

UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

CREATIVITY IN THE FUZZY FRONT END:
THE INFLUENCE OF EVALUATION STRUCTURE AND CRITERIA

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

Degree of

DOCTOR OF PHILOSOPHY

By

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Norman, Oklahoma

2013

CREATIVITY IN THE FUZZY FRONT END:
THE INFLUENCE OF EVALUATION STRUCTURE AND CRITERIA

A DISSERTATION APPROVED FOR THE
DEPARTMENT OF PSYCHOLOGY

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This dissertation is dedicated to my wife, Katherine, and sons, Christian, Liam, and Graham.

Acknowledgements

I would like to thank my doctoral advisor, Dr. Michael Mumford, without whose instruction I would even less competent than I am today. I would also like to thank the members of my dissertation committee, Dr. Michael Buckley, Dr. Shane Connelly, Dr. Eric Day, and Dr. Robert Terry, whose contributions and expertise have made the OU doctoral program what it is. I am grateful to be one of its many graduates. Thank you all.

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Abstract

Activities in the fuzzy front end of product development are critical for subsequent product performance. Despite calls to study these activities, relatively little research has focused on how to manage these early stage development processes. We draw on the psychology and management literatures to study the role of idea evaluation in the development of new product concepts. In an experimental study, participants were given restaurant industry information and asked to develop new restaurant concepts. We manipulated the evaluation structure and criteria provided to participants for evaluating the restaurant industry information prior to developing their restaurant concepts. Both evaluation structure and criteria significantly influenced the creativity of participants' restaurant concepts. Implications for integrating creative cognition into the study and practice product innovation management are discussed.

[Begin your abstract here.]

Introduction

One of the most important influences on the development of new products is the evaluative decisions made about those product projects (Schmidt, Sarangee, & Montoya, 2009). Many of the decisions are framed in terms of go/no-go decisions. These include which themes and ideas to explore, which ideas to develop, which projects to cancel and which to implement (K. G. Baker & Albaum, 1986; Cooper, 1990). Traditionally research on new product evaluation decisions has focused on these types of dichotomous screening decisions (Carbonell-Foulquié, Munuera-Alemán, & Rodríguez-Escudero, 2004; Cooper, 1988; Cordero, 1990). While framing project evaluation in terms of dichotomous decisions is important when considering the development of project portfolios, go/no-go decisions are less useful for understanding the development of individual projects.

The dichotomous decision perspective is useful for managing project portfolios where multiple projects are evaluated in the context of other projects competing for the same resources. Indeed one of the benefits of project portfolios is that they mitigate risk by spreading it across multiple projects, some of which will inevitably be cancelled and others pursued (Schmidt et al., 2009). However, screening across multiple projects does not speak to the development of individual projects, that is, how the individuals working on an individual project refine and improve that project (Jespersen, 2012). This perspective is a critical compliment to broader screening decisions as together both provide a more realistic, multilevel view of new product development (Heising, 2012; Jiménez-Zarco, Martínez-Ruiz, & González-Benito, 2006; Khurana & Rosenthal, 1997). On the one hand there is a clear need to sift through projects in order to allocate

scarce resources to only the most promising projects. On the other hand projects that are selected for continuation must be developed—the ideas forming the genesis of any project are of course not marketable in their raw form. Thus it is important to distinguish between, and integrate, portfolio development, driven by screening decisions, and project development, driven by the transformation of ideas into products (Khurana & Rosenthal, 1997; Roberts & Fusfeld, 1981).

The development of individual projects begins with what has been labeled the fuzzy front end of development (Reinertsen, 1985), or the period of time between when an idea is first considered and when it is ready for development (Kim & Wilemon, 2002; Reid & de Brentani, 2004). The label is appropriate given the substantial ambiguity surrounding predevelopment activities and their impact on various performance outcomes. The activities comprising the fuzzy front end are critical to subsequent project development (Cooper, 1988; Evanschitzky, Eisend, Calantone, & Jiang, 2012; Khurana & Rosenthal, 1997; Kim & Wilemon, 2002; O'Connor & Rice, 2013; van Riel, Semeijn, Hammedi, & Henseler, 2011). Cooper (1988) noted that not only is the success (or failure) of new products often determined in the fuzzy front end but also that the success factors that “separate winners from losers most often lie within the hands of the people who manage and undertake the new product project” (p. 237). The criticality of predevelopment activities combined with the relative lack of understanding about them poses a particularly important problem for project development.

In response to this gap scholars have sought to develop frameworks for understanding the fuzzy front end and how it influences project development. Khurana

and Rosenthal (1997) described three front end phases pertaining to individual projects. In the context of foundational organizational characteristics (e.g., portfolio strategy), organizations identify opportunities, explore those opportunities, and generate plans for developing the proposed product. Cooper (1988) described three predevelopment stages, each one ending in a go/no-go decision for continuing the next stage. First, a number of potential ideas are generated. Some of those ideas are explored during a preliminary assessment stage. Finally, a single, clear product concept is defined and evaluated.

Both these efforts and others (Kim & Wilemon, 2002; Reid & de Brentani, 2004; Reinertsen, 1999) to structure fuzzy front end activities point to the importance of generating and evaluating ideas and defining a well-defined product concept, which concepts form the basis of subsequent project planning (Khurana & Rosenthal, 1997; Mumford, Bedell-Avers, & Hunter, 2008). A number of empirical studies have provided evidence of the importance of a clear, well-defined product concept to subsequent project performance (Cooper & Kleinschmidt, 1987, 2000; Murphy & Kumar, 1997; Parsa, Self, Njite, & King, 2005). And the impact of these predevelopment activities on product success are held to generalize across many types of product innovation (Cooper & Kleinschmidt, 2000). What should be recognized here is that fuzzy front end activities are closely related to creative processes discussed in the psychology and management literatures.

Many have pointed to the need to study creativity more in organizations, particularly as a driver of organizational innovation (Bharadwaj & Menon, 2000; Brown & Eisenhardt, 1995; Damanpour, 1991; Montoya-Weiss & Calantone, 1994). However,

despite the recent progress in our understanding of predevelopment activities, much of the front end remains fuzzy. This study answers a recent call to integrate both broader theoretical schema and less common research designs in the study of product innovation management (Evanschitzky et al., 2012; Guo, 2008). In particular, we draw from both the project management literature and the psychology and management literatures to further our understanding of creativity in the fuzzy front end of product development. We use an experimental design to study the causal effects of project evaluation on the creative problem-solving efforts of those asked to work on product development projects.

Creativity in the Fuzzy Front End

A number of scholars have argued that creativity is what happens in the fuzzy front end while innovation occurs in subsequent development processes (Amabile, 1988; Day, 1994; J. Hauser, Tellis, & Griffin, 2006; Im, Montoya, & Workman, 2013; Poskela & Martinsuo, 2009). A lack of integration of the psychology and management literatures on creativity into the product management literature may contribute to the persistent fuzziness of front end activities (J. Hauser et al., 2006; Heising, 2012). The model of creativity proposed by Mumford, Connelly, and Gaddis (2003) holds that the creative cognition of leaders occurs through idea evaluation. Rather than generating the initial ideas for a project, leaders evaluate the ideas of others. This evaluation provides the basis for the recombination and revision of ideas.

The importance of front end creativity is also supported by project management research (Cooper, 1988; Khurana & Rosenthal, 1997; Kim & Wilemon, 2002; Reid & de Brentani, 2004). In terms of Cooper's (1988) three predevelopment stages, Stage 1

(Idea Generation) individuals generate and screen multiple initial product ideas. During Stage 2 (Preliminary Assessment) individuals refine project ideas vis-à-vis elaboration on additional market and technical information. Finally, in Stage 3 (Concept Definition), the final predevelopment phase, a product concept is produced, which concept serves as a basis for planning subsequent development activities (Khurana & Rosenthal, 1997; Kim & Wilemon, 2002; Mumford et al., 2008). It is important to note here that individuals are asked to evaluate ideas within each of these three predevelopment phases. Thus, idea evaluation is held to activate creative thought (Mumford, Lonergan, & Scott, 2002).

Project evaluation studies typically focus on the eventual success of a product. Despite the obvious importance of overall product success some have argued that it is important to distinguish this from other, stage-specific performance outcomes (e.g., creativity, strategic opportunity, product attractiveness; (S. Hart, Jan Hultink, Tzokas, & Commandeur, 2003; Kim & Wilemon, 2002; Martinsuo & Poskela, 2011; Molina-Castillo & Munuera-Alemán, 2009a; Poskela & Martinsuo, 2009; Reid & de Brentani, 2010). One important predevelopment outcome that has received relatively little attention in the project management literature is creativity. Most models of creativity assume that creative ideas or products must be both high quality and original (Amabile, 1988; Bharadwaj & Menon, 2000; Im et al., 2013; M. A. Runco & Jaeger, 2012). There is some evidence of a third component (Besemer & O'Quin, 1999a; Christiaans, 2002; Simonton, 2012). Sometimes referred to as elegance (Mumford, Hester, & Robledo, 2012), this component refers to the aesthetic or design appeal of the idea (Christiaans, 2002; Dym, Agogino, Eris, Frey, & Leifer, 2005). Thus an important outcome of fuzzy

front end idea development is the quality, originality, and elegance of product concepts (Cordero, 1990; Kim & Wilemon, 2002).

