

A Multicriterial Approach to Creativity for Realistic Divergent Thinking Problems

Narendra K. Sharma and Deepika Rastogi

Indian Institute of Technology, Kanpur, India.

Measurement issue has plagued creativity research. The multiplicity of definitions and criteria used to describe the phenomena has led to a variety of approaches to measure creativity. Each of these has certain methodological limitations and by themselves these approaches do not provide a complete understanding of the concept. The present paper suggests a multicriterial approach to overcome some of the deficiencies associated with the methods used for studying creativity for realistic divergent thinking problems by introducing two indices in addition to the conventionally used measures. First, based on the two most characteristic features of creativity, a single measure called the Composite Creativity Score (CCS) is introduced. A second measure called the Frequency Creativity Index (FCI) is proposed to provide an objective measurement of novelty, considered to be the most representative trait of the creativity complex. Together with the existing measures used to study creativity, the two indices proposed in the study point to a more exhaustive methodology by representing a combination of the objective and subjective scoring approaches to studying divergent thinking problems. Multicriterial measures of creativity can be effectively used in HR, managerial and business domains.

Keywords: Appropriateness, Frequency, Measurement, Multicriterial approach, Novelty

One of the most controversial issues in creativity research concerns how to study and measure creativity. This arises largely due to the complexity of the term and the multiple definitions available to describe the phenomena. Although most definitions of creativity emphasize the two hallmark characteristics, namely novelty and appropriateness, yet researchers are divided on the operationalization of these terms and their appropriate measurement.

While originality has often been used interchangeably for the feature of "novelty", terms like usefulness, valuable, significance, adaptiveness, utility etc. are the other synonyms used for "appropriateness". If originality is considered to be the most representative characteristic of the creativity

complex, it is appropriateness which distinguishes creative ideas from absurd, immoral or illegal ideas that may be highly novel, yet totally irrelevant to the task at hand. In other words, there seems to be some agreement with regard to the criterion of creativity. However, when one turns to the measurement of these criteria or even how these criteria are tied to each other, several issues arise.

If the two criteria are unanimously accepted as the defining characteristics of creativity, one would make assumptions of the two being related to each other. That is to say that if any product or idea is high on novelty and usefulness, it shall qualify as being creative. Similarly, low novelty and low appropriateness would indicate low creativity.

This would imply a positive correlation between the two measures. However, the relationship between the two measures is far from being as simple and direct as it may appear. Their interrelationship and relative contributions in assessing creativity have revealed mixed findings in research. In a study by Runco and Charles (1993), originality and appropriateness scores were found to be inversely correlated for ideational pools. Further, Runco and Charles showed that originality was a more reliable predictor of creativity than appropriateness. In another similar study, the authors remarked that "...although theories positing that creative things are both original and appropriate make sense, it is difficult to demonstrate that originality and appropriateness themselves are related" (Runco, Illies, & Reiter-Palmon, 2003). In a series of important experiments regarding a comparison of strategies and criteria of creativity, Runco and his associates (Runco, 1988; Runco & Charles 1993; Runco et al., 2003) demonstrated that although appropriateness is an inseparable part of creativity, yet there are some semantic and measurement issues related to it, which need to be addressed in future research. This ambiguity regarding the criteria may in turn have important theoretical implications for the definition of creativity and its measurement, which regards both these measures as important. Therefore, the objective of this paper is to propose a multicriterial framework for measuring creativity for realistic divergent thinking problems by independently looking at some of the relevant measures and further exploring how they can be combined to come up with two new indices in addition to the conventional measures used in creativity research.

Nature of Creativity

Even though researchers consistently argue that the two most outstanding characteristics of creativity include novelty and appropriateness, they have also

established the fact that creativity is a multifaceted concept; a reason why several theorists have referred to creativity as the "creativity complex" (Albert & Runco, 1989) or "creativity syndrome" (MacKinnon, 1960; Mumford & Gustafson, 1988). Depending on the approach taken to study creativity, certain other measures are considered while making judgments about creativity. For instance, in the psychometric tradition, which widely used the divergent thinking tasks, separate scores were assigned for flexibility, fluency and elaboration; all of which are considered while drawing any conclusions about the creative potential of an individual. Where on the one hand, flexibility refers to the number of different categories of relevant responses, fluency of scores refers to the total number of relevant responses. Elaboration refers to the amount of detail in responses. These indicators are generally more applicable to creative ideas or divergent thinking tasks. In cases of evaluation of creative products, other criteria such as aesthetic appeal, craftsmanship, functionality, technical appeal etc. may be used. Therefore, measurement criteria may actually depend on the following two questions:

1. Unit of study i.e. whether creativity is a property of people, products or processes
2. Nature of task i.e. what kind of problem solving task is selected for measurement of creativity

In other words, the criteria may change depending on the answers sought for these two questions. For the first question, in case the creative person is the focus of study, individual differences will gain prominence and an attempt to identify the correlates of a creative personality (like attraction to complexity, self acceptance, courage, spontaneity etc.) will be made. If the creative product is the focus of study, then dimensions like aesthetic appeal, functionality, technical goodness etc. may assume importance. And finally, if the creative process is studied, then

complexity, integration, divergence, fluency, elaboration etc. may become important considerations.

