Linking intrinsic motivation, risk taking, and employee creativity in an R&D environment

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Intrinsic motivation is thought to spur risk taking and creativity. Nonetheless, the relationship between common creativity antecedents and intrinsic motivation is seldom clarified and the assertion that intrinsic motivation spurs risk taking and creativity has rarely been addressed. The current study adopts an individual level of analysis and attempts to link several common creativity antecedents, intrinsic motivation, and one’s willingness to take risks to employee creativity. Using survey data collected from 165 research and development personnel and their supervisors, evidence is provided showing that intrinsic motivation mediates the relationship between certain antecedents and one’s willingness to take risks and that this willingness mediates the effect of intrinsic motivation on employee creativity. However, starkly different findings emerge when using subjective versus objective indicators of employee creativity, suggesting that further theoretical development is in order to explain the differences.

1. Introduction

The effectiveness of R&D units has been considered by a host of authors (e.g. Brown and Svenson, 1998; Cocca, 2001; Garcia-Valderrama and Mulero-Mendigorri, 2005). One key determinant of research and development (R&D) effectiveness in need of further consideration is the management and functioning of R&D personnel at the individual level of analysis. However, the most popular measures of R&D effectiveness (e.g. R&D spending as a percent of sales, number of ongoing projects, total patents filed/awarded/pending; Donnelly, 2000; Bremser and Barsky, 2004) typically do not focus on personnel management. While the literature has considered topics such as the leadership of R&D personnel and groups (Hirst and Mann, 2004; Berson and Linton, 2005) and the effects of cognitive style and problem-solving training on R&D effectiveness (e.g. Wang et al., 1999; Wang and Horng, 2002), much remains to be explored. In particular, R&D personnel are often said to be driven by intrinsic motivation (Amabile and Gyskiewicz, 1987) – long thought to be a key to employee creativity (e.g. Amabile, 1983, 1996). Nonetheless, the role of intrinsic motivation in this context has received almost no attention. Intrinsically motivated behaviors are ones for which there is no apparent reward except the activity itself (Deci, 1975). The value of intrinsic motivation has been demonstrated in a variety of contexts (e.g. Amabile, 1996; Cameron and Pierce, 1996; Ryan and Deci, 1996). In particular, it has been shown that intrinsic motivation is important for productivity in science (e.g. Fox, 1983) and R&D efforts (e.g. Scott and Bruce, 1994; Tierney et al., 1999). This is typically explained by suggesting that intrinsic motivation encourages exploration (Zhou, 1998), persistence (Oldham and Cummings, 1996; Zhou, 1998), flexibility, spontaneity, and ultimately creativity (e.g. Amabile, 1983, 1996; Deci and Ryan, 1985; Ryan and Deci, 2000). Creativity is defined here
as the production of novel and useful ideas, processes, or products by a person or group (e.g. Woodman et al., 1993; Oldham and Cummings, 1996; Zhou and George, 2001).

Nonetheless, several issues surrounding the role of intrinsic motivation have received little attention. While intrinsic motivation has been linked to increased risk taking (e.g. Lepper and Greene, 1978), field evidence, particularly in R&D settings, has been scant at best. In fact, only recently has the role of risk in employee creativity been formally addressed beyond an anecdotal level (Dewett, in press). In a broader sense, although intrinsic motivation is often mentioned in research related to creativity or R&D or new product development as an important theoretical consideration (e.g. Redmond et al., 1993; Shalley, 1995; Oldham and Cummings, 1996; Zhou, 1998; Shalley et al., 2000; George and Zhou, 2001), it is rarely empirically assessed (Shalley and Gilson, 2004), with few exceptions (Tierney et al., 1999; Shin and Zhou, 2003). As a result, the role of intrinsic motivation relative to risk taking and creativity remains largely unexplored in applied settings. Is intrinsic motivation simply an independent variable like any other or is its role more central to understanding creative work? Further, researchers’ reliance on subjective indicators of creative work (e.g. supervisor ratings of employee creativity as opposed to objective indicators such as patents) has raised doubts about the ultimate utility of our conclusions (e.g. Zhou and Shalley, 2003).