Idea Evaluation and Predevelopment Creativity

Individuals evaluate ideas by forecasting the implications of an idea (Mumford et al., 2002). Those forecasts, however, depend on contextual information such as goals and performance requirements (Hershey, Walsh, Read, & Chulef, 1990; Smith, Locke, & Barry, 1990). To obtain information bearing on goals and performance requirements individuals engage in a sensemaking process (Drazin, Glynn, & Kazanjian, 1999; Thomas, Clark, & Gioia, 1993; Weick, 1995). In sensemaking individuals scan internal (e.g., past experience) and external (e.g., policies and procedures) sources for relevant information and then elaborate on and interpret that information (Mumford et al., 2008; Mumford, Schultz, & Van Doorn, 2001). The interpreted information is then applied to the evaluation and development of ideas (Elsbach & Kramer, 2003; Lonergan, Scott, & Mumford, 2004; Mumford et al., 2002). In the context of new product development goals are dictated by the development stage and performance requirements are communicated by the way individuals are asked to evaluate projects. Thus as individuals are asked to evaluate ideas in each predevelopment stage (Idea Generation, Preliminary Assessment, Concept Development; Cooper, 1988; Murphy & Kumar, 1997), they scan for information, interpret that information, and apply those interpretations to the incremental development of product ideas.

Studies of evaluation processes in new product development have identified two broad characteristics of evaluations which influence performance outcomes. Product evaluation processes have been found to vary in terms of structure (Jespersen, 2012;

Martinsuo & Poskela, 2011; Sethi & Iqbal, 2008; Van Oorschot, Sengupta, Akkermans, & Van Wassenhove, 2010) and content (S. Hart et al., 2003; Molina-Castillo & Munuera-Alemán, 2009a; Schmidt et al., 2009). With regard to structure, evaluations can be structured or unstructured, formal or informal, specified or open-ended. Structured evaluations often require individuals to assess a project in terms of a specified set of criteria or standards, with projects receiving a numerical rating on each standard applied (Cooper, 1985; Cordero, 1990). Unstructured evaluations are less formal, and may simply be initiated with open-ended questions (Henriksen & Traynor, 1999).

There is some debate about the value of structured versus unstructured evaluation instructions (Martinsuo & Poskela, 2011). Structured evaluations are held to provide standardized information across projects (Calantone, Benedetto, & Schmidt, 1999) and help control individual evaluator biases (Perks, 2007). Structured evaluations, however, likely restrict the exploratory and creative efforts of those being asked to evaluate projects (Koen et al., 2002; Nijssen, Hillebrand, de Jong, & Kemp, 2012; Nobelius & Trygg, 2002; Sethi & Iqbal, 2008; Zippel-Schultz & Schultz, 2011). Unstructured evaluations are held to facilitate creativity by allowing individuals to evaluate projects without restricting their cognition (Hammedi, Van Riel, & Sasovova, 2011). These observations lead to our first hypothesis.

H1: The structure of evaluations will influence creativity such that open-ended evaluations will lead to new product concepts of higher quality, originality, and elegance.

A second aspect of evaluations held to influence the creativity of idea evaluators is the content of evaluations (Lonergan et al., 2004; Mumford et al., 2002). A number of studies from the project management and psychology literatures have examined the effects of different evaluation criteria on creative performance (Carbonell, Rodríguez-Escudero, & Munuera-Aleman, 2004; Carbonell-Foulquié et al., 2004; S. Hart et al., 2003; Lonergan et al., 2004; Martinsuo & Poskela, 2011). For example, Lonergan et al. (2004) compared the impact of innovative and operational evaluation criteria on the creativity of marketing concept plans. They found that creativity was highest when innovative criteria were applied to less original ideas and when operational criteria were applied to more original ideas. Similarly, Martinsuo and Poskela (2011) found that the assessment criteria used by industrial organizations in the fuzzy front end were significantly related to measures of predevelopment performance.

Studies of the criteria used in evaluating new products have identified a large number of criteria. With some variation, these criteria generally are categorized into three or four evaluation dimensions—strategic, market, product, and financial criteria (Griffin & Page, 1996; S. Hart et al., 2003; Martinsuo & Poskela, 2011; Ronkainen, 1985; Schmidt et al., 2009). Moreover, a general pattern has emerged showing a relationship between the use of certain dimensions and various performance measures. In general, product performance is positively associated with an emphasis on market-based evaluation criteria with consideration of other criteria in different developmental stages (Carbonell-Foulquié et al., 2004; S. Hart et al., 2003).

It is important to note, however, that the appropriateness of evaluation criteria should be determined with regard to the effects of the criteria on a specified outcome (S.

Hart et al., 2003; J. R. Hauser & Zettelmeyer, 1997; J. R. Hauser, 1998). Thus criteria which may be related to the performance outcomes of interest to those managing project portfolios (e.g., risk, resource requirements) may not be the same as the criteria considered appropriate for those concerned with developing individual creative products (e.g., adaptability, market potential). As noted above, no project evaluation studies have examined the effects of different evaluation criteria on the individual creative performance of the people evaluating the projects. However, research on the cognitive processes involved in idea evaluation suggest which criteria, of those commonly cited in the project management literature, might enhance or inhibit individual creativity. For example, individuals who forecast a wider and longer range of potential outcomes of an idea tend to produce more creative ideas (Byrne, Shipman, & Mumford, 2010; Shipman, Byrne, & Mumford, 2010).

During idea generation individuals are developing problem representations. These problem representations serve as the basis of subsequent creative processes such as the evaluation and refinement of existing or the generation of additional ideas. This suggests that evaluation criteria may serve to broaden or narrow the scope of forecasting and therefore enhance or inhibit creative performance, respectively. For example, criteria that focus people's attention on resource requirements (Mumford et al., 2008), risk (Blair & Mumford, 2007; Licuanan, Dailey, & Mumford, 2007), and short-term performance (Byrne et al., 2010; Shipman et al., 2010) may constrain individuals to generating only ideas that can be accomplished with existing resources, are less risky, and achieve short-term gains. Criteria that focus people's attention on multiple related ideas, long-term success, and adaptability are more likely to broaden

peoples' problem representations and sensemaking processes (Acar & Runco, 2012; Byrne et al., 2010; M. a. Runco & Acar, 2012; Shipman et al., 2010).

After ideas have been generated and additional market and technical information is being considered (i.e., Preliminary Assessment stage), individuals are more focused on developing their ideas (Mumford et al., 2003, 2002; Mumford, Medeiros, & Partlow, 2012). Developing ideas in this stage involves scanning additional market and technological data (Cooper, 1988) and applying that information to improving ideas (Mumford et al., 2002, 2001). Here evaluation criteria focused on feasibility (De Dreu, Baas, & Nijstad, 2012), resource requirements (Peterson et al., in press), and market potential are likely to be useful in improving ideas (Mumford et al., 2008). However, because product ideas are not yet fully developed, less effective criteria are likely to emphasize schedule performance, current market acceptance, or financial concerns (Mumford et al., 2008). Table 1 and Table 2 contain lists of evaluation criteria used in this study and their expected effects on creativity at each predevelopment stage.

H2: The content of evaluation instructions will influence creativity such that criteria considered inappropriate will negatively influence the creative performance of individuals evaluating developing projects.

In addition to structure and content, the timing of evaluations has been found to influence front end and overall product performance. The importance of timing stems from the sequential nature of idea and product development. Front end activities are incremental—the activities and outcomes of one stage have a substantial impact on the activities and outcomes in subsequent stages (Lewis, Welsh, Dehler, & Green, 2002; Martinsuo, Suomala, & Kanniainen, 2013; Van Oorschot et al., 2010). And the goals

Table 1.
Evaluation Criteria for Stage 1: Idea Generation

Criteria	Prompt	Expected Effect	Presence in Project Management	Presence in Psychology
Generative Potential	“Potential to generate new ideas or projects: Continuing work on this project is likely to stimulate additional new ideas or projects”	+	(Martinsuo & Poskela, 2011) (Heising, 2012) (Martinsuo & Poskela, 2011)	Forecasting broader range of outcomes enhances creativity (Byrne et al., 2010; Shipman et al., 2010).
Long-Term Success	“Continuing work on this project is likely to result in a successful expansion of our business plan (i.e., in us being able to continue to develop additional restaurants).”	+	(Martinsuo & Poskela, 2011) (Molina-Castillo & Munuera-Alemán, 2009a) (Nijssen et al., 2012)	Long-range forecasting is positively related to creativity (Byrne et al., 2010; Shipman et al., 2010).
Adaptability	“The work we do on this project can easily be applied to other projects—either existing (i.e., advising other restaurant owners) or new (i.e., new ways to expand our business).”	+	(Martinsuo & Poskela, 2011) (Heising, 2012)	Forecasting broader range of outcomes enhances creativity (Byrne et al., 2010; Shipman et al., 2010). Divergent thinking positively contributes to idea generation (Acar & Runco, 2012; M. a. Runco & Acar, 2012)
Resource Requirements	“We can reasonably expect to already have or obtain the resources (e.g., staff, supplies, building etc.) needed to complete this project.”	-	(Martinsuo & Poskela, 2011) (Schmidt et al., 2009)	Important to consider (Peterson et al., in press), but may be too early in the idea development process at this point because constrained to readily available resources (Mumford et al., 2008)
Risk	“Continuing work on this project poses a significant risk to the company (consider our reputation, money, time, resources, etc.)”	-	(Carbonell-Fouquier et al., 2004) (Schmidt et al., 2009)	Risk aversion likely to lead to rejection of more creative ideas (Blair & Mumford, 2007; Licuanan et al., 2007)
Short-Term Performance	“Immediate Performance: The board is likely to allow this project to continue to the next phase.”	-	(Van Oorschot et al., 2010) (Schultz, Salomo, De Brentani, & Kleinschmidt, 2013) (Salomo, Talke, & Strecker, 2008) (Laurie, Doz, & Sheer, 2006) (Storey & Kelly, 2001) (Dekimpe & Hanssens, 1999)	Long-range forecasting is positively related to creativity (Byrne et al., 2010; Shipman et al., 2010).