Similarly, the task chosen to assess creativity depends on the research objective and the focus of study. For example, research investigations that have employed poems and stories or other such creative outcomes as the basis for creative performance, divergence, originality, and elaboration are the common measures. These measures are usually rated independently by a set of judges to assess the level of creativity. This method of obtaining independent ratings by a set of judges is called Consensual Assessment Technique (CAT), which was developed by Amabile (1992). When interior design projects or problems involving object manipulation are used, aesthetic appeal, artistic merit, thematic expression etc. are employed as the criteria of creativity. Therefore, based on a number of considerations like research objective, focus of study and the nature of task used in the study, the criterion for creativity may be accordingly determined.

Another issue of concern with regard to “the criterion problem” (Shapiro, 1970) is the predictive efficiency of these measures of creativity. Depending on the nature of tasks used for measurement of creativity, certain criteria may assume greater importance over the other, which in turn may affect their relative contributions to the creativity score. In tasks involving open-ended and realistic divergent thinking problems, appropriateness becomes an important consideration in the assessment of creativity besides novelty. So far, a lot of experimental and psychometric studies on creativity have focused on creative productions in laboratory like art, poems, music or on divergent thinking tasks. However, little attention has been directed towards how creativity can be assessed for open-ended real life situations.

Table 1 summarizes the approaches for measuring creativity. These include psychometric, experimental, biographical, computational, and contextual approaches. The specific characteristics of these approaches and methodologies adopted under each are also indicated.

Table 1. Approaches Used for Measurement of Creativity

Approach	Characteristics	Specific Methodologies
Psychometric	Measured in terms of divergent thinking skills such as fluency, flexibility, originality, elaboration, redefinition etc.	Divergent thinking tests (e.g. SOI tests, TTCT etc.)
Experimental	(a) Controlled environment (b) Quantitative measurement (c) Cognitive task analysis	Controlled, multifactor experiments
Biographical	(a) Qualitative analysis (b) Authentic environments	(a) Case study method (b) Historiometric method
Biological	Physiological correlates of creative thinking are identified	(a) EEG measures (b) PET measures
Computational	Computer modeling is used to simulate creative production	Artificial intelligence techniques
Contextual	Creativity is studied in social and cultural contexts	Field study

Divergent Thinking Tests

The starting point for all psychometric measures of creativity was the divergent thinking tests developed by Guilford. Based on the Structure of Intellect Model of intelligence and a decade of research thereafter, Guilford (1967) identified several abilities that he collectively termed as divergent thinking. These abilities included *fluency, flexibility, originality, redefinition, elaboration* etc. According to Guilford, divergent thinking, or the development of many ideas was critical to creativity; for the greater the number of ideas produced, the higher the likelihood that those ideas would be creative. Since then, research supports Guilford's claim that there is a strong relation between divergent thinking and creativity and that the ability to generate ideas is predictive of the ability to develop original solutions (Clapham, 2001; Milgram, 1990).

These divergent thinking tests were further refined by Torrance (1974) who developed the widely used battery of tests called Torrance Tests of Creative thinking (TTCT). These tests seek multiple responses to either verbal or figural prompts that could be tested for fluency (or number of ideas), flexibility (divergence of perspectives represented in the ideas), originality (statistical infrequency) and elaboration of ideas beyond that required by the prompt. Divergent thinking tests have now become the lightning rod for the psychometric study of creativity and a reliable measure of assessing the creative potential.

Regarding the nature of divergent thinking tasks, a finer distinction can be made between realistic and unrealistic divergent thinking tasks. Standard tests on creativity, such as Torrance Test for Creative Thinking (TTCT), Remote Associates Test (RAT) etc. are examples of unrealistic divergent thinking tasks, where the subject may have to give responses to Instances questions like "name round things" or Uses tests like "name uses

of a brick" etc. On the other hand, realistic divergent thinking tasks may involve responses to problems faced in real life, like at home, work, or some larger social, political problems etc. Studies on creativity have employed both kinds of tasks extensively. Some studies have specifically tried to investigate how explicit instructions to be original, appropriate and creative have changed the responses for each of these two kinds of tasks, namely realistic and unrealistic divergent thinking tasks (Runco et al., 2003).

