who had and had not been exposed to training.

The data from the 186 panelists were factor analyzed. The factor analysis was performed on the correlation matrix for the 103 items. Missing data were handled by replacement by mean values prior to computing correlations (Finkbeiner, 1979). The number of factors was decided by examining the stream of eigenvalues of the correlation matrix with diagonals reduced to the squared-multiple-correlations. Four factors were chosen. The factors were extracted using a least-squares technique. The criteria used for rotation for interpretability were primarily those of simple structure. The technique is described in Tucker and Finkbeiner (Note 1). The final solution

meets all of L.L. Thurstone's five criteria for unique determination of a simple structure (Thurstone, 1947).

RESULTS

The first 15 eigenvalues of the reduced correlation matrix and their first differences are listed in Table 1. On this basis and after examination of residual correlations, four factors were chosen. The maximum residual correlation after extracting four factors was 0.35. While this is a fairly high residual, it is not unusual for a factor analysis of very large questionnaires. (A large residual correlation indicates that not all of the observed correlations are accounted for by the factors.)

Table 1

First Fifteen Eigenvalues of the Reduced Correlation Matrix

	1	2	3	4	5	6	7	
<u>Eigenvalues</u>	14.05	4.96	3.55	2.87	2.33	2.26	2.20	
<u>First Differences</u>	9.10	1.41	0.68	0.54	0.07	0.05	0.14	
	8	9	10	11	12	13	14	15
<u>Eigenvalues</u>	2.07	1.88	1.88	1.73	1.65	1.53	1.51	1.47
<u>First Differences</u>	0.18	0.05	0.10	0.08	0.12	0.03	0.04	

Next, the four factors were examined for item content and labelled accordingly. The 4 factors identified were (#1) "preference for ideation", (#2) "tendency for premature critical evaluation of ideas, (#3) "valuing new ideas", and (#4) "belief that creative thinking is bizarre." Each factor had a large number of items which loaded substantially on that factor alone. The items loading on the four factors are presented in Table 2 through 6 and the correlations among the four factors are presented in Table 6.

Table 2

Factor #1: "Preference for Ideation"

<u>Item #</u>	<u>Description</u>	<u>Loading</u>	<u>Other Factors with Large Loadings on Item Factor 2</u>
100	I think everyone should say whatever pops into their head whenever possible.	.47	
1	I feel that all ideas should be given equal time and listened to with an open mind regardless of how zany they seem to be.	.38	
93	The only time I need to defer critical judgment is when I want to provide the opportunity to find creative solutions to my problem.	.37	.34
3	Most often I'd rather spend my time listening to a lot of wild thoughts rather than a few good ideas.	.37	-.36
38	The best way to generate new ideas is to listen to others then tail-gate or add on.	.35	
9	I like to listen to other people's crazy ideas since even the wackiest often leads to the best solution.	.35	
2	I feel that people at work ought to be encouraged to share <u>all</u> their ideas, because you never know when a crazy-sounding one might turn out to be the best.	.34	
59	Idea generation and judgment can be effectively combined to produce quality ideas.	.34	.52
82	One new idea is worth 10 old ones.	.33	

Table 3

Factor #2: "Tendency for Premature Critical Evaluation of Ideas"

<u>Item #</u>	<u>Description</u>	<u>Loading</u>	<u>Other Factors with Large Loadings on Item</u>		
			<u>Factor 3</u>	<u>Factor 4</u>	<u>Factor 1</u>
51	Quality is a lot more important than quantity in generating ideas	.72			
60	Judgment is necessary during idea generation to ensure that only quality ideas are developed	.72			
18	We should cut off ideas when they get ridiculous and get on with it	.67			
62	You need to be able to recognize and eliminate wild ideas during idea generation	.65			
47	I should do some pre-judgment of my ideas before telling them to others	.60			
11	I wish people would think about whether or not an idea is practical before they open their mouth	.59			
50	A group must be focused and on track to produce worthwhile ideas	.55			
16	When we know what the problem is we should concentrate on solutions	.53			
59	Idea generation and judgment can be effectively combined to produce quality ideas	.52			.34
52	Lots of time can be wasted on wild ideas	.51			
10	It is very important to help others understand why their ideas are good or bad just as soon as they've stated them	.50			