The current paper begins to address these issues. In short, the relationship between common creativity antecedents (e.g. both contextual and individual difference variables), intrinsic motivation, risk taking, and employee creativity is clarified within an R&D environment at the individual employee level. In short, various influences support or do not support intrinsic motivation at work (one’s enjoyment of the work itself). Intrinsic motivation bolsters one’s willingness to take risks (voluntarily experimenting with new ideas). One’s willingness to take risks is positively associated with employee creativity. Thus, it is argued that intrinsic motivation serves as a mediator of various influences on an employee’s willingness to take risks, which itself mediates the influence of intrinsic motivation on employee creativity. If supported, this would be the first test of all of these links simultaneously, in an R&D environment or elsewhere. Although it is stated more formally in hypotheses that follow, these general predictions can be conceptually depicted as follows.

The remainder of the paper is organized as follows: first, a brief summary of the intrinsic motivation construct is provided. Next, the hypotheses noted above are developed by drawing from the research on employee creativity. Finally, tests of the hypotheses are conducted, the results are explained, and considerations for future research are discussed.

2. Intrinsic motivation and employee creativity

Intrinsic motivation was studied as early as the 1950s but the construct became prominent due to the work of Deci (1975) and Deci and Ryan (1985). These authors first offered Self-Determination Theory, which distinguishes between two types of motivation based on the different causes that give rise to an event. At the heart of their theory is the distinction between intrinsic and extrinsic motivation. Intrinsic motivation refers to the motivational state in which an individual is attracted to their work in and of itself, not due to any external outcomes that might result from task engagement (Deci, 1975; Deci and Ryan, 1985). Thus, motivation deriving from external pressures or constraints is referred to as extrinsic motivation. Over three decades of research in this area suggests that the quality of task experience and performance can be very different when one is behaving for intrinsic versus extrinsic reasons (Ryan and Deci, 2000).

As a subtheory of Self Determination Theory, Deci and Ryan (1985) defined Cognitive Evaluation Theory (CET) to specify the factors in social contexts that produce variability in intrinsic motivation. CET views intrinsic motivation as a construct involving interest in the focal task predicated on feelings of self-determination and competence (Deci and Ryan, 1985). In short, interpersonal events and structures (e.g. rewards, feedback) that produce feelings of competence can enhance intrinsic motivation. More specifically, CET suggests that feelings of competence will not enhance intrinsic motivation unless accompanied by autonomy, which provides a sense of control. Reviews of the literature on intrinsic motivation suggest that it is vital to task performance and often quite sensitive to external forms of motivation (Ryan and Deci, 1996), although the issue is still debated (e.g. Cameron and Pierce, 1994, 1996).

Amabile (1983, 1996) developed what is likely the most well-known model of employee creativity.
Building on the work of Deci, Ryan, and many other scholars, she developed the Componential Model of Creativity. The basic model explores the contributions of three factors on employee creativity: domain-relevant skills, creativity-relevant processes, and task motivation. Domain-relevant skills refer to task knowledge and technical skills and depend on inputs such as cognitive skills and education. Creativity-relevant skills include things such as knowledge of heuristics for generating ideas and depend on training and experience. The final component is task motivation. Here, the importance of intrinsic motivation is paramount and the model addresses the influence of the environment (e.g. extrinsic influences) on one’s task motivation. Intrinsic motivation is in fact so vital to creativity that Amabile developed the Intrinsic Motivation Principle of Creativity: intrinsic motivation is conducive to creativity; controlling extrinsic motivation is detrimental to creativity, but informational or enabling extrinsic motivation can be conducive, particularly if initial levels of intrinsic motivation are high.

Thus, it has become commonly accepted that intrinsically motivated behaviors result in risk taking, flexibility, and spontaneity (Lepper and Greene, 1978; Amabile, 1983; Deci and Ryan, 1985). Nonetheless, while many studies note the important role of intrinsic motivation (e.g. Zhou, 1998), in applied settings the construct is rarely actually measured (Shalley and Gilson, 2004). Exceptions are provided by Shin and Zhou (2003) and Tierney et al. (1999). However, Shin and Zhou (2003) rely on Tierney et al.’s (1999) measure, which drew from Amabile’s (1985) study of creative writers. The items used measure general interest in global issues of problem solving and new ideas, not task-specific intrinsic motivation. Using this approach, Shin and Zhou (2003) and Tierney et al. (1999) do link intrinsic motivation to creativity, although potential mediators (e.g. increased risk taking) are not modeled. Further, while Amabile and Gryskiewicz (1987) link intrinsic motivation and risk orientation to creativity in a qualitative study of R&D personnel, the potential links between the two constructs are not addressed.