Through their study, Runco et al. demonstrated that there was a significant interaction between the type of task and type of instructions with the realistic divergent thinking task eliciting high appropriateness scores and unrealistic divergent thinking task yielding high originality scores. Such findings indicate that there is a need to look into how exactly the indicators of creativity are related to each other, specifically for different kinds of tasks. For this, it may be more appropriate to take ratings for each of these dimensions separately, not only to examine the relationship between the two but also to assess how efficiently each of these contributes to the measure of creativity.

A lot of research on creativity has employed CAT, whereby a set of independent judges base their judgments of creativity by giving a composite score on dimensions like divergence; perhaps the most common measure of creativity. The assumption here is that judges will be able to recognize something as creative based on their understanding of what are the characteristics of creativity. However, an absence of studies, which obtain separate ratings by judges on the two most widely accepted components of creativity, namely novelty and appropriateness is indicative of a gap in literature, particularly owing to the kind of ambiguous relationship that has been reported between the two. Thus, an important objective of the present paper is to obtain

separate ratings for novelty, appropriateness, and divergence by the judges and then see how they correlate with each other. In addition, ideational fluency would also be considered as a relevant measure as the task calls for divergent thinking responses. Such ratings would further enable one to make judgments about the relative contributions of each of these to the creativity complex, for a realistic divergent thinking task.

Proposed Multicriterial Approach for Realistic Divergent Thinking Tasks

Consider the following situation: There is a task involving a realistic problem that is open ended enough to allow for originality and divergent responses. Respondents are instructed to provide as many creative solutions to the problem as they can within a stipulated period of time. Creativity is operationalized as solutions that are both novel and appropriate to the problem at hand. While originality is regarded as the most widely respected trait in the creativity complex (Barron, 1995; Runco & Charles, 1993), appropriateness of solutions, in this case, assumes importance as the problem is realistic and therefore solutions need to be practical.

The following indicators can be studied to capture the entire range of the creativity complex, keeping in mind the objective of the paper and the nature of task.

1. Novelty
2. Appropriateness
3. Divergence
4. Ideational fluency

The first three criteria, namely novelty, appropriateness and divergence in thoughts would be rated independently by a set of judges, following CAT. The same judges would be employed across the measures of novelty, appropriateness and divergence. The fourth criterion would be computed by the researcher. A further description of how these ratings would be obtained for each of

these criteria follows.

1. *Novelty*. This refers to the uniqueness of the solution as felt by the judges. Each solution would be rated by three judges on a 5-point rating scale where 1 indicates low value and 5 indicates a high value. In other words, the higher the rating, the higher the novelty of the solution.

2. *Appropriateness*. This measure refers to the feasibility of the solution. Each solution would be rated by the same judges who would assess novelty on a 5-point rating scale where 1 indicates low value and 5 indicates a high value. Once again, the higher the rating, the higher would be the appropriateness of the solution.

Ratings for both novelty and appropriateness would be provided by judges for as many solutions as would be provided by a subject. Judges would also have the option of rating a solution as irrelevant or incomprehensible by marking an "X" against it. This in turn would be assigned a value of zero since novelty and appropriateness are considered as dependent measures. Consequently, a rating of "X" for one of these measures would imply an "X" for the other as well.

3. *Divergence*. This score indicates the flexibility or divergence in perspectives taken by a subject. This is a composite score, which the judges would provide for the problem on a whole. Again, this would be rated on a 5-point rating scale where 1 indicates least divergence and 5 indicates most divergence in perspective.

An inter-rater reliability (Cronbach's alpha coefficient) would be computed for all the above three measures. Given the assumption of consensual agreement between the judges, inter-rater reliability reflects construct validity. This implies that if there is independent agreement between the judges regarding the (un)creativity of a product, then it can and should be accepted

without any doubts.

4. *Ideational Fluency*. This refers to the total number of responses provided by the subjects. The researcher would compute this by simply counting the total number of solutions provided by a subject. Based on these indicators, the following two indices are proposed:

Composite Creativity Score (CCS).

Going by the operational definition used in the present paper, any solution found to be both novel and appropriate to the given problem, shall qualify as being called a creative solution. Average ratings of the three judges for each of the two dimensions, namely novelty and appropriateness, would be calculated for each solution. Further, based on the average ratings by the three judges for each solution, an average novelty score would be computed for every subject. A similar score would be computed for appropriateness, based on the average ratings provided by the judges. Since both novelty and appropriateness are considered the qualifying criteria for a solution to be called creative, it would be appropriate to develop a composite measure of creativity based on these two. This means that a solution would not be considered creative if it were only novel and not appropriate and vice versa. Moreover, it is quite possible that these two measures are interrelated. Therefore a product moment correlation value (r), between the average novelty and appropriateness ratings would be computed. Based on this, the Composite Creativity Score (CCS) would be calculated for each subject using the formula:

$$S = \sqrt{N^2 + A^2 + 2r * N * A}$$

where N = novelty score

A = appropriateness score

r = product moment correlation between novelty and appropriateness

Frequency Creativity Index (FCI).