Table 3 (Continued)

<u>Item #</u>	<u>Description</u>	<u>Loading</u>	<u>Other Factors with Large Loadings on Item</u>		
			<u>Factor 3</u>	<u>Factor 4</u>	<u>Factor 1</u>
13	It is important to identify when some idea just won't work so no more time will be wasted on it	.49			
21	We should limit the ideas and get on with how much they can really help us	.49			
39	People should be encouraged to think creatively, but there is a point not too far down the road where generating additional ideas becomes a waste of valuable time which could be used more productively	.49			
31	The quality of the ideas you get is independent of the number you generate	.48			
54	Too many ideas are a burden	.48			
61	Wild ideas have little application in industry	.48			
55	The best ideas are carefully considered	.47			
33	The most useful ideas are often those which are initially taken from areas far removed from the subject at hand	-.46	.33	.36	
87	Before we begin any project we ought to get at least 50 ideas, no matter how wild	-.43			
95	I form my ideas until I can visualize the outline before I verbalize them	.42			
49	Most good ideas are clearly relevant	.41			
94	Deferring critical judgment is merely a form of procrastination	.40			

Table 3 (Continued)

<u>Item #</u>	<u>Description</u>	<u>Loading</u>	<u>Other Factors with Large Loadings on Item</u>		
			<u>Factor 3</u>	<u>Factor 4</u>	<u>Factor 1</u>
66	In organizations, managers' greater responsibility is evaluating ideas as opposed to listening to others' ideas or generating their own ideas	.39			
29	Ideas are not worth too much until they are properly organized and clearly stated	.38			
7	I feel annoyed listening to half-completed or crazy ideas	.37			
3	Most often I'd rather spend my time listening to a lot of wild thoughts rather than a few good ideas	-.36			.37
73	Too many ideas make it impossible to separate the good ones from the bad	.35			
19	If people are trying to generate a list of ideas, they should take a break and start over if they don't have at least one ridiculous idea	-.34	.34		
74	Some people have good ideas; others are known to be poor idea generators	.34			
93	The only time I need to defer critical judgment is when I want to provide the opportunity to find creative solutions to my problem	.34			.37
65	Good time management is important; therefore, we should limit the amount of time we spend listening to new ideas	.33			
97	Occasionally it's appropriate to do some "blue sky thinking" to move a project ahead, but most of my work only requires logical, organized thinking	.33			

Table 3 (Continued)

<u>Item #</u>	<u>Description</u>	<u>Loading</u>	<u>Other Factors with Large Loadings on Item</u>		
			<u>Factor 3</u>	<u>Factor 4</u>	<u>Factor 1</u>
77	Imagination is more important than knowledge	-.33			
34	It is better to have one good actionable idea than a whole bunch of poorly thought speculations	.32			
15	I feel that irrelevant ideas are disruptive unless they are offered in a formal "brainstorming" session	.32			
12	There is a time to create ideas and a time to evaluate ideas; they do not need to be done at the same instant	-.31			

Table 4

Factor #3 -- "Valuing New Ideas"

<u>Item #</u>	<u>Description</u>	<u>Loading</u>	<u>Other Factors with Large Loadings on Item</u> <u>Factor 2</u> <u>Factor 4</u>
88	I have often been able to come up with a new idea myself based on an idea from someone else	.53	
36	Ideas are fundamental to decision making, and as such, should not be taken for granted	.49	
42	Most people never really 'open their minds' to all the possible options or alternatives when considering solutions to a problem	.49	
68	In organizations, senior management should encourage ideas by demonstrating they are willing to act on them	.47	
91	I really enjoy the challenge of finding a different way to solve a problem	.46	
81	Some people really surprise me with their new ideas	.42	
48	Most innovations occur because of needs or problems	.42	
80	When I get a new idea, I really get excited	.41	
63	All people have creative ideas from time to time	.41	
57	Crazy sounding ideas can lead to something	.39	
64	Productive change is important to a business. New ideas foster change. Therefore, new ideas are important to a business	.38	
92	The more problems I have the more opportunities I have	.38	

Table 4 (Continued)