and performance requirements vary from one stage to another, even within the

Table 2.
Evaluation Criteria for Stage 2: Preliminary Assessment

Criteria	Prompt	Expected Effect	Presence in Project Management	Presence in Psychology
Feasibility	“Considering the steps likely required to complete this project, we can reasonably expect to complete it with minimal difficulty.”	+	(S. Hart et al., 2003) (Poskela & Martinsuo, 2009) (Schmidt et al., 2009)	Feasibility perceptions positively associated with entrepreneurial intentions (Krueger, 1993) Creativity requires motivation/engagement (De Dreu et al., 2012)
Resource Requirements	“We can reasonably expect to already have or obtain the resources (e.g., staff, supplies, building, etc.) needed to complete this project.”	+	Technical/manufacturing feasibility (Poskela & Martinsuo, 2009; Schmidt et al., 2009)	Considering resource requirements positively related to creativity (Peterson et al., in press), and is appropriate at this stage because problem space has already been defined (Mumford et al., 2008).
Market Potential	“This new restaurant concept is likely to be important in satisfying the needs and/or demands of our target customers.”	+	(Cooper & Kleinschmidt, 1987) (O’Connor, 1998) (S. Hart et al., 2003)	Appropriate at this stage because problem space has already been defined (Mumford et al., 2008).
Schedule Performance ¹	“If we continue to work on this project approximately how long do you estimate it will be from now before we can begin building the restaurant?”	-	(Schultz et al., 2013) (Adams, Bessant, & Phelps, 2006) (Drazin et al., 1999)	Production criteria not considered central or useful to development of ideas (Mumford et al., 2008)
Market Acceptance	“Existing restaurants with features similar to this new restaurant concept are already well-accepted by our target customers.”	-	(S. Hart et al., 2003) (O’Connor & Rice, 2013)	Current or past acceptance of novel ideas considered not useful in developing ideas (Mumford et al., 2008)
Break-Even Point ²	“If we build this restaurant how long after opening do you expect it will be before we start to turn a profit on it?”	-	(S. Hart et al., 2003) (Koen et al., 2002)	“Application of production or financial criteria in appraising exploratory efforts will generally prove ineffective” (Mumford et al., 2008)

¹ Response options: 6 months or less; 6-12 months; 12-18 months; 18-24 months; 24 months or more

² Response options: 1 year or less; 2 years; 3 years; 4 years; 5 years or more

fuzzy front end (Cooper, 1988, 1994). In idea generation, the goal is to select ideas to be

further developed. In other words, the purpose of evaluating initial ideas is to narrow the scope of subsequent development activity. With regard to creative cognition, this is when individuals develop initial problem representations, which problem representations guide the subsequent search and interpretation of information (Mumford, Reiter-Palmon, & Redmond, 1994).

Thus it is likely that structured evaluations during idea generation will overpower the effects of evaluation structure during preliminary assessment. Structured evaluations during idea generation are likely to constrain individuals' representations of the problem. For example, in studies of design fixation, when individuals are provided with an example stimulus concept, their own original designs often share similar features with the stimulus (Jansson & Smith, 1991). Narrow problem representations thus inhibit the interpretation and integration of additional useful information gathered during the preliminary assessment stage (Mumford et al., 1994; Sethi & Iqbal, 2008). This appears to be especially true if that information is in conflict with initial problem representations (Friedrich & Mumford, 2009), presumably the kind of information that is would lead to idea improvements. These observations lead to the following hypotheses:

H3a: The effects of evaluation structure during scanning will not be dependent upon the structure of evaluation during elaboration.

H3b: The structure of evaluation instructions during the elaboration phase will only influence creative performance when either open-ended or no evaluation instructions have been provided during the earlier scanning phase.

In addition to goals, performance requirements also vary across predevelopment stages (Cooper, 1988, 1994; S. J. Hart & Craig, 1993). During the Idea Generation stage the performance concerns include the identification of promising ideas which should be explored further, not necessarily ideas which the organization can readily develop into marketable new products (Cooper, 1988, 1994; Khurana & Rosenthal, 1997). On the other hand, during the Preliminary Assessment stage performance concerns center around the likely market and technical performance of new ideas. As noted above, these different performance requirements represent project-relevant information which individuals use in forecasting the potential outcomes of product ideas. These forecasts then form the basis of idea evaluations (Mumford et al., 2002). This implies that the effects of evaluation criteria on creative performance will also vary by stage.

Consistent with the notion of different performance requirements, organizations use different evaluation standards at different product development stages (S. Hart et al., 2003; Ronkainen, 1985). However, while the use of different evaluation criteria at different stage is widely acknowledged, the effect of these criteria on individual creativity in the fuzzy front end has not been studied. As discussed above, research on creative cognition suggests which criteria, of those commonly cited in the project management literature, might enhance or inhibit creativity during the idea generation and preliminary appraisal predevelopment stages. These observations, together with the observations about evaluation structure lead to our final hypotheses.

H4a: The effects of evaluation criteria during the Idea Generation stage will not be dependent upon the content of evaluation during the Preliminary Assessment stage.

H4b: The evaluation criteria during the Preliminary Assessment stage will only influence creative performance when open-ended or no evaluation instructions have been provided during the Idea Generation stage.

Methods

Sample

To test these hypotheses, 168 English-speaking business management students were recruited from business courses at a large university in the southern United States. Participants were sent an email from their professor telling them they could earn extra credit by participating in a study of entrepreneurial problem solving. Additionally, participants were told that by participating they could be entered into a drawing to win a \$45 gift card to a local restaurant. There were 92 male and 76 female students. Participants had completed an average of 3.23 prior management classes. The mean age was 20.70. The median number of years participants had worked was 2.00. Mean overall GPA (3.22) and ACT scores (26.04) were representative of the broader student population at the university.

Typically student samples are not preferred. However, use of a student sample in this study was desirable in order to experimentally test the causal effects of evaluation on evaluator creative performance. Past research has indicated that use of a student sample is warranted under certain circumstances (Gordon, Slade, & Scmitt, 1986, 1987; Greenberg, 1987).

First, student samples may be used if managers and students do not have substantially differing levels of experience with the phenomena being studied (Kinnear & Klammer, 1987; Moon, Miller, & Kim, 2013). The experimental task employed in

this study, generating basic restaurant concepts for college towns in the USA, was selected to minimize this gap. Approximately half of the money American's spend on food is spent in the restaurant industry (NRA, 2012). Restaurant consumers known as "Millennials"—those in their late teens to early thirties—are a unique group (Debevec, Schewe, Madden, & Diamond, 2013). They make up the largest proportions of multiple restaurant consumer groups (NRA, 2012, 2013) and, compared to other consumers, they are both more knowledgeable and particular about restaurants (NPD, 2009; Strom, 2013). The amount of time they spend in restaurants, the amount of relevant information available to them, and their relatively strong opinions of the restaurant industry all suggest that Millennials, and college students, have some significant amount of expertise with at least certain aspects of restaurants. To further address a potential expertise gap, these already knowledgeable participants were provided with summaries of real restaurant market information during the experiment.

Second, if a student sample is employed the task being asked of the student participants must be within their ability to complete (Gordon et al., 1986, 1987; Greenberg, 1987). The experimental task employed in this study was selected, in part, because it could be completed by knowledgeable restaurant consumers. Specifically, participants were asked to develop concepts for new restaurants by describing the cuisine, general service approach, and atmosphere of their new restaurant. These restaurant characteristics are readily observable by consumers and, in fact, often are the subjects of consumer opinions about restaurants (NPD, 2009; Strom, 2013). Finally, the restaurant was to serve a target market with which the student participants are very familiar—college students in the U.S.

It is important to note too that constraining the experimental task to the capabilities of the student sample did not limit the realism of the task. In fact, this task was selected precisely because it is both within the realm of capability of the student sample without being substantially altered. Research has identified entrepreneurs' development of a clear restaurant concept, a concept which describes the restaurant's cuisine, service approach, and customer experience, as a critical factor in the success of new restaurants (Goldman, 1993; Parsa et al., 2005). Thus, participants were asked to complete a realistic task with which they could be expected to have sufficient expertise to complete (c.f Baker & Albaum, 1986).

General Procedures

Participants were sent an email with a link to the study materials. In this email participants were told they could participate in a study of entrepreneurial problem solving for extra course credit and for a chance to win a \$45 restaurant gift card. They were told they would play the role of a new manager in a restaurant consulting firm. Participants were told to expect to spend approximately 2 hours completing the study. On average participants spent approximately 90 minutes completing all study materials. Ninety minutes was determined to be a sufficient amount of time based on the results of pilot participants who completed study materials for the purpose of determining the time required to appropriately complete the study.

