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Generating a Judging Protocol for Measuring Group Creativity

Talya Steinberg
Pacific University

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Abstract
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GENERATING A JUDGING PROTOCOL FOR MEASURING GROUP CREATIVITY

A THESIS
SUBMITTED TO THE FACULTY
OF
SCHOOL OF PROFESSIONAL PSYCHOLOGY
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BY
TALYA STEINBERG
IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE
OF
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APPROVED:

/ / Jay C. Thomas, Ph.D. ABPP

David Foster, Ph.D.
Abstract

Though groups are regularly utilized to solve complicated problems facing organizations and society today, little research has addressed group creativity to date. The purpose of the present study was to both develop a model of the group creative process and to assess the psychometric properties of a methodology for measuring the group creative process derived from this model. The proposed model defines group creativity in terms of divergent thinking, composed of fluency and flexibility, and convergent thinking, composed of integration and evaluation. Nine graduate students (4 male, 4 female) viewed two videos of groups performing problem solving tasks and provided scores on the dimensions of group creativity for each group. The findings indicate that participants' scores were reliable. Implications and limitations of the measure are discussed.
Generating a Judging Protocol for Measuring Group Creativity

Introduction and Statement of the Problem

The history of human beings has been characterized by technological and social progress. From the use of primitive hieroglyphics, to the launch of the first satellite, humans have used knowledge provided by predecessors to solve increasingly complicated problems. Paradoxically, the creative achievements of the past have played a large role in the instigation of a number of difficult and complicated dilemmas that we face today. For example, the medical, civil engineering, and agricultural advances to date have led to a longer average lifespan and subsequent overpopulation (Buxton, 1957; Horvath, 2004; Dawes, 1980). In order to support this growth in population, depletion of our natural resources has become an immediate concern (Dawes, 1980). Furthermore, with the explosion of commercial and corporate products, a hyper-competitive global market has developed in which the survival of organizations depends on the construction of intricate, cutting-edge products (Hage, 1999). In the face of such pressing challenges, creativity has become a vital element in today’s society. As Csikszentmihalyi suggests, “There is no question that the human species could not survive, either now or in the years to come, if creativity were to run dry” (1996, p.317).

The increasing complexity of the challenges facing humans today has also created the need to use groups of people to solve these issues. The use of groups is necessary because the information contained within the many domains of human knowledge, such
as math, world relations, and chemistry, has increased exponentially over the last century. Consequently, it is virtually impossible for one single person to have all of the necessary expertise to understand and solve these issues alone. Given these reasons, most organizations and scientific disciplines now rely on the work of teams (Paulus & Nijstad, 2003). The use of groups for making such difficult decisions are predicated on the assumptions that groups can produce higher quality decisions than individuals working alone (Brodbeck, Kerschreiter, Mojzisch, Frey, & Schulz-Hardt, 2002) and that groups can derive more creative solutions to problems than individuals (Paulus & Dzindolet, 1993). It is suggested that groups enhance creative performance because many perspectives and skills can be shared in the process of group brainstorming (Taggar, 2001). Furthermore, group processes may defer the process of selecting of a single solution, thereby increasing the number of ideas considered (Osborn, 1963). Research shows that groups are more likely than individuals to identify and correct mistakes, resulting in higher quality, creative decisions (Orlitzky & Hirokawa, 2001). Consequently, understanding and nurturing creativity, especially in groups, is more important now than ever before (Runco, 2004).

The concept of creativity has been examined and discussed in a massive volume of psychological literature. Such research has approached creativity from the varying perspectives of many subfields and interests, including cognition, motivation, personality, and organizational psychology. Dozens of definitions and models of creativity have been offered, including Guilford’s theory of divergent and convergent thinking (Guilford, 1950, 1957, 1967), Baer and Kaufman’s (2005) Amusement Park theoretical model of creativity, and Kirton’s (1976) Adaptation-Innovation theory. Furthermore, many
programs intended to enhance creativity have proliferated. For instance, Nunamaker, Dennis, Valacich, Vogel, & George (1991) developed GroupSystems, the first commercial system designed to improve creativity of groups through electronic brainstorming (EBS), and a wide variety of more recent EBS tools are currently available.

There are two major gaps, however, in creativity research that make it difficult to apply to the understanding of creative group functioning. The first gap is the lack of universal consensus regarding the construct of creativity. Despite the impressive scope of literature and intervention application, creativity continues to be regarded as one of the most enigmatic subjects in psychology (Kim, Cramond, & Bandalos, 2006). A major source of the perplexity surrounding the construct of creativity has been the inability of scientists and philosophers to agree upon an objective definition of creativity (Rookey, 1973; Feldhusen & Goh, 1995). For example, Guilford (1950) defines creativity as a set of traits that are characteristic of creative persons, Vernon (1989) defines creativity as the ability to produce ideas, inventions, artistic objects, insights, restructurings, and products that are viewed as highly creative by experts, and Torrance (1979) defines creativity as the capacity to deal with problems by using a set of abilities, skills, motivations and emotional states. The lack of a universally agreed upon definition of creativity makes it difficult to understand and apply the results of creativity research to the group level.