Similarly, several organizational studies assert that risk taking is integral to creativity, even when not specifically addressing intrinsic motivation (e.g. Abbey and Dickson, 1983; Fidler and Johnson, 1984; Jalan and Kleiner, 1995; Shalley, 1995; Tesluk et al., 1997; Zhou and George, 2001). Risk can be defined in this context as the extent to which there is uncertainty about whether potentially significant and/or disappointing outcomes of decisions will be realized (Sitkin and Pablo, 1992), given creative efforts. For example, Sethia (1989) states that creativity is risky because it is highly uncertain and the action-outcome link is often tortuous and spread out over time. In general, new ideas and behaviors are risky as they represent disturbances in the status quo and power balances (Albrecht and Hall, 1991). In short, many authors agree that a climate for creativity exists when employees are willing to take risks (Tesluk et al., 1997); yet, the construct is rarely measured. One exception is provided by Dewett (in press), who found that an employee’s willingness to take risks mediates the influence of supervisor encouragement for creativity and employee creative performance.

Although Amabile’s work highlighted the influence of the social environment on intrinsic motivation, there has been little evidence in applied settings. At least two studies provide exceptions. For example, Shin and Zhou (2003) provide evidence that intrinsic motivation mediates the effect of the interaction between leader charismatic behavior and conservation (an individual difference) on creativity. Similarly, Sundgren et al. (2005) link various independent variables to intrinsic motivation to creative climate. To be clear, the focus of the current research is not to identify new antecedents of intrinsic motivation or employee creativity per se. Rather, for the purpose of examining the links depicted in Figure 1, four common antecedents found in the literature were selected for inclusion in this work: supervisory encouragement (contextual), autonomy (contextual), self-efficacy (individual difference), and openness to experience (individual difference). Of course, many additional studies utilizing a variety of variables can be found in recent reviews of the creativity literature (for

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**Figure 1.** The path to employee creativity.
reviews, please see Zhou and Shalley, 2003; Shalley and Gilson, 2004). These four were selected because they are representative of the literature, known to be related to creativity, and provide a solid basis for examining intrinsic motivation and one's willingness to take risks.

Supervisory encouragement is the most frequently mentioned facilitating factor for creativity in the literature (Amabile et al., 1996). In general, encouragement and enthusiasm for idea generation at all levels of the organization has been a recurring theme (e.g. Abbey and Dickson, 1983; Delbecq and Mills, 1985; Amabile, 1988; Burnside et al., 1988; Amabile and Gryskiewicz, 1989; West, 1989; West and Farr, 1989; Farr and Ford, 1990; Tesluk et al., 1997). People are more likely to produce novel and useful ideas when given the permission to do so through communications or instructions (Parnes and Meadow, 1959; Parnes, 1964).

Autonomy refers to the degree to which a task provides substantial freedom, independence, and discretion to individuals in determining the procedures to be used in carrying out a task (Hackman and Oldham, 1980). Scholars have suggested that in order to be creative, people require freedom so that they can play with ideas and expand the range of possibilities and materials from which a solution may emerge (Amabile, 1983). Many authors have considered the importance of autonomy for the facilitation of creativity (e.g. Abbey and Dickson, 1983; Deci and Ryan, 1987; Amabile, 1988, 1996; Mumford and Gustafson, 1988; Deci et al., 1989; Shalley, 1991; Scott and Bruce, 1994; Zhou, 1998; Shalley et al., 2000). For example, in Amabile and Gryskiewicz's (1987) interview study of R&D scientists they note that the most frequently mentioned contextual factor characterizing high-creativity events was freedom. Similarly, the most frequently mentioned factor in low-creativity events was lack of freedom.