<u>Item #</u>	<u>Description</u>	<u>Loading</u>	<u>Other Factors with Large Loadings on Item</u>	
			<u>Factor 2</u>	<u>Factor 4</u>
67	Everyone has at least one good idea	.37		
71	I feel that giving people time to think up ideas is a waste of time	-.37		
46	Most good ideas which end in a positive result do so because their originators "made it happen"	.37		
41	In organizations many individuals automatically cite policy or procedure reasons as to why an idea will never make it	.37		
72	Only groups of people who have the same problems should work on ideas to solve those problems	-.37		
23	Most truly creative ideas were considered stupid or impossible when first expressed	.36		
83	I like to take a few minutes every day or so just to think up new ideas	.35		
58	We constantly change the way things are done - this is an indication that there may be better ways to make some decisions better and quicker	.33		
33	The most useful ideas are often those which are initially taken from areas far removed from the subject at hand	.33	-.46	-.36
37	Great decisions are the result of great ideas	.32		
30	Building on ideas is an essential step toward making them useful	.31		

Table 5

Factor #4 -- "Belief that Creative Thinking is Bizarre"

<u>Item #</u>	<u>Description</u>	<u>Loading</u>	<u>Other Factors with Large Loadings on Item</u>	
			<u>Factor 2</u>	<u>Factor 3</u>
98	Creative people generally seem to have scrambled minds	.58		
89	New ideas seldom work out	.49		
43	Truly creative people also have unusual lifestyles	.49		
99	I'm often too embarrassed to suggest my wild ideas. People laugh and suspect I can't think straight	.42		
78	Really creative people are never very organized	.41		
96	I don't have much time for thinking up wild ideas, I'm too busy just getting my job done	.40		
86	Why is everybody always talking about ideas? I've got more work now than I know what to do with	.40		
70	Ideas are only important if they impact on major projects	.37		
76	The boss's idea is usually always the best since it comes from a much broader perspective	.37		
33	The most useful ideas are often those which are initially taken from areas far removed from the subject at hand	.36	-.46	.33
4	Listening to other people's ideas is a waste of time	.35		
75	If everyone is providing ideas, then no one gets any work done	.34		
25	Only smart, knowledgeable people have good ideas	.34		

Table 5 (Continued)

<u>Item #</u>	<u>Description</u>	<u>Loading</u>	<u>Other Factors with</u> <u>Large Loadings on Item</u> <u>Factor 2</u> <u>Factor 3</u>
19	If people are trying to generate a list of ideas, they should take a break and start over if they don't have at least one ridiculous idea	.34	
101	Groups of people don't think very well together. The best ideas come from individuals in seclusion	.31	

Table 6

Correlations Among Factors in Study #1

	<u>Factor #1</u>	<u>Factor #2</u>	<u>Factor #3</u>	<u>Factor #4</u>
Factor #1	1.00			
Factor #2	-.19	1.00		
Factor #3	.11	-.23	1.00	
Factor #4	-.04	.31	-.21	1.00

DISCUSSION

We appear to have identified four separate attitudinal factors relating to ideation. Further research to confirm these factors is underway. This differentiation may be particularly useful in helping organizations and individuals better understand specific attitudes affecting creative behavior and how training in creative problem solving works. For example, it may be that organizations desiring to provide training emphasizing ideation should identify which of these four attitudinal factors may need relatively more emphasis. It may be that reducing the tendency for premature critical evaluation of ideas may be deemed most critical to encourage more ideas to flow forward from organizational members who are intimidated by fear of rejection of their ideas. On the other hand, it may be most important to convince organizational members that creative thinking is not "bizarre" to encourage more of them to do it. Perhaps increasing attitudes of valuing new ideas should be targeted preferentially. Or perhaps increasing the preference for ideation should be targeted to increase the flow of new ideas in an organization that already values new ideas, does not prematurely criticize ideas and does not think creative thinking is bizarre, but still doesn't get enough ideas generated. Also when such training is provided, the concept of ideation may now be better and more completely explained to participants. It seems probable that organizational members currently have substantially different interpretations of the meaning of constructs associated with creative problem solving such as "ideation". At least some of those different interpretations seem to be represented by the four factors suggested in this research. Some of the "mystery" about creativity training may thus be reduced. Perhaps organizations which have been hesitant to begin organized efforts to improve innovation may be more likely to do so if they better understand what is involved in creative problem solving training.