Secondly, research on creativity has focused almost exclusively on creativity of the individual. Little research has addressed the role of creativity in group problem solving and decision making. Consequently, most measures of creativity are catered to the assessment of individuals alone. In fact, Sternberg’s Handbook on Creativity (1999),
a comprehensive review of the creativity findings until the 21st century, did not include group creativity in the subject index. It has been argued that only within the last 10 years has interest on group creativity begun to develop (Paulus & Nijstad, 2003). This increase in interest has resulted in a few theories and models of group creativity, as well as organizational programs claimed to enhance employee creativity. However, the research that has addressed group creativity has relied almost entirely on the assessment of a creative product or solution. Though this method has demonstrated moderate to high reliability (Hennessey & Amabile, 1988), it may not be relevant for many “real-world” applications and research protocols. Furthermore, measuring creativity via products may lack construct validity (Runco, 2004), suggesting that it may not capture the entire construct. For example, consider that one group creates a very creative product due to the dominance of an extremely creative person dominates, while a second group of moderately creative people, working together effectively, generate a number of ideas and come up with an equally creative solution. Which group is more creative? More importantly, what can we understand about the creative process by watching these two very differently functioning groups?

Consequently, the purpose of this paper is twofold. First, I will develop and specify a model for understanding creative group processes. Second, based on this model, I will develop and assess the psychometric properties of a methodology for measuring the creativity in groups’ problem solving processes.
Literature Review

Creativity as an Individual-level phenomenon

The preponderance of research on creativity to date has been at the level of the individual. One focus of this work has been to understand the personality correlates associated with creativity. Over the past several decades, a plethora of fascinating associations between creativity and personality traits have been empirically supported. For example, numerous researchers have reported significant relationships between creativity and schizotypal traits (Schuldberg, 1988; Prentky, 1980; Richards, 1981; Burch, 2006). Burch, Pavelis, Hemsley, and Corr (2006) found that visual artists scored significantly higher than non-artists on measures of positive-schizotypy, disorganized-schizotypy, and asocial-schizotypy, and Schuldberg, French, Stone, and Heberle (1988) found that participants high on schizotypal traits of perceptual aberration and magical ideation scored significantly higher on measures of creativity than controls. Correlations have also been reported between creativity and extroversion (Schuldberg, 2005), creativity and sexuality (Csikzentmihalyi, 1996) and creativity and alcoholism (Noble, Runco, & Ozkaragoz, 1993). The research on creativity and individual characteristics has informed researchers in the development of numerous assessment tools. For example, the Torrance Tests of Creative Thinking (Torrance, 1966), the Guilford Battery (Guilford, 1962), and the Hobby-Accomplishment Information Questionnaire (Stafford & Browne, 1972), have been designed to measure an individual's level of creativity, and the
Kirton Adaptation Inventory (Kirton, 1976) has been designed to categorize an individual's style of creativity.

Other lines of research on creativity have explored the cognitive processes involved in creative thinking and problem solving. From this work, numerous theoretical models of the creative process have been proposed. For example, Csikszentmihalyi (1996) theorizes that the creative process is often activated by a problem that has been posed to the creator by another person, and is characterized by "flow", an enjoyable state of such deep involvement in the activity of creating that awareness of the self and time become suspended. Furthermore, Amabile (1990) suggests that the creative process includes external input, preparation, memory and environment search, response generation, and response evaluation.

The methodology utilized to study individual-level creativity has typically involved studying individuals identified by society as creative. For example, Csikszentmihalyi (1996) interviewed 100 individuals who had been publicly recognized as creative in order to explore personality and contextual factors associated with creativity. Likewise, Gardner (1982) studied the lives of both famous individuals, such as Mozart, and children for over 15 years in his research on the creative process. This qualitative method of measuring creativity has helped to illuminate many aspects of the creative personality and process. However, this approach is not as appropriate for research on group creativity for a number of reasons. One primary limitation to using this method of studying group creativity is that there are few groups deemed creative by society that are readily available to study. Furthermore, inherent in this method is the assumption that creativity is a stable personality characteristic. Contrary to individuals,
group creativity is likely to be even more sensitive to contextual and group interaction factors, which may make creativity of groups less consistent. For example, Milliken, Bartel, & Kurtzberg, (2003) suggest that differences among group members’ perspectives on a task should enhance a group’s creative process, as the differences in perspective are likely to increase the number of alternatives considered and the quantity of unique information that is shared. Therefore, the creative performance of a single group may differ depending on the task and the group members’ corresponding perspectives regarding that task.

A second method of studying individual creativity has been through the use of creativity measures. Many creativity measures exist today. For example, the Torrance Test (1984) assesses an individual’s fluency, flexibility, originality, and elaboration. However, adding together the creativity scores of individuals in a group may not provide an accurate representation of group creativity, as the whole may be greater than the sum of the its parts. Many aspects of the group interaction and composition appear to affect overall group creativity (Kasof, 1995). For example, Dunbar (1995) found that diversity in intellectual background affected rates of group innovative ideas among molecular biologists. Furthermore, Mumford, Feldman, Hein, & Nagao, (2001) found that sharing mental models of how to solve a problem enhanced a group’s ability to produce new creative ideas. Therefore, a group’s creative performance may depend on the group members’ intellectual backgrounds regarding the specific task and the number of mental models shared. Consequently, this method of assessing group creativity based on the creativity of individuals also offers little utility in assessing group creativity.