Self-efficacy can generally be defined as belief in one’s capability of performing a specific task (Bandura, 1986). In a broad sense, having a positive sense of self has been linked to creativity for many years (e.g. Fromm, 1959; Coopersmith, 1967). Research in the organizational literature specifically addressing self-efficacy demonstrates much the same (e.g. Gist, 1989; Farr and Ford, 1990; Redmond et al., 1993). For example, Gist (1989) demonstrated that increases in self-efficacy were associated with a higher quantity and divergence of ideas generated in a problem-solving task. Redmond et al. (1993) showed a complementary finding indicating a significant effect of self-efficacy on the quality of solutions provided in a laboratory experiment involving a marketing task.

Openness to experience describes the extent to which individuals are imaginative, sensitive to aesthetics, curious, independent thinkers, and or amenable to new ideas, experiences, and unconventional views (Costa and McCrae, 1992; McCrae, 1996; McCrae and Costa, 1997). Prior research has established that openness to experience is related to creativity (McCrae, 1987, 1996; Costa and McCrae, 1992; McCrae and Costa, 1997; Feist, 1998; Griffin and McDermott, 1998; George and Zhou, 2001). For example, McCrae (1987) empirically established the relationship between creativity, measured by Gough’s (1979) popular CPS scale, and measures of divergent thinking and openness to experience. He states that people high on openness to experience share an interest in experience for its own sake. George and Zhou (2001) found that openness to experience may serve to encourage creativity when the situation allows for the manifestation of the influence of the trait. Specifically, in a sample of workers from a petroleum drilling company, they found that creativity was the highest when individuals who were high on openness to experience received positive feedback and worked on a heuristic task.

In short, while researchers have examined creativity in R&D contexts (e.g. Subramanian and Ganesan, 1982; Abbey and Dickson, 1983; Amabile and Gryskiewicz, 1987; Dewett, in press; Scott and Bruce, 1994; Tierney et al., 1999; Bain et al., 2001; Shin and Zhou, 2003) as well as other organizational contexts, greater efforts are needed to define the links among several related constructs. Following Figure 1 and combining the findings from the studies noted above, I offer two hypotheses.

H1: Intrinsic motivation mediates the influence of contextual and individual difference variables (e.g. encouragement, autonomy, self-efficacy, openness) on an employee’s willingness to take risks.

H2: An employee’s willingness to take risks mediates the influence of intrinsic motivation on employee creativity.

3. Methods

The data for this study are part of a larger research project involving employees of a large
private R&D organization located in the Southwest United States. The organization uses several thousand employees and its work is divided roughly in half between projects for private industry and projects for the federal government. Permission to collect data was granted based on the researcher’s commitment to provide a copy of the results to the organization. Questionnaires were administered to all of the organization’s R&D personnel who held traditional technical positions, and their immediate supervisors. This group was dominated by research scientists but also included highly skilled technical personnel working directly on ongoing R&D projects. The potential sample consisted of 716 pairs (e.g. the employee and their supervisor) of possible respondents. The information was collected with a mail-out survey using the names and addresses supplied by the organization. One month after the initial mailing, a follow-up mailing was conducted. Usable questionnaires were returned by 165 employee/supervisor pairs, representing an overall paired response rate of 23%.

To avoid problems associated with common method variance often found in cross-sectional survey research, four steps were taken. First, separate questionnaires were completed by the R&D personnel, to capture the independent variables and self-reports of objective creative outcomes, and by their supervisors, to capture ratings of employee creativity. Second, the listing of items was sequenced such that the self-report DV was listed last (Salancik and Pfeffer, 1977; Podsakoff and Organ, 1978). Next, I examined each returned questionnaire to consider whether or not the respondent understood the items. No face validity problems were detected. Finally, as a hedge against social desirability bias, all participants were informed that their participation was completely voluntary and confidential. Methods such as these, while not perfect, have proven sufficient in other empirical research using this type of data (e.g. Abbott et al., 2006).

3.1. Measures

Unless otherwise noted, all variables included in this study were measured using a seven-point Likert-type scale from 1, strongly disagree, to 7, strongly agree.