After clicking on the link in the email participants were taken to a website with a summary of the study. Participants who agreed to participate entered the study by clicking a link on this page. The study materials, all presented via Qualtrics software, were divided into two sections. In the first section, participants played the role of a new

manager in a restaurant consulting firm. Instructions were given through a series of emails from other fictional members of the firm, presented as screenshots of actual email messages. Participants were asked to assist in developing a line of business the firm had not previously offered—developing their own restaurants to open in college towns in the United States.

In the second section of the study, participants were presented with a series of covariate control measures. After completing both sections, participants were presented with a screen where they could input their name and email address to receive extra credit for their participation and to be entered in the drawing for the \$45 gift card.

Experimental Task

In the experimental task participants played the role of Pat Murphy, a manager at O’Toole Restaurant Consultants, Inc., a fictional restaurant consulting firm. All instructions and manipulations were embedded in emails sent by two other members of the organization—an administrative assistant and the Vice President of Research and Development. Email messages were presented sequentially with one email presented at a time as participants clicked through a series of screens. Participants were allowed to view each page (email) only once; they could not click “back” through the screens.

The first email, from the administrative assistant, was designed to setup the scenario by providing participants with background information about the organization, a brief description of their job, and an organizational chart explaining their relationship with other members of the organization. According to this email, the consulting firm possessed knowledge and expertise in a wide variety of restaurants and providing advice and consulting services to clients who owned their own restaurants. Participants

had recently been promoted to a project manager position in the Research and Development division of the organization. Managers in the R&D department carried out projects designed to explore new business opportunities. As manager, participants would receive project reports from their project team. Participants would report directly to the VP of R&D who, in turn, would persuade the executive board to fund the most promising projects.

The second email, from the VP of R&D, presented participants with the specific project they would be asked to work on. According to this email, the VP wanted participants to explore the possibility of the consulting firm developing its own restaurants. The idea was to determine whether the firm could develop new restaurant concepts and then partner with other firms to actually develop the restaurants. To do this, participants would be asked to develop a single prototype restaurant concept. In this email, the VP stated that the project would consist of three phases, with participants providing a brief summary to the VP after each phase. In Phase 1 the project team would provide participants with information on market and technology trends. In Phase 2 the project team would provide participants with additional information expanding on the information gathered in the first phase. In Phase 3 participants would be asked to provide a description of a single new restaurant concept. Finally, it was noted that other expansion projects were also being conducted by other managers. After each phase, the VP of R&D and other executives would decide which projects to continue and which to cancel.

The third email, from the administrative assistant, included a three-page report (approximately 1,200 words) from the first phase of the project. This report was divided

into an introduction and three content sections. The introduction described the restaurant industry and the target market for the proposed restaurant concept—college towns located in small- and mid-size metro areas throughout the United States. Citing actual industry and economic data (AIER, 2013; NRA, 2012, 2013), the restaurant industry was expected to grow as people continued to eat out more. Consumers in college towns were said to be dissatisfied with current restaurant options. The example cities listed, Oklahoma City, Richmond, and Fort Collins, were familiar to participants. The three content sections focused on information identified by previous research (Parsa et al., 2005) as characteristic of concepts used by successful, but not failed, new restaurants—information about the customer experience, the service approach, and the cuisine.

The fourth email, from the VP of R&D, contained an “attached” feedback form which all participants were asked to complete as a report of Phase 1 to the VP of R&D. Participants were asked to briefly describe up to 5 distinct restaurant concepts. Five small text boxes, with 5 lines of space, were provided for participants to describe their ideas. Prior to being asked to describe these ideas, some participants were provided with certain types of evaluation instructions. The different evaluation instructions provided are described below.

The sixth email, from the VP of R&D, indicated that the board had approved the project for continuing to the next phase. The seventh email, from the administrative assistant, included another three-page report (approximately 1,000 words). This report, divided into the same subsections as the first report, elaborated on the three content

areas by describing the features of each component that should be considered in developing a restaurant concept.

The eighth email, from the VP of R&D, asked all participants to indicate whether they wanted to keep or discard each of the restaurant ideas they provided in the fourth email. Because this study was conducted online, participant responses were automatically copied from the fourth email. Two boxes were presented next to each of these ideas and participants were asked to select one box for each idea, indicating whether they wanted to keep or discard that idea. Next, participants were asked to describe up to 5 additional distinct restaurant concepts. As in email four, prior to being asked to generate these ideas some participants were provided with certain types of evaluation instructions.

The ninth email, from the VP of R&D, indicated that the board had approved the project for continuing to the final phase. Only a few of the organization's expansion projects had been approved for this stage and only one of these would be selected for implementation. Accordingly, participants were asked by the VP of R&D to produce a product concept for a single new restaurant. An "attached" form was provided to help participants structure their product concept. On this form participants were asked to type the name of their restaurant. Four large text boxes were provided where participants were asked to give a (1) brief summary description of their restaurant, and a detailed description of the (2) customer experience, (3) service approach, and (4) cuisine.

Having completed their product concepts, the next screen indicated that participants had completed the first section of the study and could take a brief break if

needed. Section 2 of the study contained a series of covariate measures. These measures are described later.

Manipulations

Project Stage. All information contained in the project reports was derived from the 2012 Restaurant Industry Forecast published by the National Restaurant Association (NRA, 2012, 2013). These annual reports provide accessible information about expected industry and consumer trends in the coming year and are widely used by professionals in the restaurant industry. Project stage was manipulated both by the sequential nature of the study and by the type of information provided in each project report.

The Stage 1 report contained background information about the restaurant industry—the type of information likely to be useful for individuals developing initial representations of the problem scenario (Mumford et al., 1994) and generating ideas for solving the problem (Cooper, 1988). Basic economic information was provided about the proposed target markets—small- and mid-sized college towns in the United States. To enhance participant engagement in the task, this information presented an achievable but challenging scenario (De Dreu et al., 2012). For example, participants were told that the restaurant industry was expected to grow but that consumers were becoming somewhat dissatisfied with current options. The rest of the information in this report was explicitly organized into what were described as three critical restaurant components—the customer experience, the service approach, and the food (Parsa et al., 2005). For example, information was provided about customer restaurant preferences (e.g., value, convenience, nutrition), various service approaches (e.g., fine dining, casual

dining, fast-casual, etc.), and cuisine trends (e.g., locally sourced food, sustainable food).

The Stage 2 report contained additional market data and information bearing on the features of the customer experience, service approach, and cuisine that would need to be considered in developing a restaurant concept. For example, this report noted the importance of attracting repeat customers. The report also provided descriptions of specific features pertaining to customer experience (e.g., lighting, noise), service approaches (e.g., typical price points, challenges, advantages of fast-casual, quick-service, etc.), and cuisine (e.g., type of food, variety, availability). Thus, the information provided during the Preliminary Assessment stage reflected the market and technical assessments characteristic of this developmental stage (Cooper, 1988). This also follows recommendations for the type of information that should be considered for developing viable restaurant concepts when a location (i.e., college towns) has already been selected (Goldman, 1993).

Evaluation Structure and Criteria. The structure and content of evaluations were manipulated via the evaluation instructions provided to participants. Following each of the progress reports (emails 3 and 7), participants received an email from the VP of R&D (emails 4 and 8). This email asked participants to evaluate the project they had just read. Some participants were given open-ended evaluation instructions (“a paragraph or two about why we should or should not continue the project”). Other participants were given either creativity-enhancing or creativity-inhibiting evaluation criteria (see Tables 1 and 2). With regard to the evaluation standards, whether the new project (developing a new restaurant concept) was actually adaptable, risky, feasible,

etc. was not the focus of this study. Rather, what was of concern was the influence of asking participants to focus their attention on certain evaluation criteria.

Dependent Variables

In accordance with prior work, individual creative performance as measured vis-à-vis the creativity of the restaurant concepts produced by participants (Burroughs, Dahl, Moreau, Chattopadhyay, & Gorn, 2011; Redmond, Mumford, & Teach, 1993). The final email participants received in this study asked them to provide a description of their new restaurant concepts. They were asked to provide a summary description of the restaurant as well as a paragraph or two each detailing the customer experience, service approach, and cuisine of their restaurants. To assess the creativity of these restaurant concepts, 3 judges, all research assistants working in an Industrial/Organizational Psychology lab, assessed the quality, originality, and elegance (Besemer & O'Quin, 1999b; Christiaans, 2002). Concept quality was defined as complete, coherent, and functionally sound concepts containing information about all three critical restaurant components (Parsa et al., 2005). Original concepts were or contained features that were new, surprising, or unexpected. Concepts were considered elegant if the three restaurant components were well-integrated, orderly, and harmonious.

To facilitate judges' ratings of concept quality, originality, and elegance 5-point benchmark rating scales were constructed (Redmond et al., 1993). First, judges were presented with operational definitions of concept quality, originality, and elegance. Judges then rated a sample of 20 concepts. Concepts which had high, medium, or low scores and high interrater agreement scores were selected as anchors for scale points 5, 3, and 1, respectively. The benchmarks used are present in Figure 1. Judges then applied

these benchmark rating scales to assess the quality, originality, and elegance of the restaurant concepts produced by participants. Prior to making their individual judgments, however, raters spent approximately 40 hours completing practice ratings, discussing discrepant judgments, completing more practice ratings, and so forth.