Creativity as a group-level phenomenon
Relative to the research on the individual-level creativity, very little literature has investigated creativity using a system-level perspective. Recently, however, a number of researchers have suggested that environmental and situational factors play integral roles in creativity (Schuldberg, 1999; Kasof, 1995). For example, Treffinger, Feldhusen, and Isaksen (1990) incorporate the role of contextual and social influences in their interactionist model of creative behavior. According to this model, milieu, context, press, and environment mediate creativity by affecting an individual's motivation to be creative. Csikszentmihalyi (1996) illustrates the social environment's vital role in creativity by highlighting the fact that creative renaissances, such as the Renaissance in Florence between 1400 and 1421, have been stimulated by increased interest and demand for the arts, rather than sudden rises in the population of creative individuals. Furthermore, it is suggested that creativity may actually emerge through the interaction of individuals in a group setting (Paulus & Nijstad, 2003). However, the concept of group creativity is only now beginning to receive attention in the psychological literature.

Methods of Measuring Group Creativity

In the studies that have explored group creativity, there has been a marked tendency to measure group creativity on the basis of the creativity of a product. In such research, groups of individuals are typically assigned to create a particular type of product, such as a collage or slogan (Corko & Vranic, 2004; Chirumbolob, Mannetti, Pierro, Areni, & Kruglanski, 2005; Grawitch et al, 2003). The creativity of groups' products is subsequently assessed by expert judges. For example, Corko and Vranic (2004) studied how different levels of specificity regarding the creative goal effect group creativity using judges to rate the creativity of the group-produced collage. This method
of assessment, termed "consensual agreement", has proven to be very reliable (Amabile, 1987).

Group creativity is also often assessed by brainstorming tasks, which require groups to list as many possible answers to a given problem as possible. Creativity on such measures is typically determined by fluency, or the ability to produce many ideas in succession, originality, and appropriateness of ideas. For example, in Taggar’s (2001) study of work groups, external judges rated group creativity on fluency, originality, elaboration, and appropriateness of ideas. Results of this study indicated that team creativity-relevant processes, such as team citizenship, effective communication, involving others, providing feedback, and conflict management, and the creativity of individual group members, as judged by their peers, positively affected group creativity.

Though evaluation of group creativity is often based either on a product or the number of ideas, originality, and appropriateness of ideas generated during brainstorming tasks, these approaches are limited by the lack of agreement on the role of productivity in creativity. As Runco (2004) wrote:

"The problem with this method is that it often informs us only about productivity and not about creativity. Also, it can be quite misleading because what it takes to be productive may differ from what it takes to be creative."

(p.663).

Many authors have suggested that creativity does not necessitate the production of a socially valued product (Baron & Harrington, 1981). Furthermore, assessing creativity based on productivity does not shed light on the processes involved in group creativity. For example, Baron and Harrington highlight the problems
inherent of assessing creativity through products in their statement “what happens between [problem assignment and solution] is anybody’s guess” (p. 443). It is questionable, therefore, if the creativity of a product is an accurate indicator of group creativity. For example, is a group that explores many highly original ideas but ultimately establishes a product that is not original less creative than another group that immediately agrees upon an unusual solution but does not entertain any other ideas? Furthermore, it can be argued that evaluating creativity based on brainstorming and problem solving tasks that ask groups to generate lists of many potential answers ignore other conceptually relevant dimensions of creativity, such as convergent thinking, or the ability to make agree upon one idea (Guilford, 1957).

There are a number of reasons why assessment of a product and brainstorming may remain the most common assessment methods of group creativity. In his presidential address, Guilford (1950) suggests that, like intelligence tests, creativity assessment may fall into certain stereotyped patterns due to the demands for objectivity and scoring convenience. Because consensual agreement has been demonstrated to achieve strong reliability, many researchers feel confident in this approach. Furthermore, counting the number of generated ideas offers a quick and practical method of assessment. However, Guilford postulates that such methodological inflexibility may lead to oversight of many aspects of creativity. A second deterrent to developing alternative measures of creativity of groups is the lack of consensus regarding the objective definition of creativity. This lack of agreement has made the development of a model of group creativity a daunting task for researchers.
The current lack of agreement on what constitutes creativity and the lack of information that the two most common approaches to measuring group creativity provide in terms of understanding the process of creativity in groups suggests that alternative approaches to measuring creativity is required. Consequently, we need a way to assess the creative process in groups in order to understand it better. The purpose of this study is to specify a model of creative group processes and determine if group creativity can be assessed reliably.