Antecedents to intrinsic motivation. As noted earlier, four variables commonly found in the creativity literature were chosen for inclusion in this study: supervisor encouragement for creativity (e.g. Amabile et al., 1996; Tesluk et al., 1997), autonomy (e.g. Mumford and Gustafson, 1988; Shalley, 1991; Shalley et al., 2000), self-efficacy (e.g. Gist, 1989; Farr and Ford, 1990; Redmond et al., 1993), and openness to experience (e.g. Costa and McCrae, 1992; Griffin and McDermott, 1998; George and Zhou, 2001). Each was chosen because of their stated relationships with intrinsic motivation, risk taking, and/or creativity. In addition, at least three (i.e. encouragement, self-efficacy, autonomy) were chosen because they speak directly to the contention that intrinsic motivation is predicated on feelings of self-determination and competence (Deci and Ryan, 1985).

The scale used to measure encouragement contained eight items adapted from Scott and Bruce (1994) and several developed for this study. The scale is intended to capture the degree to which the employee feels that creativity is encouraged by their immediate supervisor and includes items such as ‘I am encouraged to be creative.’ Coefficient $z$ for the scale was 0.88. Autonomy was measured using five items adapted from Ibarra and Andrews (1993). The scale seeks to measure the degree to which the employee perceives that they are able to carry out their work free from excessive control and constraints from their supervisor. It includes items such as ‘I can use my personal initiative and judgment in carrying out my work’ and had a coefficient $z$ of 0.87. Self-efficacy was measured by building on Bandura’s (1986) definition pertaining to task-specific competency beliefs. A four-item scale was developed for use in this study and included items such as ‘I am highly skilled at my job.’ The scale had a coefficient $z$ of 0.80. Openness to experience was measured with eight items adapted from the short form of the NEO PI scale created by Costa and McCrae (1992). The scale included items such as ‘I often enjoy playing with theories or abstract ideas.’ Coefficient $z$ for the openness to experience scale was 0.66.

3.1.1. Intrinsic motivation

Given the scarcity of intrinsic motivation measures available in the organizational literature and their global nature noted above, this variable was measured using six items developed for this study. The items were designed to assess the amount of intrinsic enjoyment an employee derives from the tasks that comprise their work, building on the work of Amabile (1996) and Deci and Ryan (1985). It included items such as ‘I feel driven to do my job because I genuinely like the tasks I work on.’ The scale had a coefficient $z$ of 0.84.
3.1.2. Willingness to take risks

Dewett’s (in press) measure of an employee’s willingness to take risks was used in this study. The measure is designed to understand how willing to take risks an employee is in an effort to produce high-quality work. It contains eight items including ‘When I think of a good way to improve the way I accomplish my work, I will risk potential failure to try it out.’ Coefficient $\alpha$ for this scale was 0.93.

3.1.3. Creativity

Ratings of employee creativity were obtained from each employee’s immediate supervisor. The scale included six items adapted from George and Zhou (2001) and Scott and Bruce (1994). The items ask supervisors how characteristic various creative behaviors are of their subordinate. The scale included items such as ‘novel and practical work-related ideas’ and used a five-point Likert-type scale from 1, not at all characteristic, to 5, highly characteristic. Coefficient $\alpha$ for the creativity scale was 0.96.

In addition, each employee included in the sample had the opportunity to produce several different objective creative products as a normal part of their job. Subjective supervisor ratings of employee creativity have dominated the literature, although several notable exceptions exist (e.g. Pelz and Andrews, 1966; Scott and Bruce, 1994; Oldham and Cummings, 1996; Tierney et al., 1999). While some have found similar, but not identical, patterns of results when comparing subjective and objective indicators of creativity (e.g. Tierney et al., 1999), others have found divergent results (e.g. Oldham and Cummings, 1996). The question remains open as to whether objective indicators are the same as creativity itself (Zhou and Shalley, 2003). As a result, it was decided to include objective indicators in the study. These included self-reports for each participant of research paper presentations to industry organizations, awards from technical organizations/associations, invention disclosures, patent applications, and patents awarded. Each employee was asked to indicate how many of each type of outcome they had obtained over the past year. Each instance of any of these outcomes was then totaled and an average score was obtained, rendering each employee an objective creativity score. The objective creativity variable had a mean of 2.61 and ranged from 1 to 7.