This index refers to the objective measurement of novelty or originality of solutions by taking the frequency of responses given across all the subjects. In divergent thinking tests, originality of a solution is defined as the statistical infrequency of that particular solution. Accordingly, any response that is reported by less than 5 % respondents is considered to be high on originality. Therefore, in addition to the subjective ratings that would be provided by judges for novelty of the responses, an objective approach to the same would also be adopted by computing this index. A frequency based content analysis of the various responses would be carried out to assign a particular creativity score to every solution provided by the subjects. This would be done by compiling a list of the total number of solutions across the subjects and identifying some common/broad categories under which solutions could be placed. After this, frequencies would be obtained by calculating how many subjects gave responses in these categories of solutions. In this way, FCI of every subject would be obtained by totaling the creativity scores of every solution provided by that particular subject. Thus, based on the frequency tally of responses, Frequency Creativity Index (FCI) would be computed by using the expression:

$$FCI = \bar{O} [(1-f/N)*100]$$

where, \bar{O} = sum of creativity scores of all solutions given by a subject

f = frequency of a response

N = Total number of responses across subjects

Here, the range of scores obtained for each solution would be between 1 and 100, where 1 represents the lower end and 100 the higher end. In other words, the higher the value of FCI, the more creative the solution would be. In this manner, based on

the solutions provided by the subjects, their total creativity would be assessed by adding up the creativity score for each solution they provided.

Together these indices serve to complement the already existing procedures for measuring creativity. An advantage of obtaining separate ratings for novelty and appropriateness is that not only can we have a combined score resulting in CCS, but we can also independently assess the relative contributions of each of these by regressing them on the two indices proposed, namely

CCS and FCI. A good idea would be to conduct a step-wise regression analysis to obtain more insights as to which characteristic assumes importance over the other for both the indices. Further, correlations for each of these measures may be computed, which may shed some light on the nature of relationship between them.

Table 2 summarizes the measures of creativity proposed in this paper. It indicates the nature, a brief description, strengths, and weaknesses of each measure.

Table 2. A Summary of the Proposed Measures of Creativity

Measure	Nature	Description	Strengths	Weaknesses
Divergence	Subjective	Variability in perspective	Valid predictor of creative potential	Disregards novelty and appropriateness
Ideational Fluency	Objective	Total number of responses	Quick and easy to compute	Quality overlooked in favor of quantity
Composite Creativity Score	Subjective	Composite score based on novelty and appropriateness	(a) Single score accounting for the two most representative characteristics (novelty and appropriateness) of creativity (b) Relative contributions of novelty and appropriateness may be assessed	Does not account for ideational fluency
Frequency Creativity Index:	Objective	Creativity score based on statistical infrequency	Provides an objective measurement of novelty	Does not account for divergence or appropriateness.

These measures can be effectively used in HR, managerial and business domains where innovation and multitasking are in great demand.

Summary

The conventional measures used in creativity research, namely divergence, novelty, appropriateness and ideational fluency by themselves do not provide an exhaustive assessment of creativity. Independently considered, each suffers from one or the other criterial or methodological deficiency. A good idea would be to consider all or at least a combination of most of them for overcoming the inadequacy of one measure

over the other. For instance, the ratings provided by the judges for novelty, appropriateness and divergence are their subjective assessment and these three measures do not take into account the total number of solutions that are provided. Similarly, ideational fluency does not take into account the quality of solutions in terms of their novelty and appropriateness. Therefore, in addition to obtaining divergence and ideational fluency scores for divergent thinking tasks, the two indices introduced in this study may provide a more comprehensive way of studying creativity. While on the one hand, Composite Creativity Score (CCS) provides a single index based

on the two defining characteristics of creativity, on the other hand, Frequency Creativity Index (FCI) provides an objective measurement of originality by assigning a unique creativity score to every category of solution identified for a problem. It may be worthwhile to empirically validate these indices in future research.

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Narendra K. Sharma, PhD, Professor and Head, Department of Industrial and Management Engineering, Indian Institute of Technology Kanpur, Kanpur - 208 016, India

Deepika Rastogi, PhD, Research Scholar, Indian Institute of Technology Kanpur, Kanpur - 208 016, India

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