To assess the interrater agreement of judges' ratings r^*wg was calculated (Lindell, Brandt, & Whitney, 1999; Lindell & Brandt, 1999). Interrater agreement was found to be high for judges' ratings of concept quality (.86), originality (.80), and elegance (.81). Moreover, the pattern of correlations among these dependent variables fit the expected pattern found in prior research (Hester et al., 2012; Mumford, Hester, Robledo, et al., 2012).

Covariate Measures

After completing the first half of the study, participants were asked to complete a number of covariate measures. These measures were intended to control for the effects of divergent thinking, conceptual combination skill, domain experience, intelligence, and personality characteristics which have been found to influence creative performance. To measure divergent thinking, participants were asked to complete the Alternative Uses Test of divergent thinking (Merrifield, Guilford, Christensen, & Frick, 1962). Participants were presented with 9 common object words (e.g., potato, brick, shoe) in sets of 3. They were given 12 minutes (4 minutes per set of 3 words) to write as many possible alternative uses they could think of for each word. Divergent thinking scores were generated for each participant by calculating the average number of alternate uses provided across all 9 words.

Quality	Originality	Elegance
<p>5) High Quality: The atmosphere will be very serene. There will be a green theme throughout the restaurant. The restaurant will have a very earthy, yet clean feel to it. Customers have the option to sit at bar like tables or in booths. Customers will have the opportunity to send their orders directly to the kitchen with the use of touch screens on the tables of the booths (this saves time from having to hire too many servers and order-takers). The kitchen will be located in the back and will be closed off as to reduce the amount of noise in order to keep a calm environment. It will be a mix of fast-casual and quick service. Customers are able to sit in and dine if they wish, but those on the go, who are busy and also want to eat healthy, will be able to order through a few touch screens outside the restaurant and have their orders delivered to their vehicles. Prices will range from \$5 to \$10. Organic 2 Go will offer a variety of healthy options. Sandwiches, burgers, soups, small pizzas, salads, fruit smoothies, juices. There will also be combination options for a certain price that could be a special. There will also be breakfast options during the morning hours that can include breakfast versions of the items mentioned above along with biscuits and breakfast burritos.</p>	<p>5) High Originality: It is casual, trendy. There is a garden in the back for people to eat near, employees can be seen picking vegetables from the garden. All utensils and plates are bio-degradable. Patio umbrellas have solar panels on top of them, the building is composed of a glass-like substance for natural lighting. At night, compact fluorescent bulbs will be used for lighting. Electric car charging stations will be placed out front. Customers will seat themselves in the garden, then proceed to order and checkout through iPads powered by solar panels. The only person to make contact with them will be the person to bring them their food. Vegetarian/vegan meals will be served, and coffee/tea will be one of the main draws. The menu will consist mostly of salads and wraps that only have one big piece of lettuce. The menu will also contain a paragraph about how natural their water is.</p>	<p>5) High Elegance: UppitEase is a restaurant where you can count on the staff being there for anything you need. You can enjoy a great meal in a laid-back environment. We encourage you to be yourself at UppitEase and let us take care of you. The service at UppitEase will focus on friendliness, promptness and politeness. We will cater to the customer. There will always be a manager within sight. If there is ever an issue we will take care of it immediately. We want the customer to feel special when they are in our restaurant. Everything is made fresh daily. The vegetables are brought in fresh and the French fries are cut daily. The burgers will come from local cattle and the hamburger buns are baked in-house. For the health conscious we will have turkey burgers or a vegetarian menu that will offer low-fat alternatives. There will be no canned foods in the restaurant. If it is on the menu it is going to be fresh.</p>

Figure 1. Selected Anchors for Quality, Originality, and Elegance Benchmarks

Quality	Originality	Elegance
<p>3) Med Quality: Sooner will be a restaurant and bar. The customer will be welcomed when coming in the door but is free to sit anywhere they like. The customers can watch television while eating and enjoy the sporty atmosphere. There will also be a bar people can sit at and enjoy drinks and a full menu. The customers will have waiter come to them to order their drinks and food and the wait staff will get them anything they may need or want. The food will consist of a typical 'American' food menu with burgers sandwiches, but will also include chips and salsa, queso, fried pickles, nachos, and various side items.</p>	<p>3) Med Originality: The customer experience will be a blend of local traditions in style, design, and custom while adding a hip trend to the restaurant as a whole. The idea will be to attract younger clientele while maintaining the "values" of more traditional casual options. The service approach will be to interact with customers and employees in a nonchalant, relaxed demeanor. The restaurant should give employees and customers both the sense that they can rest within the traditions they grew up with. The cuisine will feature local delicacies and dishes with a upbeat twist. Customers should be able to recognize most of the dishes on the menu if they are from the area but the taste will be revamped so as to keep up with younger customer bases. This will also appeal to those from beyond the local area.</p>	<p>3) Med Elegance: This new restaurant is bringing the campus to the community with a different philanthropic topic each month to highlight. With a portion of all sales going toward a different organization on campus' philanthropy. The customer experience will be a combination of optimistic and hunkered down because it will be in a college campus town. Service approach: fast-casual so there are opportunities to take-and-go, yet still give back, and opportunity to sit-down and catch-up with friends and/or family. High flexibility and variety providing all meal-types of food, such as waffles and french toast (breakfast), soups and sandwiches (lunch), and grilled chicken and spaghetti (dinner); and drinks such as limited alcoholic drinks, coffee, pops.</p>
<p>1) Low Quality: Dare to eat out and enjoy eating healthy every day. Whole grain meals are our everyday deals. Maximum customer satisfaction. The happiness of our customers is a matter of great importance. Service will be speedy, friendly, and accurate. This one will serve fresh, healthy subs and soups.</p>	<p>1) Low Originality: The customer will indulge in a sports bar atmosphere. Upon walking in the customer will be greeted by an outgoing staff. They will come for the food and drinks and stay for the amazing time they are having. Customers will sit at a table where they will be served. The waiter will present the customers with the days beer special. Food will be prepared upon request and made fresh. Mack's will be known for its amazing burgers and also the wings. There will be a large amount of different wing flavors, and burgers cook to customer specifications. We will also serve dinner salads, hot dogs, chicken fingers, and brats.</p>	<p>1) Low Elegance: This restaurant will be a hybrid from semi fast food all the way up to casual dining. We will appeal to many age groups and socioeconomic statuses. The atmosphere will be all booths, no tables with minimal lighting. We will put a major emphasis on exceptional service. We will put an emphasis on our staff knowing our regulars and building relationships with them. Our service is extremely important. It will be prompt and accurate. We will make sure our staff is friendly and professional. We will have all types of cuisine, from sandwiches to complicated dishes. This way, we appeal to many people.</p>

Figure 1 Cont.

Conceptual combination skill was measured using the procedures described by (Mobley, Doares, & Mumford, 1992). Accordingly, participants were first provided with 3 lists of 4 words representing separate categories—chair, couch, lamp, pictures; tire, eat, wheel, brakes; and Mars, Jupiter, Earth, Venus. Participants were asked to generate a category label for each of these three lists (e.g., household items, automobile parts, planets). Finally, participants were asked to also generate a category label for all 12 words and a one sentence description of this category. Two judges, both research assistants in an industrial/organizational psychology research laboratory, scored the quality of these category labels on a 5-point scale, where quality was concerned with whether the each label captured all underlying words. Average interrater agreement (Lindell et al., 1999; Lindell & Brandt, 1999) for these ratings was found to be adequate (.77). Moreover, the pattern of correlations between conceptual combination scores and intelligence (.23) and concept quality (.23), originality (.19), and elegance (.18) support the construct validity of this measure.

A variation of Scott, Lonergan, and Mumford's (2005) life history questions were used to measure the restaurant domain experience of participants. Specifically, six questions asked participants about their exposure to and interest in the restaurant domain. Sample questions include “How often do you think about how you could make restaurants better?” and “How often do you discuss restaurants with your friends?” Responses are provided on a 5-point Likert scale and scores are calculated as the mean of all 6 questions. Cronbach’s alpha (.77) indicated adequate justification for aggregating the individual items.

To measure intelligence participants were asked to complete the Wonderlic Personnel Test (Wonderlic & Associates, 1992). This 50-item measure of intelligence has produced test-retest reliabilities from .82-.94, split-half reliabilities above .80, and adequate construct and predictive validity (Bell, Matthews, Lassiter, & Leverett, 2002; Frisch & Jessop, n.d.; Hawkins, Faraone, Pepple, Seidman, & Tsuang, 1990; Wonderlic & Associates, 1992).

Personality was measured using John, Donahue, and Kentle's (1991) Big Five Inventory (John, Naumann, & Soto, 2008). This test asks participants to indicate, on a 5-point Likert scale, the extent to which each of 44 statements describe them. Sample items include "I am someone who is reserved" and "I am someone who does a thorough job." The Cronbach's alpha coefficients for the five subscales measured by this test, extraversion (.88), agreeableness (.74), conscientiousness (.82), neuroticism (.79), and openness (.78), demonstrated adequate reliability.

Results

Correlations

Means, standard deviations, and correlations of all main study variables are presented in Table 3. The pattern of correlations provides some evidence for the construct validity of the measures used in this study. For example, as would be expected, restaurant concept quality was positively related to domain experience (.23), conceptual combination skill (.23), and divergent thinking (.20). Concept originality was positively related conceptual combination skill (.19) and domain experience (.17). Concept elegance was positively related to conceptual combination skill (.18),

intelligence (.12), and conscientiousness (.11). Finally, intelligence was positively related to divergent thinking (.19) and conceptual combination skill (.23).