3.1.4. Control variables

Two control variables were included in this study. First, education level was measured and coded as a dummy variable because it is related to an employee’s domain knowledge and could thus partially account for differences in creative ability (Amabile, 1988; Tierney et al., 1999). Twenty-three respondents possessed a bachelor degree, 50 possessed a master’s degree, 55 possessed a doctorate, and the remainder either had less than a bachelors or had at least some graduate training. Next, building on research suggesting gender differences in creative ability (Conti et al., 2001) and research suggesting that the creative achievements of females are often not as valued as those produced by males (Evans, 1979), gender was coded as a dummy variable. There were 21 females and 144 males in the sample.

4. Results

The descriptive statistics for the study variables are shown in Table 1.

In order to test the two hypotheses, mediated regression models were computed (e.g. James and Brett, 1984; Barron and Kenny, 1986). A variable is said to function as a mediator when variations in the independent variables significantly account

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Table 1. Means, standard deviations, and correlations

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<th>6</th>
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<tbody>
<tr>
<td>1. Education</td>
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<td>2. Gender</td>
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<tr>
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<td>0.22**</td>
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<td>4. Autonomy</td>
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<td>0.58**</td>
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<tr>
<td>5. Self-efficacy</td>
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<td>0.05</td>
<td>0.19*</td>
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<tr>
<td>6. Openness to experience</td>
<td>4.67</td>
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<td>0.04</td>
<td>0.02</td>
<td>0.14</td>
<td>0.24**</td>
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<td>7. Intrinsic motivation</td>
<td>5.35</td>
<td>0.93</td>
<td>0.07</td>
<td>0.12</td>
<td>0.39**</td>
<td>0.26**</td>
<td>0.40**</td>
<td>0.16*</td>
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<td>8. Willingness to take risks</td>
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<td>0.25**</td>
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<td>33***</td>
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<td>9. Creativity (subjective)</td>
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<td>0.06</td>
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<td>0.22**</td>
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<td>0.17*</td>
<td>0.19*</td>
<td>0.26**</td>
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<td>10. Creativity (objective)</td>
<td>2.62</td>
<td>1.54</td>
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<td>0.28**</td>
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<td>0.17*</td>
<td>0.17*</td>
<td>0.16*</td>
<td>0.23**</td>
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</tbody>
</table>

N = 165.  
*P<0.05; **P<0.01.
for variations in the proposed mediator, variations in the mediator significantly account for variations in the dependent variable, and, when controlling for the mediator, a previously significant relationship between the independent variable(s) and the dependent variable decreases or becomes insignificant. One can test these conditions by regressing the mediator on the independent variable, regressing the dependent variable on the independent variable, and regressing the dependent on both the independent variable and the mediator (Barron and Kenny, 1986).

Table 2 displays the results of regression analyses used to test Hypothesis 1.

As noted above, both encouragement for creativity and self-efficacy were significantly related to intrinsic motivation in the first model ($\beta = 0.39, P < 0.01$ and $\beta = 0.38, P < 0.01$, respectively) and to willingness to take risks in the second model ($\beta = 0.19, P < 0.05$ and $\beta = 0.15, P < 0.05$, respectively). In the third model, with intrinsic motivation as a mediator, neither encouragement nor self-efficacy significantly influenced the employee’s willingness to take risks. Intrinsic motivation, however, was significant ($\beta = 0.18, P < 0.05$), indicating full mediation. Thus, although two independent variables did not show the anticipated significant relationships (e.g. autonomy, openness), those that were significant were fully mediated (e.g. encouragement, self-efficacy) and so Hypothesis 1 is supported.

Table 3 displays the results of regression analyses used to test Hypothesis 2, using supervisor ratings of employee creativity as the dependent variable.

The table shows that intrinsic motivation significantly influenced willingness to take risks in the first model ($\beta = 0.30, P < 0.01$) and creativity in the second model ($\beta = 0.17, P < 0.05$). In the last model, with willingness to take risks included as a mediator, the effect of intrinsic motivation

<table>
<thead>
<tr>
<th>Variables</th>
<th>Model 1: DV = intrinsic motivation</th>
<th>Model 2: DV = willingness to take risks</th>
<th>Model 3: DV = willingness to take risks</th>
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</thead>
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<tr>
<td>Control variables</td>
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<td>Gender</td>
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<td>0.15*</td>
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<tr>
<td>Independent variables</td>
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<td>Encouragement</td>
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<td>Self-efficacy</td>
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<td>Openness to experience</td>
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<td>Mediator</td>
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<tr>
<td>Intrinsic motivation</td>
<td>0.31**</td>
<td>0.25**</td>
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<td>$R^2$</td>
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<td>$\Delta R^2$</td>
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<td>0.18**</td>
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</table>