_A Proposed Two-Factor Model of Group Creativity_

Despite the recent emergence of research on group creativity and programs intended to enhance group creativity, there are no existing models for the creative group process. The model of group creativity proposed in the current study (see Figure A1) is informed largely from research on the creative process of individuals and theories about specific aspects of group creativity. According to this model, group creativity is defined as the extent to which groups engage in divergent and convergent thinking. Though this closely resembles the model of individual creativity originally proposed by Guilford (1957), the components of divergent and convergent thinking included in the current model of group creativity differ from Guilford’s conceptualization.
Traditionally, most theories of creativity have assumed that divergent thinking is the primary mechanism involved in the creative process. The author most strongly associated with divergent thinking is Guilford. Guilford’s theory of creative thinking proposes that the creative process is influenced primarily, though not entirely, by divergent thinking, or generation of varying ideas. Included in his conceptualization of divergent thinking, Guilford hypothesizes that the three factors, which include fluency (word, associational, ideational, expressive), flexibility (spontaneous and adaptive), and originality (Guilford, 1957; Guilford, 1967). Though numerous theories on the creative process have been proposed throughout the years, Guilford’s concept of divergent thinking has demonstrated resiliency in creativity literature (Runco, 1991). These three factors, fluency, flexibility, and originality of responses to a given problem situation, continue to appear in nearly every article addressing the concept of creativity, as well as virtually every measure of creativity. However, while fluency and flexibility refer to
mental processes involved in the creation of creative ideas, originality instead appears to reflect the outcome of the creative process. In other words, it can be argued that production of many ideas in succession and flexible thinking and underlie the creation of original ideas. Consequently, the current model views divergent thinking as composed of fluency and flexibility.

Fluency. Guilford defines fluency as the ability to generate a succession of ideas, words, or associations meeting certain meaningful requirements (Guilford, 1957). Underlying the importance of fluency is the argument that the production of many ideas makes it more likely that the best idea will be unveiled. Therefore, fluency is characterized by quantity rather than quality.

Fluency has been a factor in most measures of individual creativity. For example, Guilford's tests include a measure of fluency, and most tests of individual creativity developed since have followed suite. Furthermore, most group brainstorming tasks include a fluency factor in their scoring procedure. For example, Grawitch, Munz, Elliot & Mathis (2003) evaluated the creativity of groups' responses to how the quality of life at their university might be improved based on fluency, peer ratings of originality, and peer ratings of importance. Mumford and colleagues (2001) based their assessment of group creativity on the fluency, originality, and quality of group responses to social and cognitive problem-solving tasks. Finally, Brophy (2006) measured the creativity of group-generated solutions based on fluency, utility of responses, and originality.

Fluency is important in the process of group creativity both because it ensures that multiple solutions to a problem will be evaluated and enhances the potential that an
effective solution will emerge. The underlying assumption in the use of groups is that the combined ideas of a group of individuals will enhance innovative idea production.

**Flexibility.** According to Guilford's original theory of creativity, flexibility refers to the ability to transform ideas (Guilford, 1967). Flexibility is the capacity to replace one interpretation or conception of an object with a new function or use. For example, Guilford suggests that using the cover glass of a watch as a condensing lens to start a fire is an example of flexibility (Guilford, 1957). Since Guilford's theory of divergent thinking, the term flexibility has been included in virtually every description of creativity. Though often defined somewhat differently, most researchers would agree that flexibility refers to the ability to take different perspectives on a particular problem, concept, or object. For example, Grawitch and colleagues (2003) define flexibility as the variety of ideas produced in response to a particular scenario, and Runco (2004) defines flexibility as the antidote to "fixidity", or the inability to perceive ideas different than the idea of focus.

Being a primary component of most creativity conceptualizations, flexibility has been included as a factor in most measures of individual creativity. Not surprisingly, Guilford's creativity tests include a flexibility score. Informed by Guilford's research, Torrance's Test of Creative Thinking, currently the most widely used test for individual-level creativity (Colangelo & Davis, 1997), also includes a subscore of flexibility. The Alternative Uses Test by Wallach and Kogan (1965) also measures flexibility as the number of different categories a respondent's answers fall into.

However, most measures of group creativity do not include flexibility in their assessment of a creative product or creative solution. Paulus and Nijstad (2003) suggest
that creativity of groups is enhanced when several members take different angles or backgrounds to a problem or task. A number of researchers have demonstrated that group-generated products are more creative when at least two perspectives to approaching a problem or task are considered (De Dreu & West, 2001; Nemeth, 1986). Furthermore, divergent thinking in groups may be promoted by the degree to multiple alternatives are considered before the group commits to any one decision (Paulus & Nijstad, 2003). Both of these processes, utilizing multiple perspectives to approaching a problem and considering multiple solutions before agreeing on an action, can be considered elements of flexibility. Though different from the way that flexibility appears is manifested in individuals, these processes suggest the ability to produce a variety of ideas and take multiple perspectives to a problem. Furthermore, the process of considering a number of ideas before agreeing on one suggests the ability to abandon or alter ideas, a process linked with flexibility of individuals.