Ideation appears to be a relatively complex construct. Assuming further research can confirm the factor structure indicated, one important learning gained is a clearer differentiation of the concepts of "deferral of judgment" and "ideation". Various organizational members can be expected to have substantially different interpretations or attitudes that relate to it. Also when training is provided in creative problem solving emphasizing ideation, the concept can now be better and more completely explained to them in terms of the different attitudes related to it. It may also be possible to improve the explanation of the cognitive aspects of ideation. For example, it seems possible now to differentiate between the concepts of "deferral of judgment" and "ideation". These concepts have not been well separated or clarified in the literature to date (Parnes, Noller & Biondi, 1977). It is proposed that it may be one thing to passively "defer judgment", enhanced perhaps by an attitude of a low "tendency for premature critical evaluation of ideas". It may be a very different thing to actively "ideate", - that is, to actively generate a large number of ideas without using judgment, enhanced perhaps by the attitude of a high "preference for ideation". The former suggests a more passive freedom for ideation while the latter suggests a more active triggering of ideation. One could speculate that the former may be complementary or even a prerequisite for the latter. The other two attitudes could conceivably enhance either or both the active and passive aspects.

Said in another way these concepts may help clarify attitudes & cognitions relating to Osborn's four brainstorming operational rules: (1) defer judgment (2) go for quantity (3) freewheeling is welcomed (4) hitchhiking is sought. Speculatively, it would seem that high "preference for ideation" might be associated with doing the latter three operations while the attitude of a low "tendency for premature critical evaluation of ideas" might be associated with the first operation. Thus, the latter three operations

would be associated with "triggering ideation" while the first would be associated with "freedom for ideation".

Further speculating, an examination of the items in Tables 4 and 5 suggest that possibly the attitudes of low "belief that creative thinking is bizarre" and high "valuing new ideas" might be associated with the "freewheeling" and "hitchhiking" operations, respectively. These speculations are modelled in Figure 2.

This model is very tentative. If and how the attitudes actually relate to the thinking processes is a matter for further research. Perhaps behavior reflecting the thinking processes could be observed and measured then correlated against the attitudes to check for relationships. Similarly the grouping of the thinking processes needs further exploration and confirmation. The model also needs to address the effect of training on evaluation processes and other factors related to performance (Basadur, Graen and Green, 1982).