Evaluation Structure

Our first hypothesis held that providing participants with only open-ended evaluation instructions would lead to new product concepts of higher quality, originality, and elegance compared to providing them with only structured or no evaluation instructions. To test this hypothesis, participant responses were coded as receiving only specified evaluation instructions, only open-Ended evaluation instructions, a combination of specified and open-ended instructions, or no evaluation instructions. A series of ANCOVAs were conducted to test the effect of evaluation instructions on the quality, originality, and elegance of participants' restaurant concepts. Tukey-Kramer adjustments were made to predicted means to control for family-wise error rate in post-hoc comparisons. Covariates were retained at the .10 level. The results obtained provide some support for this hypothesis.

Quality. A significant effect was found for three covariates on concept quality. Conceptual combination skill, $F(1,161) = 8.49, p < .01$, partial $\eta^2 = .052$, was positively related to concept quality ($r = .23$). Divergent thinking, $F(1,161) = 3.93, p < .05$, partial $\eta^2 = .025$, was positively related to concept quality ($r = .20$). And domain experience, $F(1,161) = 7.01, p < .01$, partial $\eta^2 = .044$, was also positively related to concept quality ($r = .23$). Accounting for these control measures, the structure of participants' evaluations produced a significant effect on concept quality, $F(3,161) = 3.23, p < .05$, partial $\eta^2 = .059$. Post-hoc comparisons indicated that this effect was driven by the lower quality of concepts generated by those receiving specified ($M = 3.50$, 95% CI

[3.30, 3.71]) compared to open-ended ($M = 4.10$, 95% CI [3.75, 4.45]) evaluation instructions.

Originality. A significant effect was found for one covariate on concept originality. Conceptual combination skill, $F(1,160) = 5.73$, $p < .05$, partial $\eta^2 = .035$, was positively related to concept originality ($r = .19$). Accounting for this effect the structure of participants' evaluations had a significant impact on concept originality, $F(3,160) = 5.16$, $p < .01$, partial $\eta^2 = .088$. Post-hoc comparisons indicated that this effect was driven by the lower originality of concepts generated by those receiving specified ($M = 2.30$, 95% CI [2.37, 2.83]) compared to open-ended ($M = 3.45$, 95% CI [3.06, 3.84]) evaluation instructions.

Elegance. A significant effect was found for one covariate on concept elegance. Conceptual combination skill, $F(1,160) = 5.44$, $p < .05$, partial $\eta^2 = .033$, was positively related to restaurant concept elegance ($r = .18$). Controlling for this effect, the structure of participants' evaluations produced a sizeable, significant effect on the elegance of their restaurant concepts, $F(3,160) = 7.56$, $p < .001$, partial $\eta^2 = .124$. A significant effect was found for the type of evaluation instructions on Elegance. Post-hoc comparisons indicated that this effect was driven by the lower elegance of concepts generated by those receiving specified ($M = 3.29$, 95% CI [3.10, 3.48]) compared to open-ended ($M = 4.07$, 95% CI [3.75, 4.38]) or no ($M = 4.12$, 95% CI [3.58, 4.66]) evaluation instructions.

Thus asking participants to evaluate project information in a structured format substantially inhibits their creative performance. Asking people to complete open-ended evaluations resulted in product concepts of higher quality, originality, and elegance.

And imposing structure on the evaluations even led to less elegant concepts than not asking individuals to evaluate project information at all.

Evaluation Criteria

Our second hypothesis held that providing participants with only evaluation criteria considered inappropriate would negatively influence the quality, originality, and elegance of individuals' new product concepts, compared to providing only appropriate criteria, no criteria, a combination of criteria, or no evaluation instructions. The appropriateness of the criteria was determined according to relevant findings from the psychology. To test Hypothesis 2 participant responses were dummy-coded for the content of the evaluation instructions. Participants received instructions with (1) stage-appropriate evaluation standards, (2) stage-inappropriate evaluation standards, (3) no standards, (4) a combination of appropriate, inappropriate, or open-ended instructions, or (5) no evaluation instructions at all. A series of ANCOVAs were conducted to test the effects of the different evaluation criteria on the quality, originality, and elegance of participants' new product concepts. Tukey-Kramer adjustments were made to predicted means to control for family-wise error rate in post-hoc comparisons. Covariates were retained at the .10 level.

Quality. A significant effect was found for two covariates on the quality of product concepts. Both conceptual combination skill, $F(1,158) = 8.12, p < .01$, partial $\eta^2 = .049$, and domain experience, $F(1,158) = 9.30, p < .01$, partial $\eta^2 = .056$, were positively related to the quality of product concepts. Controlling for these effects, the criteria participants used to evaluate project information had a significant effect on product concept quality, $F(4,158) = 4.74, p < .01$, partial $\eta^2 = .107$. Post-hoc

comparisons indicated that this effect was driven by the lower quality of concepts generated by those receiving only stage-inappropriate ($M = 3.19$, 95% CI [2.87, 3.51]) compared to only open-ended ($M = 4.16$, 95% CI [3.82, 4.49]) or mixed ($M = 3.77$, 95% CI [3.55, 3.99]) evaluation criteria.

Originality. A significant effect was also found for two covariates on product concept originality. Again, both conceptual combination skill, $F(1,158) = 5.47$, $p < .05$, partial $\eta^2 = .034$, and domain experience, $F(1,158) = 4.69$, $p < .05$, partial $\eta^2 = .029$, were positively related to the originality of product concepts. Accounting for these effects, the evaluation criteria used by participants produced a significant effect on restaurant concept originality, $F(4,158) = 4.51$, $p < .01$, partial $\eta^2 = .103$. Post-hoc comparisons indicated that this effect was driven by the lower originality of concepts generated by those receiving only stage-inappropriate ($M = 2.32$, 95% CI [1.96, 2.69]) compared to only open-ended ($M = 3.41$, 95% CI [3.03, 3.80]) evaluation criteria.

Elegance. A significant effect was found for conceptual combination skill on the elegance of product concepts, $F(1,159) = 5.64$, $p < .05$, partial $\eta^2 = .034$. Moreover, conceptual combination skill was positively related ($r = .18$) to concept elegance. Taking this effect into account, the evaluation criteria provided to participants significantly influenced the elegance of their new product concepts, $F(4,159) = 5.80$, $p < .001$, partial $\eta^2 = .127$. Post-hoc comparisons indicated that this effect was driven by the lower elegance of concepts generated by those receiving only stage-inappropriate ($M = 3.23$, 95% CI [2.93, 3.53]) or only stage-appropriate ($M = 3.23$, 95% CI [2.90, 3.56]) compared to only open-ended ($M = 4.07$, 95% CI [3.75, 4.38]) evaluation criteria or no evaluation instructions at all ($M = 4.12$, 95% CI [3.59, 4.66]). Additionally,

participants receiving open-ended evaluation criteria produced significantly more elegant solutions than those receiving mixed evaluation criteria ($M = 3.53$, 95% CI [3.33, 3.74]).

Thus the criteria people use to evaluate new product information influences their creative performance when generating new product concepts. The quality, originality, and elegance of new product concepts were inhibited when people were given evaluation criteria held to be incongruent with the performance objectives of predevelopment stages.

Timing and Evaluation Structure

Hypothesis 3a held that the effects of evaluation structure in the Idea Generation stage on product concept quality, originality, and elegance would not be dependent upon evaluation structure during the Preliminary Assessment stage. Similarly, Hypothesis 3b held that evaluation structure during the Preliminary Assessment stage would only influence the quality, originality, and elegance of product concepts when either open-ended or no evaluation instructions were given during the Idea Generation stage.

To test these hypotheses, two dummy coded variables were constructed to reflect the type of evaluation instructions provided at the Idea Generation (Stage 1) and Preliminary Assessment (Stage 2) stages. At each stage participants received either specified, open-ended, or no evaluation instructions. A series of 3x3 ANCOVAs were conducted to examine how the effects of evaluation structure differed depending on the timing of evaluation. To further examine the combined effects of evaluation structure at

each stage, simple effects analyses were conducted by testing the effects of Stage 1 evaluation structure within the levels of Stage 2 structure, and vice versa.

According to the recommendations of Tybout, Sternthal, and Keppel (2001), simple effects were conducted in the presence of a significant interaction term. When the interaction was not significant, but the main effect for Stage 1 evaluations was significant, simple effects were tested for Stage 2 evaluations, and vice versa. For example, if a main effect for Stage 1 evaluations was found, the effects of Time 2 instructions on Originality were examined for within levels of Time 1 instructions. When the interaction was not significant and neither main effect was significant simple effects were tested for both Stage 1 within Stage 2 and Stage 2 within Stage 1. This simple effects analysis allows for the examination of the influence of particular combinations of evaluation instructions on product concept creativity. As before, Tukey-Kramer adjustments were made to predicted means to control for family-wise error rate in post-hoc comparisons. Covariates were retained at the .10 level.