Convergent Thinking

While most measures of individual creativity have based their assessment of the creativity of products or ideas on divergent thinking, convergent thought may also be an important aspect of group creativity (Brophy, 1998). Convergent thinking refers to the process of evaluating alternatives and deciding on one to use (Paulus & Nijstad, 2003). Guilford (1957) proposes that though divergent thinking may be the most obvious feature of creativity, other abilities, such as the ability to synthesize, analyze, reorganize, redefine, and evaluate also play central roles in creativity. This theory of the role of convergent creative thinking has been echoed by a number of writers (Paulus & Nijstad,

Convergent thinking may play an even more significant role in group creativity than individual creativity, as the sharing and synthesis of information, as well as group evaluation of ideas, is the conceptual basis for utilizing problem solving and decision making groups. Groups may be in a stronger position to engage in convergent thinking, as the work of varied persons can be combined (Brophy, 1998). Convergent thinking allows groups to aggregate ideas, evaluate ideas, integrate ideas, and make decisions about which idea to implement. As Milliken and colleagues suggest, through convergent thinking, “work groups funnel down a set of ideas or opportunities into manageable decisions from which to proceed to implementation (2003, p.35). The current model hypothesizes that convergent thinking in groups is composed of both the integration and evaluation of ideas.

Integration. Research suggests that for creative individuals, synthesizing ideas to produce novel concepts is more accessible (Schaefer, 1971). The Cognitive Network Model of Creativity posits that creative solutions are the product of new associations formed between disparate elements from memory (Santanen, 2002). The advantage of teamwork in creativity tasks rests on the assumption that the sharing of ideas can foster even more dynamic creativity, as the ideas of different individuals are likely to be more diverse. The process by which different group members' ideas converge into new ideas can be considered a process of integration. Integration has not been included in the empirical research on group creativity to date.
Evaluation. Evaluation of ideas appears to play a critical role in the process of defining workable solutions on complex creative problem solving tasks (Brophy, 1998). In order to creatively solve a problem, evaluation of the problem and potential solutions must occur. Guilford (1950) hypothesizes that evaluation is required for the selection of surviving ideas. Problem solving and decision making groups are unique from individual tasks in that every idea proposed must either be accepted or rejected by the group, as mediated through evaluation of the idea. Research suggests that evaluation of the negative consequences of solutions is a strong predictor of group decision making quality (Orlitzky & Hirokawa, 2001). However, evaluation has not been included in the empirical research on group creativity to date.

To summarize, it is conceptualized that group creativity is composed of divergent thinking, including fluency and flexibility, and convergent thinking, including evaluation and integration. Furthermore, it can be conceptualized that the processes of flexibility, fluency, integration, and evaluation interact with and enhance one another. Consequently, this two factor model of group creativity will be used to determine if observers can reliably assess creative group processes.

Method

Participants

The participants were 9 graduate students in the Psychology doctorate program at a small university Pacific Northwest. Of this sample, 5 participants were males and 4
18 participants were females. The mean age was 27 (SD=2.81). Participation was voluntary. However, data from one participant were excluded from analyses, as the participant clearly did not understand the directions of the task. The final composition of participants included 4 males and 4 females, with a mean age of 27 (SD=2.72).

**Measures**

*Introduction to the study.*

Each participant was provided with a brief, one-page introduction to the task (see appendix A). This sheet described the procedure of the study and the materials that participants would receive. Additionally, the sheet included a list of the dimensions of group creativity that participants would be assessing and a summary of the scoring procedure.

*Dimensions of group creativity tutorial*

Each participant was provided with a three-page tutorial on the dimensions of group creativity (see appendix B). This tutorial included definitions each of the dimensions of group creativity, an explanation of the relationship between the dimensions, and examples both of the dimensions alone and combinations of the dimensions as follows:

**Fluency:** Fluency refers to the number of ideas generated about how to solve a problem. In this study, the group members must decide on which items are most important to their survival. In other words, they must determine how to be as resourceful as possible given the available items. Fluency reflects the number of ideas offered about how to use a particular item in order to meet the presented challenge. In order to be counted as fluency, the group member must specify how the item should be used. When
it is suggested that the object be used for its typical purpose, the group receives one point for fluency (e.g., “Let’s use the wood to make a fire”).

*Flexibility:* Flexibility refers to the ability to adapt. Flexibility of ideas is refers to the ability to change or adjust ideas in order to meet the needs of a given situation. In this study, the group receives one point for Flexibility of ideas in addition to fluency whenever a group member either proposes a new way of utilizing a particular item, or proposes an alternative method of tackling a problem. Flexibility cannot occur without fluency (e.g., “Let’s use the food as bait to hunt animals”). When the idea reflects a novel use of the object, or an atypical use of that object, the group receives one point for fluency and one point for flexibility (e.g., “Let’s make shelter using the jackets”).