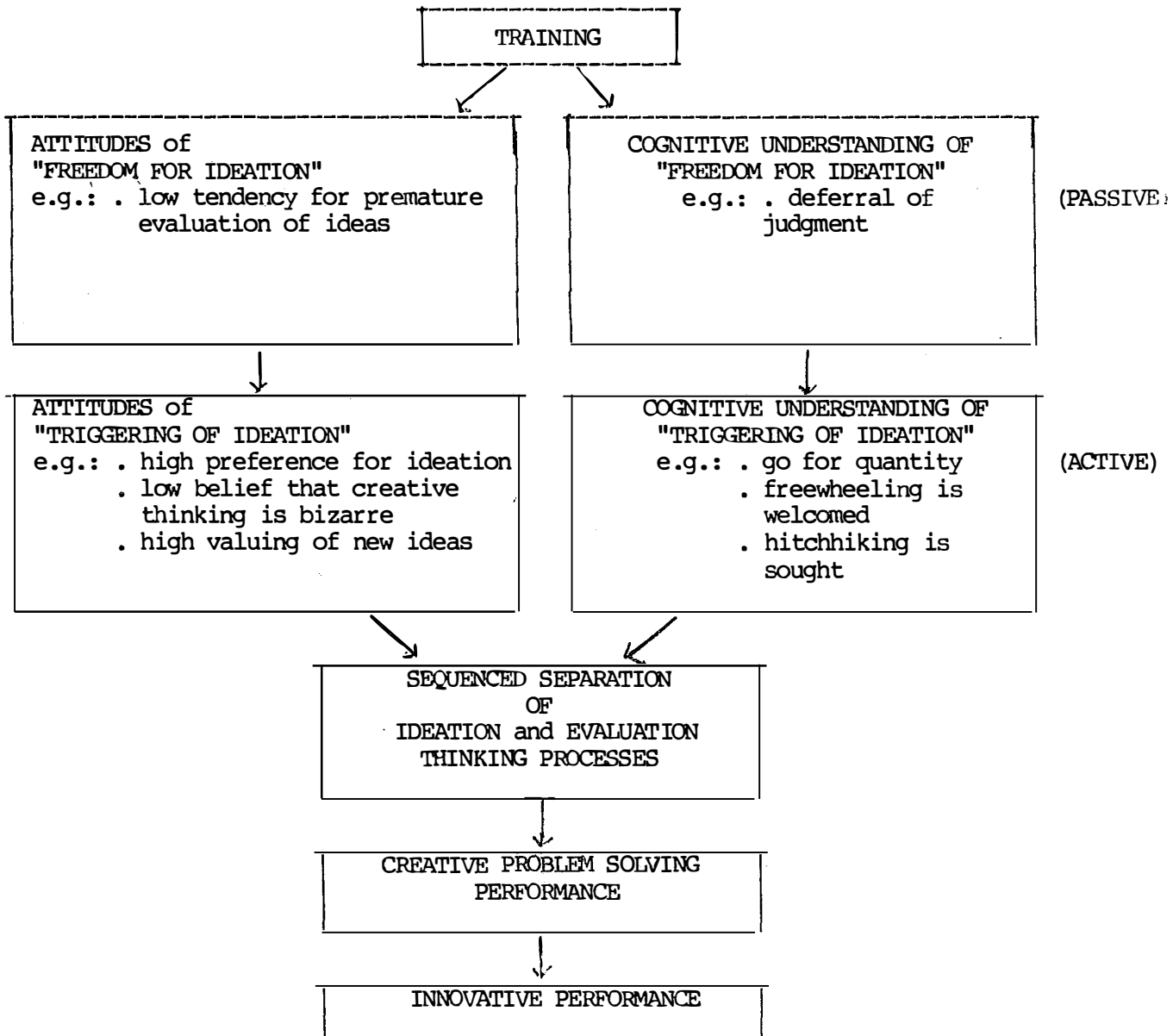
The next research step should be reliability and validity assessment of all four identified factors. Some work is already underway. In a preliminary study of two of the four factors, a moderate reliability was established for scales representing the two factors. Internal consistency for the two scales was established by reconfirming factor structure. In another preliminary study of one of the four factors, external validity of the factor was established by comparing responses to a scale representing it with another in two externally defined groups. We are proceeding to involve all four factors now in similar studies based on these encouraging results.

FIGURE 2

Revised Model of Creative Problem Solving Training Emphasizing Ideation

Differentiating Between

"IDEATION FREEING" and "IDEATION TRIGGERING"



Reference Note

1. Tucker, L.R., and Finkbeiner, C.T., "Transformation of Factors by Artificial Personal Probability Functions," Research Report RR81-58, Educational Testing Service, Princeton, N.J., 1981.

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Appendix 1

Preliminary Preference for Ideation Scale

Instructions

Listed below are several statements concerning various situations. Read each statement carefully and indicate the extent to which you agree or disagree with the statements by circling the letter which corresponds.

- A = Strongly Agree
- B = Agree
- C = Neither Agree Nor Disagree
- D = Disagree
- E = Strongly Disagree

1. I feel that all ideas should be given equal time and listened to with an open mind regardless of how zany they seem to be.

A B C D E

2. I feel that people at work ought to be encouraged to share all their ideas, because you never know when a crazy-sounding one might turn out to be the best.

A B C D E

3. Most often I'd rather spend my time listening to a lot of wild thoughts rather than a few good ideas.

A B C D E

4. Often I feel I prematurely judge others' thoughts and ideas.

A B C D E

5. When I don't feel like mentioning an idea to other people it's usually because I've evaluated it.

A B C D E

6. I often find myself jumping to solutions before considering additional alternatives.

A B C D E

7. I usually feel like contributing most of the thoughts that come to me in the meetings that I attend.

A B C D E

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