$N = 165$. $\beta$ weights are reported for the final step in each model. *$P<0.05$; **$P<0.01$.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Model 1: DV = willingness to take risks</th>
<th>Model 2: DV = creativity</th>
<th>Model 3: DV = creativity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control variables</td>
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<td></td>
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<tr>
<td>Education</td>
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<td>0.01</td>
<td>-0.01</td>
</tr>
<tr>
<td>Gender</td>
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<td>0.19*</td>
<td>0.15*</td>
</tr>
<tr>
<td>Independent variables</td>
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<tr>
<td>Intrinsic motivation</td>
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<td>0.17*</td>
<td>0.11</td>
</tr>
<tr>
<td>Mediator</td>
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<td></td>
<td></td>
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<tr>
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<td></td>
<td>0.19*</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.18**</td>
<td>0.07**</td>
<td>0.10**</td>
</tr>
<tr>
<td>$\Delta R$</td>
<td></td>
<td></td>
<td>0.05**</td>
</tr>
</tbody>
</table>

$N = 165$. $\beta$ weights are reported for the final step in each model. *$P<0.05$; **$P<0.01$. 
disappears while the effect of willingness to take risks is significant ($\beta = 0.19, P < 0.05$), indicating full mediation. Thus, Hypothesis 2 is supported when using a subjective measure of creativity.

Table 4 displays the same analysis, now using the objective measure of employee creativity. The analysis using an objective measure of creativity produced a starkly different pattern of findings. While intrinsic motivation was significantly related to willingness to take risks in the first model ($\beta = 0.30, P < 0.01$), in the last two models, neither intrinsic motivation nor willingness to take risks were significantly related to creativity. Thus, while the correlations shown in Table 1 indicate a similar pattern of associations when comparing the two creativity measures, Hypothesis 2 was not supported in the regression analysis using the objective creativity measure.

Analysis of the control variables indicated that education and gender were both significantly related to the employee’s willingness to take risks and that gender was related to supervisor ratings of creativity as well as the objective ratings of creativity. Possible implications are discussed below.

5. Discussion

This research makes at least three contributions to the study of creativity in R&D environments. First, the literature often asserts the importance of intrinsic motivation in the context of employee creativity, although it is rarely measured. This study joins Shin and Zhou (2003) and Tierney et al. (1999) in demonstrating the importance of intrinsic motivation in an applied setting. It is thus becoming clear that one fundamental antecedent to employee creativity is intrinsic interest in one’s work. In addition, this is the first time that a task-specific measure of intrinsic motivation has been used to test this assumption. From a practical standpoint, this finding suggests that managers must strive to manage in a manner that does not damage employee intrinsic motivation. This finding has strong implications for the use of recognition and rewards, among other management practices, that may either support or detract from intrinsic motivation. Second, evidence is provided that the effect of intrinsic motivation on creativity is transmitted through an increased willingness to take risks – a first in the literature. While inherent interest in one’s work is thought to lead to an increase in risk taking and experimenting, this assertion has yet to be supported in an applied setting until now, suggesting that the specific causal sequence may in fact be love, engage, create.

Finally, joining Oldham and Cummings (1996), the study found that the pattern of findings varies significantly depending on the type of creativity indicator used. When using supervisor ratings of employee creativity, the findings largely conform to the extant literature. That is, the results show that encouragement and self-efficacy both play important roles in understanding employee creativity. However, the formal analysis reported here, as well as several post hoc regression analyses not reported, indicate that none of the independent variables including intrinsic motivation or willingness to take risks were related to the objective measure of creativity. In fact, post hoc regression analysis utilizing several permutations of the objective indicator (all possible subcombinations of multiple objective indicators) yielded no positive relationships between any of the antecedents and creativity.

In terms of future research, these findings suggest that additional theoretical work is required to understand the nature of both subjective and objective creative outcomes. Exactly how are subjective ratings and objective work products different indicators of creativity in organizations?