*Integration:* Integration of ideas refers to the ability to join together multiple pieces of information in order to achieve a certain goal. In this study, Integration of ideas occurs whenever the uses of two items are combined together. Integration can occur when a single group member combines two ideas or concepts together (e.g., “We could use the wood and canvas to create a shelter”). Integration can also occur whenever two group members’ ideas about how to use an item are combined (e.g., “We could use the rope to haul things.” B- “Yeah, we could use the rope to pull the oxygen tank”). Each subsequent idea that is added to an already integrated idea also receives another point for integration (e.g., “Then we could put the oxygen tank in a bag and pull that with the rope”). Flexibility/Fluency can also overlap with Integration. Ideas about how to use two items together in a novel way demonstrate flexibility, fluency, and integration (e.g., “We could use the gun to create a spark for a fire. And because alcohol is combustible, we could use the vodka and gun to make a flare”).
**Evaluation:** Evaluation refers to the ability to analyze the effectiveness of a proposed use of an item. In this study, evaluation of ideas occurs in a group whenever a group member evaluates the consequences of a proposed idea about the utility of an item. In order for the group to receive one point for evaluation, the evaluation must occur after the group demonstrated fluency and must specify why the group member thinks that the idea would work or would not work (e.g., "We couldn't use the gun to hunt on the moon because there are no animals on the moon").

**Task and Procedures**

The study was conducted during three, half-hour session, with three participants at each session. Participants were informed that they were participating in a study on group creativity. Participants completed an informed consent and short demographics questionnaire, and were then provided with the introduction to the task form, the dimensions of group creativity tutorial, and the group creativity score sheet. These forms were read aloud by the primary researcher. In order to familiarize participants with the task, the participants were shown a two-minute clip of a group decision making task as the primary researcher pointed out examples of the group creativity dimensions.

Participants then observed two videos, each approximately 5 minutes in length, portraying groups in a decision making tasks. Each video was presented twice in order to give participants an opportunity to provide final counts. The videos and transcripts were obtained from a study on group interactions conducted at Western Oregon University (The effects of personalities and group development on group process and outcomes, Foster et al., 2006). In this study, groups of three individuals were assigned to complete two problem solving and decision making tasks. For these tasks, group members were
presented with a scenario in which they were stranded in a particular location with a number of items that may aid in their survival. Group members were then asked to rank order these items in terms of their importance to the groups' survival first individually and then as a group. The videotape segments and transcripts utilized in the current study portrayed the group decision making processes of two different groups from the study. The order of the videos alternated between the three sessions, such that six participants viewed video A first while three participants viewed video B first.

Transcripts of the group problem-solving videos were also provided, which participants could read as they watched the videos if they found this helped them to follow the dialogue. While watching the videos and reading the transcripts participants provided counts for each dimension of creativity (e.g., fluency, flexibility, integration, and evaluation) on score sheets (see appendix C). Participants recorded initial counts and final counts, corresponding to the first and second observation of each group interaction.

Results

Means and standard deviations of participants' final scores for each video are shown in Table A1. These findings indicate that for both video A and B, fluency was the most frequently occurring dimension of group creativity (M=7.00, SD=2.00; M=8.63, SD=1.77, respectively), suggesting that groups in both videos spent the most time proposing ideas. This finding is consistent with the model, which defines fluency as the total number of ideas generated, and flexibility and integration as processes that enhance the novelty of an idea or integrate ideas to the form new ideas. This finding is also consistent with the task instructions, which explicitly stated that flexibility and integration could not occur without fluency.
Flexibility accounted for 66% of fluency for both videos, while integration accounted for only 29% of fluency in video A and 13% of fluency in video B. This finding suggests that a large proportion of ideas were characterized by flexibility while only a small proportion of ideas were characterized by integration. For both groups, the two dimensions of divergent thinking occurred more frequently than the dimensions of convergent thinking.

Table A1. Means and Standard Deviations of Final Counts on Video A and Video B

<table>
<thead>
<tr>
<th></th>
<th>Video A</th>
<th>Video B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Fluency</td>
<td>7.00</td>
<td>2.00</td>
</tr>
<tr>
<td>Flexibility</td>
<td>4.63</td>
<td>1.06</td>
</tr>
<tr>
<td>Integration</td>
<td>2.00</td>
<td>0.92</td>
</tr>
<tr>
<td>Evaluation</td>
<td>2.00</td>
<td>1.07</td>
</tr>
</tbody>
</table>

The main goal of the current study was to assess the interrater reliability of a measure of group creativity as derived from the two-factor model. A separate intraclass correlation (ICC) was computed for judges’ ratings of each video. Intraclass correlation is defined as the correlation between one measurement (either a single rating or the mean of several ratings) on a target and another measurement obtained on that target (Shrout & Fleiss, 1979, p. 422). Shrout and Fleiss propose that there are six specific forms of ICC. Each of these forms reflects a combination of a particular model and a particular type. The model of ICC utilized in the present study was the two-way mixed effects model, as
the raters were considered random and the creativity dimensions were considered fixed. Furthermore, the specific type of two-way mixed effects model utilized was single measure reliability, as individual ratings constituted the unit of analysis. The results indicated that judges' scores of group creativity for each video met the minimum standards for acceptable reliability (ICC = .76, p < .05; ICC = .77, p < .05, respectively). However, standard deviations on scores of the individual dimensions ranged from .92 to 2.0, indicating a substantial variance existed in judges' scores.

Discussion

The purpose of the current study was to develop a model of the group creative process and subsequently assess the interrater reliability of a new measure of group creativity derived from this model. The proposed two-factor model of group creativity describes the process of group creativity as composed of the factors divergent thinking, which includes fluency and flexibility, and convergent thinking, which includes integration and evaluation. Using this model, a measure of the group creative process was developed in order to assess these four dimensions of group creativity.