Quality. Two covariate measures produced a significant effect on the quality of product concepts. Both conceptual combination skill $F(1,150) = 7.24, p < .01$, partial $\eta^2 = .046$, and divergent thinking, $F(1,150) = 4.26, p < .05$, partial $\eta^2 = .028$, were positively related to concept quality. Controlling for these effects, a significant main effect was found for Stage 1 evaluation structure, $F(2,150) = 3.44, p < .05$, partial $\eta^2 = .044$. Post-hoc comparisons indicated that this effect was driven by the lower quality of concepts generated by those receiving specified ($M = 3.55$, 95% CI [3.31, 3.78]) compared to open-ended ($M = 4.11$, 95% CI [3.75, 4.46]) Stage 1 evaluation instructions. The main effect for Stage 2 evaluation structure was not significant,

$F(2,150) = 2.34, p < .099, \text{partial } \eta^2 = .030$. Simple effects analyses revealed no significant effects for Stage 2 structure on concept quality within levels of Stage 1 evaluation structure. The interaction between Stage 1 and Stage 2 evaluation structure was also not significant, $F(4,150) = .86, p = .491, \text{partial } \eta^2 = .022$.

Originality. A significant effect was found for two covariates on the originality of new product concepts. Conceptual combination skill, $F(1,165) = 5.33, p < .05, \text{partial } \eta^2 = .034$, and domain experience, $F(1,165) = 4.78, p < .05, \text{partial } \eta^2 = .030$, were both positively related to concept originality. Controlling for these effects, a significant main effect was found for Stage 1 evaluation structure, $F(2,165) = 8.89, p < .001, \text{partial } \eta^2 = .104$. Post-hoc comparisons indicated that this effect was driven by the lower originality of concepts generated by those receiving specified ($M = 2.55, 95\% \text{ CI } [2.30, 2.81]$) compared to open-ended ($M = 3.49, 95\% \text{ CI } [3.12, 3.86]$) evaluation instructions at Time 1. Stage 2 evaluation structure did not product a significant effect on concept originality, $F(2,165) = 1.29, p = .279, \text{partial } \eta^2 = .017$.

A significant effect was found for the interaction between Stage 1 and Stage 2 evaluation structure on the originality of product concepts, $F(4,165) = 2.54, p < .005, \text{partial } \eta^2 = .062$. Simple effects analyses were conducted to better understand the significant interaction found between Stage 1 and Stage 2 evaluation structure on product concept originality. First, simple effects analyses indicated no significant effects for Stage 2 evaluation structure within Stage 1 evaluation structure. However, a significant effect was found for Stage 1 evaluation structure when no Stage 2 evaluation instructions were given, $F(2,165) = 9.54, p < .001, \text{partial } \eta^2 = .110$. Comparison of the adjusted means indicated that this effect was driven by the less original concepts

generated when participants were given specified ($M = 2.17$, 95% CI [1.64, 2.71]) as opposed to open-ended ($M = 4.10$, 95% CI [3.37, 4.82]) Stage 1 evaluation instructions and no Stage 2 evaluation instructions.

Elegance. A significant effect was found for conceptual combination skill on the elegance of new product concepts, $F(1,165) = 4.57$, $p < .05$, partial $\eta^2 = .029$. Taking this effect into account, a significant main effect was found for Stage 1 evaluation structure on concept elegance, $F(2,165) = 7.26$, $p < .01$, partial $\eta^2 = .086$. Post-hoc comparisons indicated that this effect was driven by the lower elegance of concepts generated by those receiving specified ($M = 3.32$, 95% CI [3.11, 3.53]) compared to open-ended ($M = 4.00$, 95% CI [3.69, 4.30]) Stage 1 evaluation instructions. A significant main effect was also found for Stage 2 evaluation structure on restaurant concept elegance, $F(2,165) = 3.99$, $p < .05$, partial $\eta^2 = .049$. Post-hoc comparisons suggested that this effect was driven by the lower elegance of concepts generated when participants were provided with specified ($M = 3.42$, 95% CI [3.23, 3.61]) as opposed to open-ended ($M = 3.83$, 95% CI [3.55, 4.12]) Stage 2 evaluation structure.

A significant effect was also found for the interaction of Stage 1 and Stage 2 evaluation structure on the elegance of product concepts, $F(4,165) = 2.83$, $p < .05$, partial $\eta^2 = .068$. Simple effects analysis of this interaction indicated that Stage 2 evaluation structure significantly influenced concept elegance only when no Stage 1 evaluation instructions were provided, $F(2,165) = 5.30$, $p < .01$, partial $\eta^2 = .064$. Adjusted means indicated that this effect was driven by less elegant concepts being generated by those provided with specified ($M = 3.18$, 95% CI [2.79, 3.56]) compared

to no ($M = 4.12$, 95% CI [3.58, 4.66]) Stage 2 evaluation instructions and no Stage 1 instructions.

On the other hand, Stage 1 evaluation structure had a significant impact on concept elegance only when no Stage 2 instructions were given, $F(2,165) = 6.89$, $p < .01$, partial $\eta^2 = .082$. Adjusted means indicated that this effect was driven by the less elegant concepts generated when participants were given specified ($M = 3.06$, 95% CI [2.62, 3.51]) as opposed to either open-ended ($M = 4.26$, 95% CI [3.65, 4.86]) or no ($M = 4.12$, 95% CI [3.58, 4.67]) Stage 1 evaluation instructions and no Stage 2 evaluation instructions.

Timing and Evaluation Criteria

Hypothesis 4a held that the effects of Stage 1 evaluation criteria on the quality, originality, and elegance of product concepts would not be dependent on the evaluation criteria provided in Stage 2. Similarly, Hypothesis 4b held that Stage 2 evaluation criteria would only influence product concept quality, originality, and elegance when either open-ended or no Stage 1 evaluation instructions were provided. To test these hypotheses, two dummy coded variables were constructed to reflect the evaluation criteria provided at Stage 1 and Stage 2. At each stage participants received (1) only stage-appropriate evaluation criteria, (2) only stage-inappropriate evaluation criteria, (3) only open-ended evaluation instructions, or (4) no evaluation instructions at all.

A series of 4x4 ANCOVAs were conducted to examine how the effects of evaluation criteria given differed depending on the stage when the criteria were provided. To further examine the combined effects of evaluation criteria at each stage, simple effects analyses were conducted by testing the effects of Stage 1 criteria within

the levels of Stage 2 evaluation instructions, and vice versa. As before, simple effects were only tested according to the recommendations of Tybout et al., (2001). These simple effects analyses allowed for the examination of the influence of particular combinations of evaluation criteria on product concept creativity. As before, Tukey-Kramer adjustments were made to predicted means to control for family-wise error rate in post-hoc comparisons. Covariates were retained at the .10 level.

Quality. A significant effect was found for two covariates on the quality of new product concepts. Both conceptual combination skill, $F(1,147) = 7.15, p < .01$, partial $\eta^2 = .045$, and domain experience, $F(1,147) = 8.74, p < .01$, partial $\eta^2 = .056$, were positively related to concept quality. Controlling for these effects, a significant main effect was found for Stage 1 evaluation criteria on the quality of product concepts, $F(3,147) = 4.63, p < .01$, partial $\eta^2 = .086$. Post-hoc comparisons indicated that this effect was driven by the lower quality of concepts generated by those receiving inappropriate evaluation criteria ($M = 3.33, 95\% \text{ CI } [3.06, 3.60]$) compared to open-ended ($M = 4.06, 95\% \text{ CI } [3.76, 4.35]$) Stage 1 evaluation criteria.

No significant effect was found for either the main effect of Stage 2 evaluation criteria, $F(3,147) = 1.44, p = .235$, partial $\eta^2 = .029$, or the interaction between Stage 1 and Stage 2 evaluation criteria, $F(9,147) = .92, p = .512$, partial $\eta^2 = .053$, on product concept quality. Simple effects analyses produced no significant effects for Stage 2 evaluation criteria on concept quality within levels of Stage 1 evaluation instructions.

Originality. A significant effect was found for conceptual combination skill on the originality of new product concepts, $F(1,148) = 4.55, p < .05$, partial $\eta^2 = .030$. Controlling for this effect, a significant main effect was found for Stage 1 evaluation

criteria on concept originality, $F(3,148) = 6.10, p < .001$, partial $\eta^2 = .110$. Post-hoc comparisons indicated that this effect was driven by the lower originality of concepts generated by those receiving inappropriate ($M = 2.43$, 95% CI [2.12, 2.74]) compared to open-ended ($M = 3.40$, 95% CI [3.05, 3.74]) Stage 1 evaluation criteria.

No significant effect was found for either the main effect of Stage 2 evaluation criteria, $F(3,148) = .49, p = .687$, partial $\eta^2 = .010$, or the interaction between Stage 1 and Stage 2 evaluation criteria, $F(9,148) = 1.33, p = .226$, partial $\eta^2 = .075$, on product concept originality. Simple effects analyses produced no significant effects for Stage 2 evaluation criteria on concept originality within levels of Stage 1 evaluation instructions.

Elegance. A significant effect was found for conceptual combination skill on the elegance of new product concepts, $F(1,148) = 4.26, p < .05$, partial $\eta^2 = .028$.

Accounting for this effect, a significant main effect was found for Stage 1 evaluation criteria on the elegance of new product concepts, $F(3,148) = 3.70, p < .05$, partial $\eta^2 = .070$. Post-hoc comparisons indicated that this effect was driven by the lower elegance of concepts generated when participants were given inappropriate ($M = 3.30$, 95% CI [3.04, 3.56]) as opposed to open-ended ($M = 3.91$, 95% CI [3.63, 4.19]) Stage 1 evaluation criteria.