Table 4. Regression results – Hypothesis 2, objective measure of creativity

<table>
<thead>
<tr>
<th>Variables</th>
<th>Model 1: DV = willingness to take risks</th>
<th>Model 2: DV = creativity</th>
<th>Model 3: DV = creativity</th>
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<tr>
<td>Control variables</td>
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<td>0.45**</td>
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<tr>
<td>Independent variables</td>
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<tr>
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<td>Mediator</td>
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<td></td>
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<tr>
<td>Willingness to take risks</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>$R^2$</td>
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<td>0.29**</td>
<td>0.29**</td>
</tr>
<tr>
<td>$\Delta R^2$</td>
<td></td>
<td></td>
<td>0.01</td>
</tr>
</tbody>
</table>

$N = 165$, $\beta$ weights are reported for the final step in each model. *$P < 0.05$; **$P < 0.01$. 

Todd Dewett
It seems prudent that before suggesting additional work examining the antecedents of creativity, researchers must develop new logic and theory in support of valid measures of creativity. While it may be possible that objective indicators are not the same as creativity itself (Zhou and Shalley, 2003), the broader question is whether or not commonly used subjective ratings adequately capture creativity. Assuming there are differences, we have yet to articulate them or to suggest how subjective versus objective indicators might be predicated on somewhat different antecedents. Given that objective creative outcomes are the ultimate goal (i.e. subjective ratings of creativity are only useful to the organization to the degree that they are related to instances of novel and useful outcomes), scholars must turn their attention to understanding what may be a very different phenomenon. Further, the current study only examines intrinsic motivation, one’s willingness to take risks, and employee creativity at the individual level. There is a great opportunity for future research to expand the level of analysis to consider both group and organizational influences on individual as well as group indicators of creativity.

This study is not without limitations. While it is useful to have included a comparison of subjective and objective indicators of creativity, it should be noted that subjects were only asked to report on their objective indicators for the prior year. It is possible that different results would have been obtained if each respondent’s cumulative objective record had been captured for the duration of their tenure with the organization. Further, objective indicators other than those examined in the current study exist and could be considered (e.g. ideas submitted to a suggestion program). For both of these reasons, further research is warranted. In addition, the study was cross-sectional. While the independent variables presumably capture some longitudinal assessment, they were nonetheless measured at one point in time. Similarly, the objective creativity measure asked for retrospective recall, although it was also measured at one point in time. More detailed longitudinal analyses should be able to produce more robust causal results. One additional issue associated with cross-sectional research is the threat of common-method bias. While the participants were informed that their responses were confidential and anonymous, more can be done in future research to guard against common method bias (e.g. collecting certain measures at different times, using a heterogeneous group of scales).

It is also important to briefly note the control variable analysis. For educational attainment, an interesting finding emerged – higher educational achievement was strongly correlated to the objective measure of creativity but not the subjective measure. This has strong implications as researchers continue to understand the difference between these two fundamentally different types of dependent variables. Regarding gender, while it was shown that males were more likely to take risks and be creative, the finding is inconclusive. The small number of females in the sample precluded any additional analysis as to whether this result can best be explained by gender or by the dynamics of the work environment in which females were a sharp minority.

Additional future research is also required to establish the validity of a measure of intrinsic motivation. While past efforts have used particularly global measures of interest in problem solving and new ideas, the current study used items specifically designed to measure interest in the tasks that comprise one’s job. Even though this represents an improvement, it will be useful to further validate the measure in additional settings. In addition, researchers must include the topic of intrinsic motivation in the unfolding discussion about subjective versus objective indicators of creativity. For example, Unsworth (2001) has identified several types of creativity that might emerge, given different types of problems and different types of motivation. Might the role of intrinsic motivation vary as a function of the type of creativity pursued? Finally, the current study demonstrated the central role of one’s willingness to take risks relative to employee creativity. In concert with additional work on intrinsic motivation in applied settings, the literature will benefit from exploring what additional contextual factors influence and shape the employee’s willingness to take risks with their work.

R&D work will continue to be a driving force of the global economy. Consequently, we must be diligent in our efforts to advance our understanding of employee creativity in this environment. As the current study indicates, there is still much work to be done.

References

Todd Dewett


Linking intrinsic motivation, risk taking, and employee creativity


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