Results of the empirical portion of this study suggest that judges can reliably rate underlying dimensions of group creativity delineated in this model given explicit instructions. The availability of this measure has a number of important implications for researchers. Prior research on the creativity of groups has relied exclusively on evaluation of creativity through measures of divergent thinking (Corko & Vranic, 2004; Chirumbolob et al., 2005; Grawitch et al., 2003). Though research suggests that divergent thinking is an integral factor of group creativity, there may be other conceptually relevant
factors that also play a role in determining the most workable and effective creative solution. A number of authors suggest that the use of tests of divergent thinking are limited by the lack of agreement on the role of productivity in creativity (Runco, 2004) and the exclusion of convergent thinking (Guilford, 1957; Paulus & Nijstad, 2003; Brophy, 1989). Therefore, the proposed measure, which includes dimensions of both divergent and convergent thinking and focuses on the actual process of creativity, may offer a more thorough and comprehensive assessment of group creativity.

Additionally, the proposed measure of group creativity offers a number of practical benefits to researchers. For example, because the measure focuses on the process of group creativity, it can be utilized in a number of diverse research protocols. This measure is much simpler to utilize in research than product-based judgments of creativity. In contrast to product-based measures, which require the use of experts, people without expertise in the subject of creativity can be trained to score creativity reliably using the present protocol. Finally, because this measure focuses on creative processes themselves as opposed to the outcomes of those processes, this method of assessment offers more insight into the ongoing processes involved in group creativity.

The availability of a reliable, comprehensive measure may allow researchers to further explore factors related to group creativity that are not accessible through brainstorming and product-based measures. This information has important applications, as it can be utilized to help groups function more creatively. For example, future research using this measure to assess groups may identify critical levels of each dimension necessary for creative performance. Furthermore, future research may elucidate the optimal order in which these dimensions occur. For example, creativity may be enhanced
through evaluation in the later stages of the group interaction, yet reduced through evaluation in the earlier stages of the group interaction.

Though the current analysis indicates that the presented model provides a reliable measure of the creative process of groups using the four dimensions together, it should be noted that there was still considerable variability between participants’ scores on individual dimensions. This variability is likely to be due to a number of factors. For example, during the tutorial on group creativity, participants were provided with a substantial amount of information regarding concepts and rules that they had not been previously exposed. Because a clear understanding of these concepts and rules was imperative to appropriate scoring among the different dimensions, misunderstandings of a particular rule might create significant variability among scores. Providing training to participants on the dimensions of group creativity over at least 2 days may allow participants ample time to become familiar with the information and, therefore, reduce variability among scores.

Variability among scores on the individual dimensions was also likely due to the rapid pace of the videos. It can be conceptualized that because the content of the videos moved very quickly, participants became confused regarding the appropriate dimension in which to classify a particular dimension and ultimately placed their marks in the wrong box. Additionally, confusion and deliberation about rules may have caused participants to miss aspects of group creativity as they occurred. Allowing participants to pause and rewind the videos as necessary may reduce confusion caused by the pace of the videos. This may require judges to rate group interactions independently. Furthermore, including
bulleted definitions under each of the dimensions on the score sheet itself may give participants a convenient reference of important concepts and rules.

Finally, because no incentive was offered for participants’ accuracy, participant’s attention to the task may have not have been optimal. The resulting variability in scores may be attenuated in future research by providing participants with incentive to perform as accurately as possible. For example, offering a prize for the participant who records a final score closest to that of the researcher might enhance motivation to score accurately.

Though the present measure demonstrated acceptable interrater reliability, reliability does not denote validity. Therefore, further research is necessary regarding the validity of the proposed model and measure. Due to the lack of other research on group creativity, determining validity will require various tests of convergent, divergent, and predictive validity. Finally, it has not been determined how scores on individual dimensions should be combined into an index of group creativity. For example, it is unclear if fluency, flexibility, evaluation, and integration should contribute equal weights to the overall score. In the present study, groups demonstrated less integration and evaluation than fluency and flexibility. However, only a few of these convergent thinking dimensions may correlate to significant advancements in group creativity. Furthermore, fluency may be less important to the ability of a group to perform creatively than flexibility. Therefore, further research is required to determine how to weight each of the proposed dimensions in the calculation of overall group creativity.

In conclusion, the model proposed in the current study provides an explanation of a very important construct that has been little explored to date. In addition, a reliable
measure of the creative process of groups is identified, which has important implications for future research on group creativity. Perhaps most importantly, the present study identifies a number of future directions from which to proceed with further investigation. In this respect, the present study can be considered a first step in the process of filling a large gap in the psychological literature.
References


Appendix A
Introduction to the Study

Thank you for participating in this study! During the following 20 to 30 minutes you are going to be asked to view two short videos. Each video demonstrates a group of individuals engaging in a problem-solving task. The groups portrayed in the videos have been presented with a scenario in which to imagine themselves. According to this scenario, the groups have been stranded with only a number of items that may aid their survival. The groups have been assigned to rank these items in order of 'most important for survival' to 'least important for survival', first individually and then as a group. The videos that you will be viewing portray only the group solving the problem together.