No significant effect was found for either the main effect of Stage 2 evaluation criteria, $F(3,148) = 1.46, p = .228$, partial $\eta^2 = .029$, or the interaction between Stage 1 and Stage 2 evaluation criteria, $F(9,148) = 1.25, p = .271$, partial $\eta^2 = .071$, on product concept originality. However, simple effects analyses revealed a significant effect for Stage 2 evaluation criteria when no Stage 1 evaluation instructions were given, $F(3,148)$

= 3.42, $p < .05$, partial $\eta^2 = .065$. Adjusted means indicated that this effect was driven by less elegant concepts being generated by those provided with inappropriate Stage 2 evaluation criteria ($M = 3.23$, $SE = .266$) compared to no Stage 2 evaluation instructions at all ($M = 4.12$, $SE = .280$), $t(88) = 2.305$, $p = .024$, and no Stage 1 evaluation instructions.

Conclusions

Before turning to broader conclusions it is important to discuss a few limitations inherent in the present study. To begin, this study used an undergraduate participant sample. The use of a student sample was preferred in order to experimentally examine the causal effects of evaluation on individual creativity. When student samples are employed, however, it is important to address questions of generalization (Gordon et al., 1986, 1987; Greenberg, 1987). Generalization in this case refers to the creative performance of individuals. Thus the central concerns are whether the student sample can be expected to differ substantially from non-student samples with regard to domain expertise, whether the student sample employed was capable of completing the experimental task, and whether the task was realistic. These questions were each addressed in the present study. Given students' extensive exposure to restaurants in American college towns, and their unique critical, and information-driven consumer behavior, it can reasonably be expected that they would be capable of producing meaningful restaurant concepts. And the concepts students were asked to produce were limited to restaurant features they are likely to be very familiar with—customer experience, service approach, and cuisine. And these are precisely the features of restaurant concepts which are critical to the success of actual restaurants (Parsa et al.,

2005). Moreover, real summary market data, the same market data used by professionals in the restaurant industry, was provided to participants for designing their product concepts.

Another primary limitation of this study derives from the subset of evaluation criteria provided to participants. Many different evaluation criteria have been identified in the project management literature (Carbonell et al., 2004; Carbonell-Foulquié et al., 2004; S. Hart et al., 2003; Martinsuo & Poskela, 2011). The efforts of many researchers have resulted in an emerging coherent structure. Specifically, it appears that most evaluation criteria can be classified as either strategic, technical, market-based, financial, or production-based (Griffin & Page, 1996; S. Hart et al., 2003; Martinsuo & Poskela, 2011; Ronkainen, 1985; Schmidt et al., 2009). However, these criteria have almost exclusively been studied with regard to their effects on product performance. Much less is known about the effects of various evaluation criteria (and structure) on the performance of individuals developing new products. This study provides compelling evidence that supports the need for future research to examine the effects of evaluation and other development processes on human performance throughout product development stages.

A final limitation that should be noted here is that this study only examined the development of initial product concepts over a relatively short period of time. However new product ideas can be developed over much longer periods of time—weeks, months, years (Carson, Wu, & Moore, 2012; Molina-Castillo & Munuera-Alemán, 2009b; O'Connor & Rice, 2013). Similarly, this study only examined the ideation of individuals. New product ideas being developed over long periods of time are likely to

be influenced at least by the implicit interaction between individuals, if not explicit cooperation of new product development teams. While this study does not directly provide information bearing on the long term development of ideas within product development teams, the findings are still relevant given the importance of individual creativity to product performance (Bharadwaj & Menon, 2000; Brown & Eisenhardt, 1995).

Even bearing these limitations in mind, we believe this study makes a number of valuable contributions to the project management literature. For years researchers have pointed out the need to better understand the critical processes influencing performance in the fuzzy front end of project development (Cooper, 1988; Evanschitzky et al., 2012; Kim & Wilemon, 2002; Reinertsen, 1985). That call has been answered by a number of researchers and much progress has been made over the last 25 years (Evanschitzky et al., 2012; Khurana & Rosenthal, 1997; Kim & Wilemon, 2002; Reid & de Brentani, 2004). More recently, there have been additional calls to integrate theory from other disciplines and new methods into the project management literature (Evanschitzky et al., 2012; Guo, 2008). With regard to the fuzzy front end, some have argued that a critical factor, one which has received relatively less attention in the project management literature, underlying predevelopment activity is the creativity of the people developing new products (Amabile, 1988; Day, 1994; J. Hauser et al., 2006; Im et al., 2013; Poskela & Martinsuo, 2009).

The results of this experimental study provide compelling evidence for the influence of evaluation structure and criteria on the creative performance of individuals working in the front end of new product development. Consistent with our first and

second hypotheses, we found that both the structure and content of project evaluations in predevelopment stages significantly influenced the creative performance of individuals being asked to develop new product concepts. Specifically, we found that providing individuals with structured evaluation instructions, by asking them to rate project information according to specific criteria, lead to significantly less creative product concepts compared to when individuals were asked to provide an open-ended assessment of project performance. This finding helps explain the mechanisms by which overly tight predevelopment processes may inhibit the performance of new product projects (Koen et al., 2002; Nijssen et al., 2012; Nobelius & Trygg, 2002; Sethi & Iqbal, 2008; Zippel-Schultz & Schultz, 2011). Future research should examine the indirect effects of evaluation and other processes on product performance through the creative performance of people developing the new products. Similarly, the impact of development processes on team creativity is another potentially fruitful avenue for future research.

With regard to evaluation criteria we derived a subset of evaluation criteria that have been discussed in the project management literature. We then drew from the creativity literature in psychology and management to attempt to predict how these different criteria might influence individual creative performance. The findings in this study provide support for the hypothesized effects of the various criteria on creativity. For example, the least creative product concepts were consistently produced by individuals who were asked to evaluate projects according to evaluation criteria held to inhibit criteria. These criteria included risk, schedule performance, and market benchmarking. The impact of criteria held to enhance creativity was less convincing as

the concepts of individuals applying these appropriate criteria were usually not significantly more creative than individuals applying inappropriate criteria. However, the creativity of those applying appropriate criteria was also not usually significantly worse than those who engaged in open-ended evaluations and produced the most creative concepts.

One potential explanation for the lack of difference between groups applying appropriate and inappropriate evaluation criteria may be attributed to the subset of criteria used in this study. It may be that other criteria may lead to clearer distinctions between groups. For example, providing people with only strategic or market-based criteria versus only financial or product-based criteria may lead to larger differences in creative performance. The intent of this study was to provide evidence for the influence of a variety of evaluation criteria on individual creative performance. Having provided some evidence in this regard, future studies should examine the effects of specific types of criteria and specific criteria. Moreover, the influence of these criteria on various aspects of human performance should be examined. For example, how do different evaluation criteria influence the speed of individual and team problem-solving?

The differences in goals and performance objectives across product development stages are widely recognized (Lewis et al., 2002; Martinsuo et al., 2013; Van Oorschot et al., 2010). The implications of these differences for the present study are that the timing of evaluation should affect the effects of evaluation on creativity. We hypothesized that earlier evaluations, during the Idea Generation stage, would exert a greater influence on creativity than evaluations during the later Preliminary Assessment stage (Cooper, 1988). The findings obtained in this study provide support for these

hypotheses. The structure of evaluations at Stage 1 consistently produced significant effects on the quality, originality, and elegance of new product concepts. Specifically, open-ended evaluations consistently led to higher quality, more original, and more elegant product concepts compared to structured evaluations. However, Stage 2 evaluation structure rarely produced significant effects and when these effects were significant they were typically limited to those individuals who had received no evaluation instructions at Stage 1. These findings are consistent with the idea that creativity can be substantially inhibited by the imposition of unnecessarily tight control mechanisms (Acar & Runco, 2012; Jansson & Smith, 1991; Mumford et al., 1994).

It is important to note here that project evaluation is a multilevel phenomenon serving different purposes at different organizational levels (Khurana & Rosenthal, 1997; Martinsuo & Poskela, 2011; Roberts & Fuschel, 1981). Even though structured evaluations and certain criteria may inhibit individual criteria the information derived from conducting these evaluations may still be valuable for other stakeholders. For example, evaluations of project risk provides critical information for the management of project portfolios (N. R. Baker, 1975; Henriksen & Traynor, 1999; Kim & Wilemon, 2002). This apparent paradox highlights the need to implement development procedures which account for the multifaceted effects present in complex sociotechnical (Cooper & Foster, 1971) environments which characterize new product development.

One potential approach to balancing the need for certain information at the organizational level (i.e., risk, resources, etc) and the need to maximize the creative performance of those developing new products may be to distribute project evaluations across multiple individuals. Those working on the projects can focus on evaluations

more likely to facilitate creative processes (e.g., market potential, adaptability) while others not directly overseeing the development of the projects can focus on evaluations using other important criteria (e.g., risk, schedule performance) that may otherwise inhibit the creative development. In fact, Blindenbach-Driessen, Van Dalen, and Van Den Ende (2010) also argued that evaluation should be spread across different individuals. And there may be other benefits, such as enhanced information integration (c.f. O'Connor, 1998), to distributing evaluation activities across multiple leaders.

As many have suggested, the success of new products is often determined, or at least very heavily influenced, by the activities occurring in the fuzzy front end of new product development (Cooper, 1988). A critical predevelopment activity is the generation and development of new product concepts. The development of high quality, original, and elegant ideas is primarily the outcome of human creativity. We hope that this study will serve to stimulate additional research on creativity in the development of new products.

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