You will be provided with:

- A transcript of each group's interaction.
- Two rating sheets (one for each group).

Your objective is to count the number of times that each group demonstrates the following dimensions of group creativity:

1. Fluency
2. Flexibility
3. Integration
4. Evaluation

A more detailed explanation of each of these dimensions is provided on Form B. When each group demonstrates a behavior that fits any of these dimensions, place a mark beside the appropriate dimension. A single behavior can count as one dimension or as multiple dimensions. Behaviors that are repeated without any changes should not be counted twice. For example, if a person repeats the same idea without changing it, only count this behavior once.

As you view the groups, please read along in the transcript if you find that helps you to follow the dialogue. The video of each group will be shown twice. Please record your marks in the “initial counts” column during the first presentation of each group, and in the “final counts” column during the second presentation.
Appendix B

Dimensions of Group Creativity

Groups are often employed by organizations to solve complicated problems. Creativity is what allows groups to find the most innovative solutions to these problems. Some of the processes that foster higher levels of creativity in groups are: Fluency, Flexibility of Ideas, Integration of Ideas, and Evaluation of Ideas.

These dimensions are not exclusive. In fact, they overlap frequently. Therefore, when a group demonstrates one dimension, they also often demonstrate other dimensions as well.

Fluency

Fluency refers to the number of ideas generated about how to solve a problem. In this study, the group members must decide on which items are most important to their survival. In other words, they must determine how to be as resourceful as possible given the available items. Fluency reflects the number of ideas offered about how to use a particular item in order to meet the presented challenge. In order to be counted as fluency, the group member must specify how the item should be used.

When it is suggested that the object be used for its typical purpose, the group receives one point for fluency.
- Example: "Let's use the wood to make a fire." (Fluency)

- Example of non-fluency: "Let's rank the wood as most important." (Not Fluency-no specific explanation about how to use the item)

When the idea reflects a novel use of the object (i.e. what the object is not typically used for) the group receives one point for fluency and one point for flexibility.

- Example: "Let's make shelter using the jackets" (Fluency + Flexibility)

**Flexibility**

Flexibility refers to the ability to adapt. Flexibility of ideas is refers to the ability to change or adjust ideas in order to meet the needs of a given situation. In this study, the group receives one point for Flexibility of ideas in addition to fluency whenever a group member 1.) proposes a new way of utilizing a particular item, or 2.) an alternative method of tackling a problem.

Flexibility cannot occur without fluency.

- Example: "Let's use the food as bait to hunt animals." (Flexibility + Fluency)

Flexibility/Fluency can also overlap with Integration. Ideas about how to use two items together in a novel way demonstrate flexibility, fluency, and integration.
• Example: "We could use the gun to create a spark for a fire. And because alcohol is combustible, we could use the vodka and gun to make a flare."

(Flexibility + Fluency + Integration)

Integration

Integration of ideas refers to the ability to join together multiple pieces of information in order to achieve a certain goal. In this study, Integration of ideas occurs whenever the uses of two items are combined together.

Integration can occur when a single group member combines two ideas or concepts together.

• Example: "We could use the wood and canvas to create a shelter." (Integration + fluency)

Integration can also occur whenever two group members' ideas about how to use an item are combined.

• Example: A- "We could use the rope to haul things." B- "Yeah, we could use the rope to pull the oxygen tank." (Integration + Fluency)
Each subsequent idea that is added to an already integrated idea receives another point for integration.

- Example: “Then we could put the oxygen tank in a bag and pull that with the rope.” (Integration + Fluency)

**Evaluation**

Evaluation of Ideas refers to the ability to analyze the effectives of a proposed use of an item. In this study, evaluation of ideas occurs in a group whenever a group member evaluates the consequences of a proposed idea about the utility of an item. In order for the group to receive one point for evaluation, the evaluation must occur after the group demonstrated fluency and must specify why the group member thinks that the idea would work or would not work.

- Example: “We couldn’t use the gun to hunt on the moon because there are no animals on the moon.” (Evaluation)

- Example: “We couldn’t use the needle on the moon because it would deflate our spacesuits” (Evaluation)

- Example of non-evaluation: “I don’t think that we should rank the water as most important.”
Appendix C

SCORE SHEET

- When any group member demonstrates a behavior that fits any of these dimensions, place a mark beside the appropriate dimension.
- A single behavior can count as one dimension or as multiple dimensions.
- Behaviors that are repeated without any changes should not be counted twice. For example, if a person repeats the same idea without changing it, only count this behavior once.

<table>
<thead>
<tr>
<th>Initial Counts</th>
<th>Final Counts</th>
</tr>
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<tbody>
<tr>
<td>Fluency:</td>
<td>Fluency:</td>
</tr>
<tr>
<td>Flexibility:</td>
<td>Flexibility:</td>
</tr>
<tr>
<td>Integration:</td>
<td>Integration:</td>
</tr>
<tr>
<td>Evaluation:</td>
<td>Evaluation:</td>
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